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CASBEE-CITY AS A TOOL TO ASSESS THE SUSTAINABILITY OF NEW CITIES AND ITS ROLE IN GUIDING URBAN DEVELOPMENT

Abstract: As part of a sustainable urban development strategy, Algeria has adopted the model of new cities to relieve pressure on its metropolises and large cities. The new city of Sidi Abdallah is one of these new cities, located 30 kilometres from Algiers. This paper aims to determine the extent to which new cities contribute to development by diagnosing and comparing the development status of the new city of Sidi Abdallah and the state of Algeria using CASBEE (Comprehensive Assessment System for the Built Environment Efficiency) tools. This is based on evaluating new cities by measuring their performance, level of sustainability, and impact on the development of the mother city or region. The study concluded that the development of the new city of Sidi Abdallah according to urban sustainability criteria is a prerequisite for contributing to the establishment and management of sustainable urban development, both within the city itself and in the surrounding areas. It was also found that the CASBEE tool has the potential to achieve sustainable development, especially if it is improved by adding more indicators focusing on the economic and social dimensions of sustainability in the local context of the city.

Key words: Comprehensive Assessment System for Built Environment Efficiency (CASBEE), new cities, new city of Sidi Abdallah, urban development

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Introduction

Since the mid-twentieth century, urbanization has accelerated rapidly in most countries, outpacing government strategies, particularly in developing countries. Today, more than four billion people live in urban areas and it is estimated that by the middle of this century, almost two-thirds of the world's population will live in cities. (Vračarević, 2019). The city raises issues related to its growth, planning, and management... Indeed, the expansion of cities is a reality that is forcing all governments to face up to a thorny issue that requires major efforts. To manage and resolve the problems associated with the city, particularly those related to its growth, many countries have adopted the new city concept.

Development in general is an objective for all developed and developing countries alike. Some countries in the world have adopted the experience of new cities for sustainable metropolises to bring order and balance to the territorial space of these countries (Ben Hamouch, 2023; Hegazy & Moustafa, 2013; Zamani & Arefi, 2013). The beginning of the industrial revolution in Europe in the nineteenth century and the migration of rural populations to industrial centres had a clear impact on the phenomenon of creating new communities to be self-sufficient in terms of employment opportunities, housing, and the necessary services. At the end of the Second World War, the New Cities movement was revived to create a better urban environment in European countries, starting in Britain, France, Poland, Italy, and Germany (Gaborit, 2010; Le Galès & Harding, 1998). The idea then moved to some Arab countries in the 1970s, such as Egypt (Kenawy, 2017), Saudi Arabia, the United Arab Emirates, and finally Algeria, according to the 1995 document "Algeria Tomorrow". Among the new cities approved by the Algerian legislator under Law No. 08-02 is the new city of Sidi Abdallah, proposed as a centre of attraction to reduce pressure on the metropolitan area of Algiers (Dibe, 2012).

New cities in developed countries have over time been subjected to evaluation and analysis of their performance based on several measurement methods according to urban sustainability indicators, an alternative approach in an urbanizing world that considers the city and all its sectors as an integrated analytical unit to determine the extent of improvement or deterioration of the quality of life in all its human, economic and social contents (Al Anbari, 2016).

The issue of urban development has attracted the attention of many countries around the world, and successive conferences such as the Rio Conference in 1992 and the Aalborg Conference in 1994 have allowed the idea of sustainable urban development and how to achieve it, based on the principles of urban sustainability (Mega & Pedersen, 2012; Shen et al., 2011; Verma & Raghubanshi, 2018). Several tools and systems have been developed in many countries to measure and guide the sustainable development of cities, such as the Building Research Establishment Environmental Assessment Methodology (BREEAM) in England in 1990, Leadership in Energy and Environmental Design (LEED) in the United States in 1998, and the Comprehensive Assessment System for the Built Environment (CASBEE) in Japan in 2001 (Cole, 2005). These systems are typically concerned with assessing developments through complex approaches, with a focus on the built and natural environment. Most of these systems are based on the drip

method, assigning weights by comparing local and international averages and then awarding certificates according to several levels (Orova & Reith, 2013).

