Evaluating the Integration of Nature-Based Solutions Concept in Strategic Urban Planning in Romania

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A B S T R A C T

Nature-based solutions (NbS) are innovative approaches oriented to address societal and environmental challenges. Increasing the interest to implement NbS in cities is strongly connected with their inclusion as potential measures in urban planning. The aim of our article was to assess the inclusion of NbS in Romanian urban development strategies. We used an evaluation matrix to systematically extract data from 249 urban development strategies. Using content analysis, we assessed the level of inclusion of NbS in different sections of the strategies. Only 10% of urban strategies include different aspects related to NbS concepts, while 40% of the documents are linking NbS to objectives. More than a third of the documents focused on the creation, modernization and maintenance of green areas meanwhile ecosystem services were not presented as specific benefits. This scarce presence of NbS in urban strategies warns about limited consideration of innovative approaches in urban planning, which could influence the capacity of Romanian cities to handle climate changes and to become more sustainable, resilient, and equitable.

1. INTRODUCTION

Urban planning is constantly facing multiple challenges regarding urban sprawl, population growth (Polidoro et al., 2012), affordable land and resources, climate changes (Freire, 2006; Raco et al., 2019), which impact the environment inside the city (Næss et al., 2020), but also beyond the administrative limits. The European Union promotes urban planning through urban development strategies and focuses on dynamic urban ecosystems in an integrated manner and taking into account the spatial and temporal scales (Purkarthofer, 2019; Ahern, 2013), providing clear directions for development.

Cities represent complex socio-economic systems that should respond to challenges through pluridisciplinary approaches, as part of their aim to become resilient and sustainable (Ahern, 2013; Matlock and Lipsman, 2020). The Sustainable Development Goals (SDGs) which were proposed by United Nations in order to build a better future are centred on 17 of the main challenges affecting the environment and the human society (United Nations, 2016; 2015). Although, SDGs are focused on different domains and challenges,

urban planning is the main tool able to mitigate the targeted issues.

Urban planning promotes strategic approaches aimed to find environmental-friendly solutions which also provide social and economic benefits. The role of urban development strategies in reaching sustainability and resilience consists in presenting the development objectives, assessing the current situation and presenting solutions and targets for a better competitiveness (Krähmer, 2021; Niță et al., 2018; Gavrilidis et al., 2020).

The use of nature in achieving sustainability and resilience has great results in terms of climate change such as adapting to extreme weather conditions by carbon sequestration, improving the microclimate, capturing water from precipitation, supporting the nutrient cycle in nature, improving air quality and so on so forth (Zhang et al., 2020; Degerickx et al., 2020; Ahern, 2013).

Therefore, nature or, more precisely, nature-based solutions (NbS) can provide models and tools for solving the present challenges that cities are struggling with. According to European Commission (2021), NbS is a concept and a practice known also for its strategic spatial planning, soft engineering and performance dimensions. The concept and practices are meant to represent solutions for societal challenges that include climate resilience, air quality, water management, green management and biodiversity (Xie and Bulkeley, 2020).

Regarding urban planning and the association with NbS there are some challenges that still remain when it comes up to integrating them in the urban development strategies (Beceiro et al., 2022). The main challenges are represented by the acceptance of the authorities, private sector and general public, the costs of implementing NbS, the maintenance and technology or engineering aspects for creating NbS. Van der Jagt et al. (2020) highlight several aspects that should be taken into consideration when integrating NbS in urban planning: (i) the vision and understanding of the concept, (ii) the policies and regulations, (iii) type of governance, (iv) partnerships and (v) capital resources. All the steps should be considered for a good integration and implementation of the NbS for sustainable transition in cities (Frantzeskaki et al., 2017).

Studies on the integration of aspects related to NbS in urban planning are mostly based on content analysis of documents (i.e. strategies, plans) using established protocols (Grădinaru and Hersperger, 2019; Hossu et al., 2020; Cousins, 2021). Moreover, the information can be assessed through qualitative and quantitative analysis (De Montiset al., 2021; Davies et al., 2021). There are studies that are focused on the perspectives and opinions of stakeholders regarding NbS benefits, planning or potential, which are assessed through workshops, questionnaires and case

studies (Rizzo et al., 2021; Maćkiewicz and Asuero, 2021; Fastenrath et al., 2020; Moosavi et al., 2021). Other studies use different approaches for NbS integration in urban planning such as evaluation frameworks through indicators (Medeiros and Van Der Zwet, 2020; Cousins, 2021), indexes (Wang and Foley, 2021) or comparative analysis (Wei et al., 2020; Bayulken et al., 2021).

Studies reporting the involvement of stakeholders in defining the problems and the solutions which can be potentially delivered by NbS are still scarce (Giachino et al., 2022; Dai et al., 2021). For instance, Grădinaru and Hersperger (2019) mention that many states have not yet assimilated the scientific findings on NbS in the urban planning documents, and they are still using terms such as "green network", "ecological network", "green infrastructure". The authors pointed out that the analysed documents have a specific pattern that consists in presenting the goals, measures and recommendations regarding preservation and management of green infrastructures.