The creation and development of new urban settlements in Algeria is part of the national policy for spatial planning and sustainable development, to rebalance the urban environment, which is the objective of the spatial planning instruments, in line with the organization and development of major infrastructure and collective facilities of national interest, as provided for in the plans emanating from the National Territorial Planning Scheme (SNAT2030) (Bouabdallah, 2023). On the one hand, the redistribution of the population, on the other hand, takes into account the cultural and social characteristics of each region. The Official Journal of the Republic of Algeria N34 of 2002 contains several articles on the planning and creation of new cities in Algeria, as this minimizes regional disparities within the country and helps to reduce the housing problems that plague most large cities (GSG, 2002).

Literature Review

Assessing cities and making the results public is an essential step in raising citizens' awareness of the true state of their city. This can be a mechanism to give city governments strong incentives to improve the conditions of their cities. Cities that receive a good rating will benefit from an improved public image and sustainable growth, while cities that receive a negative rating may face a deteriorating image and a loss of population. In this way, rating cities helps to incentivize them to improve their conditions, which plays an important role in building a sustainable society. Therefore, the Japan Sustainable Building Consortium (JSBC) decided to develop a new rating tool specifically for cities by extending the CASBEE framework, which is the commonly used building rating system in Japan. (Murakami et al., 2011; Sharifi et al., 2012).

Takigami et al. (Takigami et al., 2014) applied the CASBEE-City tool to test its practicality in a rapidly developing municipality in Putrajaya City, Malaysia. Data for the evaluation was collected through a field survey using interviews. The results showed that the Built Environment Efficiency Score (BEE-City) for Putrajaya was slightly lower than the global average.

Kawakubo et al. (Kawakubo et al., 2014) conducted a study to assess the reliability of the CASBEE-City tool in Japan. Their study used statistical analysis to explore the relationship between the tool's objective ratings and subjective ratings collected through a nationwide citizen satisfaction survey. The study found a strong correlation, with coefficients ranging from 0.5 to 0.8, between citizen satisfaction and the objective results of the CASBEE-City tool. These results demonstrate the tool's effectiveness in accurately reflecting public perceptions of municipal quality. In the same vein, Shwe (Shwe, 2017) highlighted in his research the potential of CASBEE City in Pathein City, Myanmar. The purpose of this study was to find out the potential of the CASBEE tool to reflect sustainability in the performance of cities in developing countries. Through this study, it was found that CASBEE-City has the potential to achieve sustainable development at the city level in developing countries, along with the inclusion of more indicators, by strengthening the economic and social dimensions of sustainability to reflect the local context of cities.

In a study conducted by Miyazaki (Miyazaki et al., 2019), whose aim was to understand the relationship between CASBEE assessment items and the UN Sustainable Development Goals (SDGs), he found that CASBEE assessment tools can be used to measure efforts or progress towards achieving the SDGs, based on the strong relationship between CASBEE assessment items and the 17 SDGs (i.e. users of this tool can contribute to the SDGs by getting better ratings). According to Zarekar's (Zarekar et al., 2022) findings, a comprehensive assessment of a city from an eco-efficiency perspective is essential as it provides clear guidance for optimal decision making. This assessment allows planners and decision-makers to identify the key issues to focus on to improve the quality of life in the city and achieve sustainability in the medium and long term.

Based on the literature reviewed, CASBEE-City appears to be a practical tool for urban sustainability assessment, but it has not been applied to new Algerian cities. Therefore, this research aims to investigate its practicality in Sidi Abdallah city as a case study and whether it can be used as a sustainability assessment tool for other Algerian cities in the future.

Tools and Methods

Study Area

In 1995, as part of the "Algeria Tomorrow Project", the Algerian government approved several new urban projects to be built near the city of Algiers, namely Sidi Abdallah, Bouinan, Nasserieh, Afroun, and similar projects for the cities of Oran and Constantine, and in the high plateaus by reviving the Boughezoul city project, to balance the urban network, alleviate the housing crisis, eliminate slums and revive economic development in the high plateaus and the south, in addition to reviving economic development in the high plateaus and the south (see Figure 1) (Bouabdallah, 2023; Mohamed El Tijani, 2000) .