Meanwhile, other studies focused on the integration of ecosystem services in urban planning documents (Bush and Doyon, 2019) and the lack of indicators which can provide useful information for achieving the established targets and monitoring the NbS implementation (De Montis et al., 2021). Collaboration between actors is crucial for NbS implementation (Frantzeskaki and Bush, 2021), obtaining the necessary financial resources (Hagedoorn et al., 2021), monitoring and maintenance (Beceiro et al., 2022). The concept of NbS remains abstract for authorities and hard to be implemented in urban planning (Frantzeskaki et al., 2020).

Another perspective on the urban development strategies is offered by Medeiros and Van Der Zwet (2020) who state that their aim is to increase the living quality of the residents, which involves the scalar perspectives on local and detailed scale. NbS are representative for increasing green urban areas, improving quality of the environment, creating natural drainage systems, increasing value of landmarks and mitigating climate changes (Badura et al., 2021; Toxopeus and Polzin, 2021). Residents' needs may differ depending on the urban tissue they live in and the problems they are facing. Therefore, the actions regarding NbS should have a spatial reference and fit the purpose of the claimed objectives. Nordh and Olafsson (2021) concluded that only 60% of the municipalities had references regarding green infrastructures or green areas and the bigger the city the bigger the coverage on the topic.

The latest studies regarding NbS show that urban development strategies should be updated and focused on the variety of ecosystem services NbS offer (Balzan et al., 2021). Instead, in the case of Melbourne, the urban development strategy focuses on provisioning services such as habitat and biodiversity

and regulating services, especially urban heat island mitigation and water management (Rizzo et al., 2021). The authorities use a top-down approach on the NbS implementation at national level to deal with climate changes (Gómez et al., 2021) rather than rescale at urban level and adapt to the community challenges (Frantzeskaki and Bush, 2021). Thus, the NbS approach in some cases is rather general than suitable for the actual conditions in the cities.

The main gap that we found in the literature is that the strategic planning system should use complex concepts like NbS which improves the delivery of multiple benefits and co-benefits. If at strategic level the modern concepts related to NbS are not mentioned or detailed, it is very difficult to impossible to be implemented in practice and it justifies the high number of infringement proceedings. The innovative aspect of the research is that we integrated in the content analysis the latest approach on NbS and all the suggested concepts and perspectives presented by the European Commission in the latest research (European Commission, 2021), but also the acceptance of the authorities, through the presence, the vision and understanding of the concept in the strategic documents of Romanian cities. We took into consideration only the latest versions of urban development strategies we found for Romanian cities in order to verify if they had integrated any information regarding NbS or other associated concepts.

The aim of our study is to assess the NbS implementation in Romanian urban development strategies. Our paper is focused on three objectives: (1) evaluate the overall integration of NbS in urban development strategies, (2) identify the main objectives and actions associated with NbS and (3) in-depth analysis of NbS implementation for selected case studies. For a good integration and implementation of NbS for sustainable transitions in cities we focused on the first step proposed by Van der Jagt et al. (2020) which involves the vision and understanding of the concept.

2. METHODOLOGY

More than half of Romania's population lives in cities or suburban areas (INS, 2020), with different accessibility to green areas (Badiu et al., 2016). Even if NbS are well-known in scientific literature, in practice, Romanian cities host only isolated examples such as parking lots with green pavements, green tram lines, green walls or green roofs created through few pilot projects. Romania is struggling with an emerging planning system, which is beginning to slowly integrate NbS into the urban environment (Niță et al., 2018).

For this study, we considered all the cities in Romania that had urban development strategies adopted until October 2020. We found urban

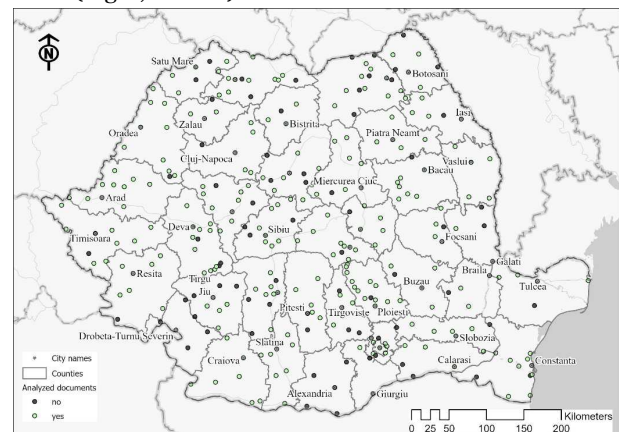development strategies for 244 out of the 319 Romanian cities (Fig. 1, Table 1).

Fig. 1. Cities included in the analysis.

Table 1. General structure of the analysed sample.

Indicator	Categories	Classes	Number of cities
Administrative rank	Rank 0	according to Law 351/2001	1
	Rank 1		10
	Rank 2		72
	Rank 3		161
Population	Small population	<10000 inhab.	77
	Medium population	10000 – 50000 inhab.	124
	Large population	>50000 inhab.	43
Administrative surface	Small surface	<5 000 ha	60
	Medium surface	5 000 – 10000 ha	96
	Large surface	>10000 ha	88
Functional profile	Agricultural	according to the share of the population employed in the 3 domains	25
	Industrial		142
	Service		77

The urban development strategies we analysed are classified in six categories: (1) development strategies, (2) sustainable development strategies, which are considering the principles of sustainable development, (3) socio-economic development strategies, sometimes called economic and social development strategies, which are focused more on the mentioned aspects, than the environmental ones, (4) integrated development strategies, (5) local or urban development strategies and (6) integrated local or urban development strategies. The denomination of urban development strategies depend on the period of approval. The development strategies are the oldest documents and were approved since 2007. They are strategic documents for cities, but they do not consider sustainability, socio-economic aspects or integrative analysis of different topics. Meanwhile, the integrated development strategies and local or urban development

strategies are the newest and were approved after 2014 (Table 2).

Table 2. Main types of urban development strategies for Romanian cities.

Types of strategies	No of strategies	Time series
Development strategy	49	2007/2020 - 2015/2030
Sustainable development strategy	76	2010/2021 - 2015/2030
Socio-economic development strategy	9	2013/2019 - 2020/2027
Integrated development strategy	6	2014/2021 - 2020/2027
Local /Urban development strategy	77	2008/2021 - 2020/2035
Integrated local /Urban development strategy	32	2014/2018 - 2020/2030

2.1. Methodological approach

The study was performed in 5 stages: (1) searching and downloading urban development strategies, (2) screening the urban development strategies, (3) developing an assessment framework, (4) coding the information, (5) performing the analysis (a) from a general perspective, (b) from a detailed perspective and (c) from a connected perspective (Fig. 2).
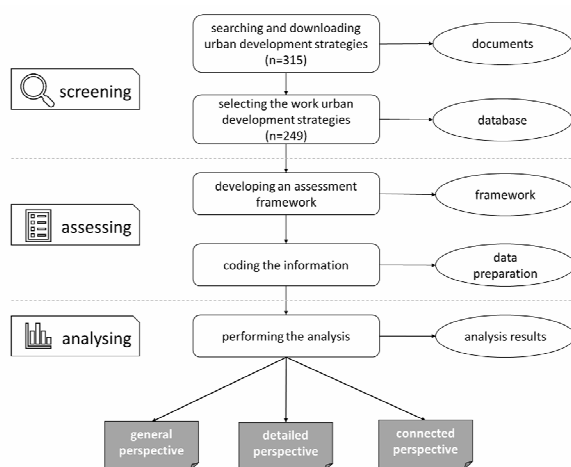

Fig. 2. Workflow of the research.

An extensive search was conducted on the Romanian municipalities' websites in order to identify and download general urban development strategies. For the present study we only targeted general urban development strategies and not the sectoral ones (e.g. climate change, energetic strategy, or mobility strategy).

The next step consisted of a screening process directed to the sample of downloaded urban development strategies. We created a database containing metadata that was used for the document selection (name of the urban development strategies, approval year, implementation period, city name, county). We screened the range of the urban

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development strategies in terms of name and approval year and decided to use only the latest documents.

We had both a quantitative and qualitative approach based on content analysis of the urban development strategies (Stevens et al., 2014). We focused on the key aspects related to NbS such as: concept familiarity ("green infrastructure", "solution based on nature", "green innovations", "urban reconversion"), how NbS was perceived by the authorities ("green urban system", "connectivity of green areas" ,"conservation, protection, modernization, restoration of green and blue infrastructure of natural areas") and how they proposed to face the main challenges of their cities ("creation of green spaces that enhance the location", "expanding the network of green spaces and leisure infrastructure").

Our assessment framework (evaluation matrix) was structured in three parts: (1) general information (GI), (2) strategic information (SI) and (3) NbS information (NBSI) (Table 3). The first one gathers items that verify if key aspects as sustainability (GI1), resilience (GI2), innovations (GI3), solutions (GI4), healthy city (GI5), green city (GI6), green innovations (GI7) and nature solutions (GI8) are identified in the urban development strategies (Hurlimann et al., 2021). Based on our previous analysis and the studies in this field (Niță et al., 2018; Gavrilidis et al., 2020; Badiu et al., 2019), the key aspects were established according to the scientific literature. The coding for criteria GI1 to GI8 is on binary ordinal scale. The presence of the mentioned key aspects was recorded in the context of NbS and not only based on the existence of the words in the analysed documents. The second part of the matrix covers the SI regarding the objectives (SI1), actions (SI2) and responsible actors (SI3), which were coded on three-level ordinal scale and are referring to the relation to NbS (Elo and Kyngäs, 2008; Ahuvia, 2001).

Usually, the administrative documents have a specific structure. In Romania, for example, the analysed documents are structured in 2 parts. The first one contains details about the present situation of the city in terms of population, economy, infrastructure etc. The second part presents the development directions of the city including the main objectives, the activities that can be implemented and even the projects that are going to be underway. The detailed information we gathered for the study - the objectives, actions and responsible actors were clearly separated in the documents (with subtitles), which made easier to establish the relation to the assessment framework.