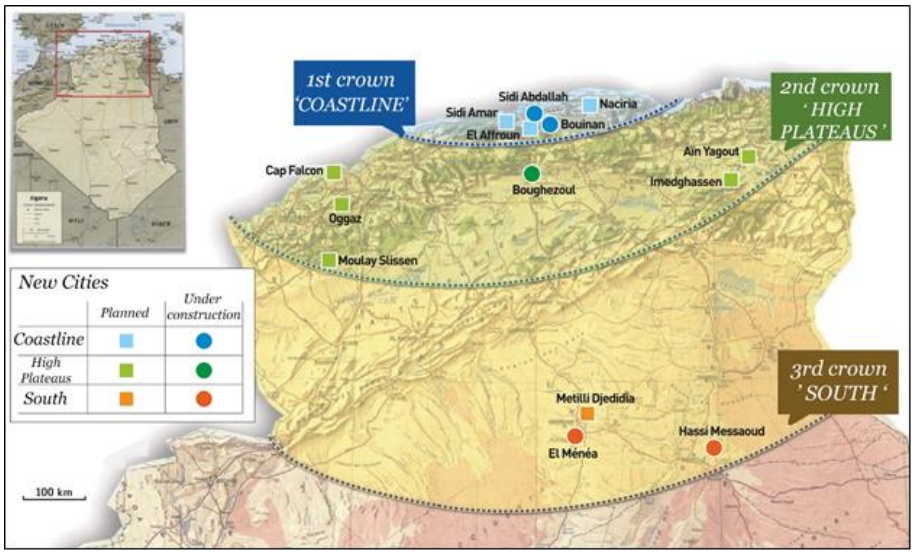

Fig. 1. Locations of new cities on the national territory and their categories (Source: Sidi Boumedine & Signoles, 2017, based on the SNAT, 2030)

Algiers is the political, administrative, and economic capital of the country, the first in terms of population (3,282,979 inhabitants), activities, and services, and one of the main economic and cultural poles of the Maghreb and the Mediterranean. (Berezowska-Azzag et al., 2014) . It is located in the north of the country and has an estimated area of 22,809 square kilometers. It is bordered by the Mediterranean Sea to the north, the state of Blida to the south, the state of Boumerdès to the east, and the state of Tipaza to the west. Situated to the south-west of Algiers, 30km from the center of the capital, the new city of Sidi Abdallah was built in 2009 on the territory of five communes on an area estimated at 7000 hectares, including 3000 hectares of urban area and 4000 hectares of green belt surrounding the city (Ben Hamouch, 2023; Deluz, 2003; VNSA & MUET, 2005). It is an urban and technological center that aims to decongest the capital and support its economic development (see Figure 2).

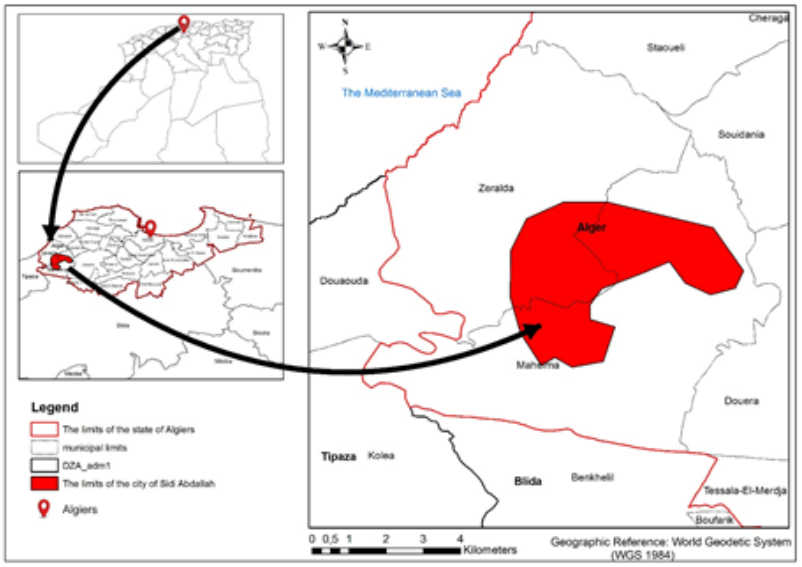

Fig. 2. Locations of the new city of Sidi Abdallah (Source: Authors, 2023)