The third part of the evaluation matrix was focused on the main objectives of the study (NbS, objectives, actions and responsible actors) and several categories of NbS types and challenge areas. Types of NbS (NBSI1), objectives related to NbS (NBSI2) and actions related to NbS (NBSI3) were coded on five-level ordinal scale represented by NbS categories as established by the European Commission (2021): green

infrastructure, blue infrastructure, green-blue infrastructure, urban forest or other categories of NbS such as urban reconversion. For items NBSI4 and NBSI5 the objectives, respectively actions, were evaluated against 12 NbS challenge areas: Climate Resilience, Water Management, Natural and Climate Hazards, Green Space Management, Biodiversity Enhancement, Air Quality, Place Regeneration, Knowledge and Social Capacity Building for Sustainable Urban Transformation, Participatory Planning and Governance, Social Justice and Social Cohesion, Health and Wellbeing, New Economic Opportunities and Green Jobs (European Commission, 2021).

Table 3. Evaluation matrix performed on the documents.

Code	Criteria	Coding scale	Justification	References
General information				
GI1	Sustainability			
GI2	Resilience			
GI3	Innovations		Knowledge of	Pulighe et al.
GI4	Solutions	0 = No	terminology is the key to	(2016)
GI5	Healthy city	1 = Yes	a better understanding	Hurlimann et al.
GI6	Green city		of planning and related	(2021)
GI7	Green innovations		applications	
GI8	Nature solutions			
Strategic information				
SI1	Objectives	0 = No	Knowledge of the	Ahuvia (2001)
SI2	Actions	1 = Yes, implicit	development directions	Hurlimann et al.
SI3	Responsible actors	2 = Yes, explicit	mentioned in the urban development strategies	(2021)
NbS information				
NBSI1	Type	0 = No mention	Knowledge of which	European
		1 = Green infrastructure	type of NbS are related	Commission
		2 = Blue infrastructure	to the objectives and	(2021), pp 17-20
NBSI2	Related objectives	3 = Green-blue infrastructure	actions and which are	Grădinaru and
		4 = Urban forest	the development	Hersperger (2019)
NBSI3	Related actions	5 = Other	directions of the cities related to NbS	
NBSI4	Objective challenge areas	0 = No mention 1 = Climate Resilience 2 = Water Management 3 = Natural and Climate Hazards 4 = Green Space Management 5 = Biodiversity Enhancement 6 = Air Quality 7 = Place Regeneration 8 = Knowledge and Social Capacity Building for Sustainable Urban Transformation 9 = Participatory Planning and Governance	Regrouping the textual meaning of objectives and actions for an easier interpretation and connection to main European approaches	European Commission (2021), pp 117-121
NBSI5	Action challenge areas	10 = Social Justice and Social Cohesion 11 = Health and Wellbeing 12 = New Economic Opportunities and Green Jobs		
NBSI6	Key actors	0 = No mention 1 = Scientific partners 2 = Economic system 3 = Political system 4 = Media 5 = Natural environment	The target group considered by the administration in the urban development strategies	European Commission (2021), pp 93-95

The coding step of the workflow was realized by two coders, native Romanian speakers with a background in Environmental Geography and experience in the fields of urban planning and NbS. If the information was missing, null values were inserted in the data base, to be sure it will not influence the statistical analysis (Table 4). The assessment matrix was firstly tested on 5 strategies and refined. The

quantitative analysis was focused on the frequency of different terms related to GI. The detailed analyses were performed only on the documents that presented objectives, actions and responsible actors.

Table 4. Specific references to the developed evaluation matrix.

City			Sibiu		Baia Mare		Husi	
Code	Criteria	Coding	Justification	Coding	Justification	Coding	Justification	
GI1	Sustainability	1	Sustainable city	1	Sustainable development	1	Sustainable city	
GI2	Resilience	0	-	0	-	1	Resilient city	
GI3	Innovations	1	Innovative actions	1	Innovative approaches	1	Innovative solutions	
GI4	Solutions	0	-	0	-	1	Innovative solutions	
GI5	Healthy city	0	-	1	Healthy city	0	-	
GI6	Green city	0	-	1	Greener city	0	-	
GI7	Green innovations	0	-	0	-	0	-	
GI8	Nature solutions	0	-	1	Green roofs, green terraces	0	-	
SI1	Objectives	2	Expanding the network of green spaces and the leisure infrastructure, diversifying the leisure infrastructure	0	-	1	Modernization of urban spaces	
SI2	Actions	2	Expansion of the network of green spaces and leisure infrastructure, modernization of infrastructure and public spaces in congested residential areas, diversification of leisure infrastructure, rehabilitation, expansion and interconnection of the network of green spaces	0	-	2	Modernization, redevelopment of parks and green areas, development of green spaces, playgrounds	
SI3	Responsible actors	0	-	0	-	2	City hall, associations of owners and or tenants, owners of heritage buildings, the local council	
NBSI1	Type	1	Network of green spaces	0	-	1	Urban spaces	
NBSI2	Related objectives	1	Same as SI1	0	-	5	Same as SI1	
NBSI3	Related actions	15	Same as SI2	0	-	1	Same as SI2	
NBSI4	Objective challenge areas	4	Same as SI1	0	-	4	Same as SI1	
NBSI5	Action challenge areas	4	Same as SI2	0	-	4	Same as SI2	
NBSI6	Key actors	0	-	0	-	35	Same as SI3	

For the present study we used Microsoft Excel for creating the database and descriptive statistic (Microsoft Corporation 2019), ArcGIS Pro 2.7 for spatial representation (Esri Inc., 2018), SankyMATIC free online tool for data relations (Bogart, 2021) and NVivo for qualitative analysis and semiautomatic coding (QSR International Pty Ltd., 2020; Auld et al., 2007).

3. RESULTS

3.1. General perspective on the analysed strategies

The main results indicate that the oldest urban development strategy was adopted in 2008, but is still

active until 2028, and the newest was from 2020. The documents cover 244 cities, from all the eight development regions of the country. Only 41 of the 42 counties were represented in the analysis, no strategy from Teleorman being retrieved. In terms of occurrence of the analysed key words it is important to mention that not all of them were found in all the urban development strategies. Sustainability was found in all the documents (GI1), but resilience was presented only in 23 documents (GI2), usually strategies for cities of second rank, medium population size and large surface, with industrial profile.

Key words as "innovation" (GI3) and "solutions" (GI4) were found in 168, respectively 104 documents. GI3 was more frequently found in documents of cities of rank 3, medium population size, with large and medium surface and industrial profile. "Solutions" were found in 68 documents from rank 3 cities, with medium population size, but large surface size, also specific for industrial cities. Associations such as "healthy city" (GI5), "green city" (GI6) and "green innovation" (GI7) were found in very few documents: 4 and 21, respectively 1 document. "Healthy city" is mentioned in documents of large cities with large surface size, with industrial or services profile. "Green cities" are usually mentioned in documents of cities which are large or medium size in terms of population and surface with an industrial profile.

The "nature solutions" (GI8) were found in 26 documents, specific for cities of rank 2 or 3 with medium to large surface, medium population size, with industrial and service profile. From the three-ordinal scale responses for objective, actions and responsible the results indicate 45 documents with clear objectives (SI1) and 158 documents with specific actions (SI2). The responsible actors were very rarely mentioned, only in 16 documents (SI3) (Fig. 3).
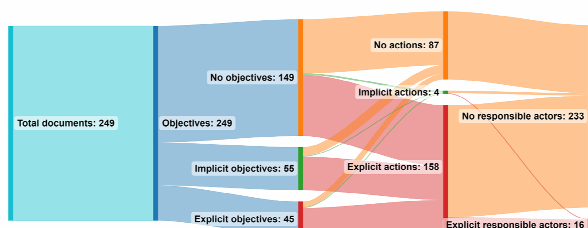

Fig. 3. Objective – actions - responsible actors presented in the documents.

The mentions were frequent in documents for cities that have an industrial profile, with large and medium surface size, medium size population and cities of rank 2 and 3.

3.2. Implementation of NbS in environmental planning and main challenge areas

The categories of NbS, objectives, actions and responsible actors presented in the urban development

strategies were analysed in detail. The results indicate that municipalities use NbS quite rarely (26 documents), instead they prefer to refer to green infrastructures related to creating, modernizing and beautification of green areas.

Green infrastructures are associated with objectives regarding their management, the way in which they can improve the resilience to natural and especially climate hazards, their contribution to urban regeneration, social cohesion and other social aspects. Other categories of NbS found in the analysed documents are represented by conservation and protection of natural areas, urban reconversion, biodiversity, recreational areas. Green-blue infrastructures were mentioned in terms of management and climate resilience, while the other categories of NbS refer to water management, place regeneration and participatory planning (Fig. 4a).

The actions proposed in the urban development strategies are focused on green infrastructure and its management. The pattern is similar with the one of the objectives, but with new challenge areas related to NbS represented by health and wellbeing of residents and air quality. Urban forest category is related to actions such as afforestation, creating green corridors, green belts, protection areas which are associated with challenges such as natural and climate hazards, green space management and in a smaller degree with water management and biodiversity conservation (Fig. 4b). All types of cities presented either objectives or actions.
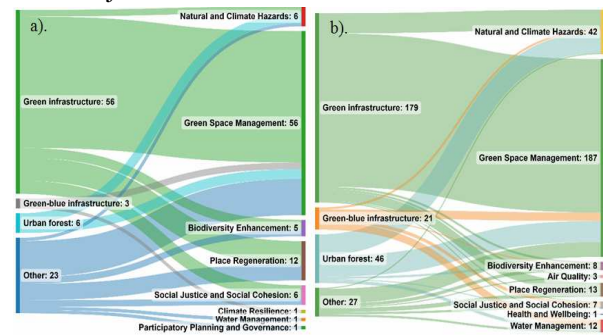

Fig. 4. a). NbS types and main challenge areas associated with objectives presented in the documents. b). NbS types and main challenge areas associated with actions presented in the documents.

The main actors presented by municipalities for implementing actions are represented by three distinctive groups: (1) political system (n=15) as city council, county council, (2) natural environment (n=6) as environmental protection agencies, owners' associations, civil society, forestry directions, NGOs and (3) economic system (n=2) as private actors and economic operators.

Responsible actors are presented by cities with small and medium population and with services and industrial function. The agricultural cities did not present any kind of stakeholders. Several examples from the analysed documents are presented in Table 5.

Table 5. Challenge areas examples regarding objectives, actions and responsible actors.

Criteria	Coding scale	Examples
Objective / action challenge areas	1 = Climate Resilience	-
	2 = Water Management	"Bad shore regularization", "landscaping lake shores"
	3 = Natural and Climate Hazards	"Improving the infrastructure for preventing natural risks", "green solutions for access road protection", "restoration of forest cover"
	4 = Green Space Management	"Arrangement, extension, modernization of green and leisure areas"
	5 = Biodiversity Enhancement	"Protection of biodiversity, landscape, environment"
	6 = Air Quality	"Improving air quality by investing in green infrastructure"
	7 = Place Regeneration	"Revitalization, regeneration of urban areas"
	8 = Knowledge and Social Capacity Building for Sustainable Urban Transformation	-
	9 = Participatory Planning and Governance	"Greening and afforestation in collaboration with NGOs"
	10 = Social Justice and Social Cohesion	"Improving the infrastructure of social, educational, cultural, recreational and sports services in the city"
	11 = Health and Wellbeing	"Increasing the quality of life, improving the quality of the environment"
	12 = New Economic Opportunities and Green Jobs	-
Key actors	1 = scientific partners	Universities or research centres such as: "University of Bucharest"
	2 = economic system	"Economic agents", "business environment"
	3 = political system	Public authorities such as "city hall", "local council", "county council"
	4 = media	Mass-media: "local newspaper", "television channel"
	5 = natural environment	Environmental authorities and civil society with environmental concerns: "NGOs", "environmental protection agencies"

3.3. Detailed analysis of NbS targeted measures

As terminology, from the qualitative perspective, the urban development strategies have more mentions of green infrastructure components, rather than NbS. Several examples of the terms found in the objectives of the urban development strategies are: infrastructure (n=22), green spaces (n=9), leisure (n=12), parks (n=8), sport (n=8) and recreation (n=6). As activities mention in the content of the strategic objectives the most frequently used are: modernization, rehabilitation, increasing, arranging, ensuring, and expanding.

Urban development strategies presented green areas from the perspective of infrastructure and protected areas, but also as leisure facilities, parks, recreational areas, sports areas and landscape. For these major coding structures, we established the connections between the main coding category mentioned earlier and the specific categories for different types of green.

The objectives regarding parks are usually focused on maintenance, beautification or planning of

green areas. Protection of green areas such as forests, leisure infrastructure, and natural heritage is associated with protected areas or cultural landscape or environmental protection and quality protection. Meanwhile, sports infrastructure is associated with sport activities, development and creation of sport facilities/areas. From the infrastructure perspective, it integrates not only sport and recreational, but also touristic, transportation and public infrastructure. Moreover, the objectives are focused on the necessity and improvement of these types of infrastructures which are related to green areas (Fig. 5a).

On the other hand, the actions are related to modernization, embellish of green areas, leisure, playgrounds etc. Considering the higher number of actions compared with objectives, the types of green areas are also more diverse: landscaping, forests, parks, natural areas, trees. Also, the actions are more various: afforestation, rehabilitation, revitalization, construction, extension, diversification etc.

As key words coded for the action section, considering the green types there are several mentions of green (n=47), parks (n=30), leisure (n=23),

infrastructure (n=13), recreation (n=9), forest (n=7) and sports (n=6). As specific codes we had for leisure: leisure areas for rehabilitation, creation, embellish, afforestation, protection, expenses. The infrastructure

was associated with afforestation, leisure infrastructure creation or development, sport facilities arrangement. All presented codes have similarities for specific actions (Fig. 5b).
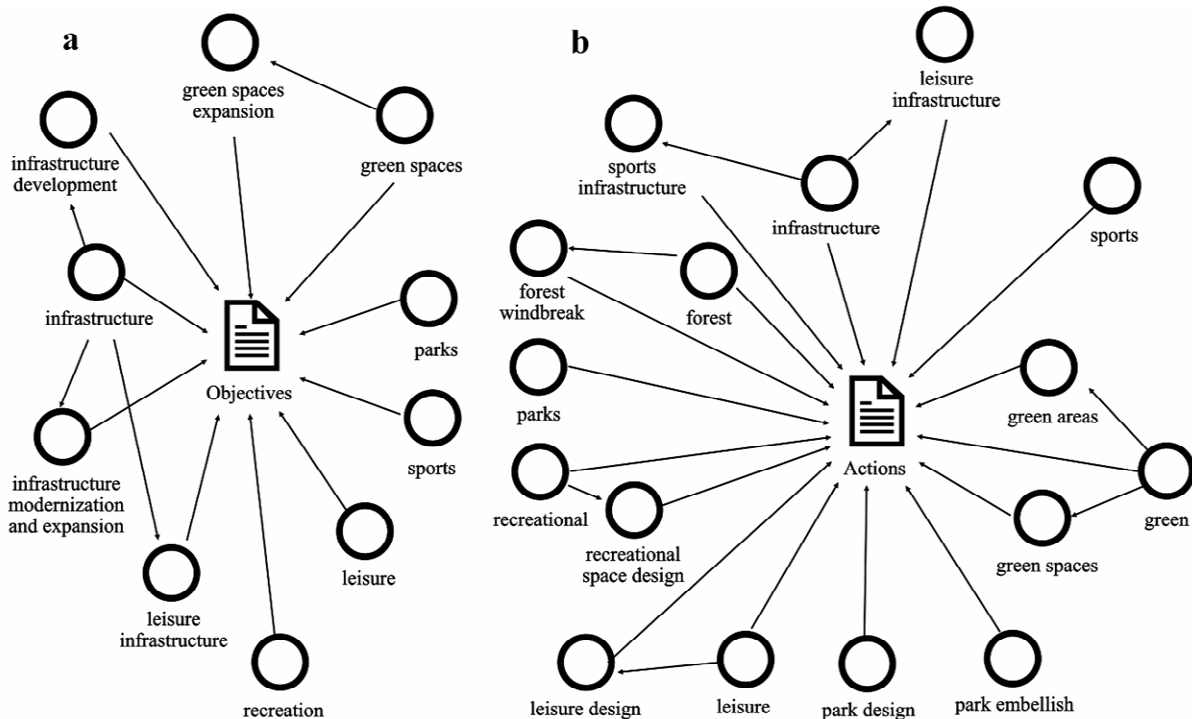

Fig. 5. a). Project map of the objectives coding elements and the connections between them. b). Project map of the actions coding elements and the connections between them.

4. DISCUSSION

4.1. NbS approach in Romanian cities

The urban development strategies focused on traditional concepts of urban planning (built-up development, quality of life, landscape conservation), rather than the new ones (Grădinaru et al., 2017). More than a third of the urban development strategies do not include NbS or other related concepts such as resilience, climate change or innovative solutions. NbS concept and the related ones are not defined or understood by all municipalities regardless of their size and specificity. The used terminology is basic and related to green areas, rather than NbS, which suggests the lack of knowledge and understanding of the new concepts that we would expect to find in the analysed documents. For instance, the innovative aspects presented in the documents are related to technological innovations meant to solve infrastructural problems. Solutions were presented as part of solving a problem rather from a socio-economic perspective than an environmental one. There are only 6 documents that mentioned innovative solutions as green roofs/green walls, but did not associate them with investments in NbS as solution-oriented to the problem (like climate change resilience) (Frantzeskaki et al., 2020).

In literature NbS are assessed thought the benefits or co-benefits delivery perspective and their

contribution to urban resilience (Beceiro et al., 2022; Fastenrath et al., 2020; Raymond et al., 2017). In practice, the municipality and stakeholders either do not know the concept or do not understand it, being very difficult to relate to the benefits that NbS bring within the community and cities (Dai et al., 2021; Diduck et al., 2020). For instance, "healthy cities" represents a cumulative effect on people wellbeing well-known as a futuristic response to human needs (Ramaswami et al., 2016). Urban development strategies do not present the positive impact on environmental conditions or the socio-economic improvement and contribution to humans' health, but the generic overcome to have healthy citizens. Medium and large cities, well developed cities (industrial or service profile) usually describe the context of sustainability, resilience, green city, the benefits and the importance of green areas in the process of becoming sustainable cities, more liveable and healthier.

The meaning of a green city is presented in the urban development strategies from two perspectives: (1) as a city with large and well-maintained green areas usually used as recreational areas and (2) as an energy efficient city focused on public transportation. Green infrastructure and green energy were trending research topics in 2010 in relation to sustainability assessment (Sharifi, 2021). The green city concept in Romanian strategies follows the European Union directions for green capitals (Badiu et al., 2016;

European Commission, 2015). Therefore, analysed urban development strategies respond to subjects popular a decade ago.

The objectives, actions and responsible actors presented in the documents are not focused specific on the implementation of NbS, but on urban infrastructures trying to be adapted to current trends and needs (Tiwary and Kumar, 2014; European Commission, 2021; Wang and Foley, 2021). For example, a third of the objectives and actions were not related with NbS at all ("creating sustainable transport systems", "development of building and housing infrastructure through the reconversion and use of degraded, vacant or unused lands and surfaces"). Other studies show that in Romania most of urban development strategies are focused on the general objectives and in terms of green they are focused on the management and modernization of green areas (Niță et al., 2018). We found objectives and actions focused on "protection and conservation of vegetation - protected natural areas and green areas" or "river bank regularizations", "development and modernization of the leisure infrastructure", "modernization of roads, intersections, passages, public spaces and pedestrian paths, green areas", which are related with NbS and green space management (44 objectives and 153 actions).

When we look and search deeper on the objective-actions-responsible actors' relation to NbS, we discover that NbS are very poorly illustrated, contoured and implemented in Romanian cities. The concept of NbS should be presented in urban development strategies which aim to create sustainable cities, since they should be able to solve problems the community is confronting with and even to reduce the climate change impact or to become resilient to local conditions (van der Jagt et al., 2020; Faivre et al., 2017; Dumitru et al., 2020).

In terms of sustainability, SDG 11 – Make cities and human settlements inclusive, safe, resilient and sustainable, designs the framework to succeed, but further studies showed that Romanian cities and practitioners still need to work on it (Firoiu et al., 2019; Gavrilidis et al., 2020; Mitincu et al., 2021). Achieving urban sustainability is a complex process that begins with the existence of an urban development strategy with clear objectives, detailed actions and stakeholders' implication in the implementation (Niță et al., 2018). Erős et al. (2022) showed that Romanian legislation is week regarding the urban development strategies and sustainability itself, but also that there are huge differences among documents comparing by the years of approval. The authors highlight the fact that authorities have limited knowledge about concepts such as sustainability, resilience, ecosystem services and climate change. Also, in depth analysis of the sustainability of Romanian cities (Popa et al., 2022) and regions (Benedek et al., 2021) show that municipalities

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focus more on the socio-economic perspective, rather than on the environment.

Romanian cities have the potential for connecting the green-blue infrastructure and to consider NbS and hybrid solutions (Iojă et al., 2021). Perhaps for the municipalities is easier to create new green areas, modernize the old ones and keep a beautiful large green area in the city centre. Other types of green areas such as green walls, green roofs, community gardens, rain gardens are harder to implement and maintain, especially if people are not familiar and supportive with this kind of innovations (Frantzeskaki et al., 2020; Dai et al., 2021). Also, a barrier in implementing NbS in cities is represented by the lack of funds or investments and even of actors responsible for implementing the solutions. The public-private partnership should be supported by municipalities in order to implement NbS in cities (Toxopeus and Polzin, 2021).

4.2. Methodological approach limitations

As obstacles and study limitations we can point out two categories: (1) the limitations specific for the design approach we used in this study and (2) the limitations related to document analysis in general. Regarding the former category, it was very difficult to find specific information for NbS, considering the terms were not ad litteram mentioned. In this case, we analysed the context of the target information we needed to complete the framework. Also, the urban development strategies search and download were difficult, because most of the municipalities do not have updated websites (Erős et al., 2022). The urban development strategies were downloaded in different formats such as word, pdf and scanned documents, but all of them were read to be sure of the outcome. Same as in the study of Mitincu et al. (2021) the preparing and screening was time consuming.

Writing an urban development strategy and implementing it are two different aspects of the Romanian planning system. Usually, urban development strategies are written because municipalities are asked to do such a document by higher authorities (Erős et al., 2022). The content of the urban development strategies is sometimes vague and general and it is hard to implement their proposed objectives and actions (Niță et al., 2018). Monitoring is a key step, currently underestimated in Romania, but vital for assessing the implementation degree of objectives and actions.

Urban development strategies have a standard structure, which was explained previously in the methodological section. This structure facilitated a more efficient search in the documents for the needed information. Unfortunately, municipalities used the structure as a guide for achieving the minimum information they should provide. Cities are complex

urban systems that have specific characteristics and needs (Nieminen et al., 2021), but also each city has a vision on its own that should be presented in the urban development strategies.

As a limitation of document analysis in general, there is the subjectivity of the coders and the replicability. Content analysis usually is performed by minimum two coders to be sure of the objectivity or at least the replicability of the method (Stevens et al., 2014; Berke and Godschalk, 2009). To reduce the subjectivity, we choose to perform semiautomatic coding for the results presented in section 3.3.

Data availability among administrative institutions and documents in Romania is a serious concern pointed out by a series of researches (Erős et al., 2022; Popa et al., 2022; Nagy et al., 2018). In our case, if we did not find all the information in the analysed documents for GI and SI, we completed as null values. The lack of data for some cities did not affect the present analysis, although it would have been better to compare all cities.

5. CONCLUSIONS

The study concentrates the content analysis of the urban development strategies from the perspective of the integration of the NbS concept at the theoretical and practical level. Considering the societal challenges of different categories of cities, NbS respond to these challenges and even improve the delivery of multiple benefits and co-benefits. The research aimed to fill the gap through which the planning systems should use these concepts, outlining the overall picture of the NbS on the vision and the degree of knowledge of the public authorities on the concept, especially through the detailed analysis of the objectives and actions proposed in the framework of urban development strategies.

Romanian cities hardly integrated any information regarding NbS or other associations isolated or in relation with the main challenges areas such as natural and climate hazards, water management, green spaces management, biodiversity or air quality. Cities used in the urban development strategies objectives and actions associated with different kind of problems, such as green infrastructure, rather the NbS. The NbS implementation in the selected case studies, where the objectives and actions were mentioned and detailed shows the lack of implementation, correlation and understanding of the NbS potential. The results showed that Romanian cities are still behind with such a new concept for the administration, even if in scientific literature is known for decades.

6. ACKNOWLEDGEMENTS

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