Methodology

Our study adopted a descriptive-analytical approach to assess the performance of the built environment in Algiers and the new city of Sidi Abdallah. To achieve this, we used the tools of the Comprehensive Assessment System for the Built Environment (CASBEE), a globally recognized assessment framework. While maintaining the basic principles of the system, we modified it to be more compatible with local conditions and specificities. In the first phase of the study, we will apply the CASBEE-city tool (Bin Hishammuddin et al., 2019; Kawakubo et al., 2014) to Algiers to determine the level of environmental efficiency and urban infrastructure, which will help improve urban planning and guide future policies towards sustainable development.

The first phase of the evaluation is divided into two main sections (CDEPATC, 2015; Yoshino, 2024):

- Quality has three main categories: Environmental Quality, Social Quality, and Economic Quality.

- Environmental Load: is the calculation of the amount of CO2 emissions from different sectors.

Each category includes a set of indicators that can be measured through 05 levels, with the third level being the reference (R), which represents an international or global average or value for the indicator (see Table 1).

Table 1. Level Distribution and Dotting

Level 1	level 2	level 3	level 4	level 5
One point	Two points	Three points	Four points	Five points
Level 1 < ½ R	½ R < level 2 < R	Level 3 = R	R < level 4 < R + ½ R	Level 5 > R + ½ R

Source: Authors, 2023

In addition, a specific weight is given to each of the categories and indicators as follows:

Table 2. Evaluation categories and their weights

indicators		**weight**
Quality (Q)	Environmental aspect	1/3
	Social aspect	1/3
	Economic aspect	1/3
	Total	1
Environmental Load (L)	CO2 Emissions	1
	Total	1

Source: CASBEE-City_2012v1.00.EN.XLS+ Authors editing

After determining the indicators and their weights, we calculate the Built Environment Efficiency Score (BEE) and present it graphically in a special chart called the BEE chart, where BEE = Total Q / Total L. In addition, the categories are graphically presented in a radar chart.

In the second phase, following the same steps, we measure the sustainability of the new city of Sidi Abdallah, but using another tool from the CASBEE family, CASBEE-for urban development (CDEPATC, 2014), which has the same main categories as the first tool and differs from it in terms of indicators and levels, and is similar in terms of weights, but there are exceptions about the environmental load L and the difficulty of calculating CO2 emissions. We used field observations and a questionnaire distributed to the population to count the steps taken to reduce emissions at the level of the selected areas in the city. Finally, as in the first phase, we present the results graphically in various columns and diagrams.

Results

In this study we provide an in-depth analysis of the urban and environmental infrastructure in these two areas, highlighting the effectiveness of urban planning in achieving sustainability and environmental quality standards. Our findings are as follows: (see Table 3).

Table 3. Results of applying the evaluation indicators using CASBEE tools to Algiers and the new city of Sidi Abdallah

	CASBEE-City indicators: Algiers	Score (points)	CASBEE-UD indicators Sidi Abdallah city	Score (points)
Quality (Q)	**Q1 .Environmental aspect**	Total:1.375	**QUD1 .The environment**	Total: 2.27
	Forest area per capita	01	Water resources and recycling	3.125
	Rate of air pollutants + Percentage of population with access to safe drinking water	2.5	Percentage of greening of surfaces and walls	3.6875
	Waste recycling rate	01	Assessing a building with CASBEE	0
	CO_2 absorption by forests	01		
	Q2 .Social aspect	Total: 3.33	**QUD2 .The Society**	Total: 3.29
	Housing environment in terms of quality, safety, security, and preparedness	04	Community engagement and neighborhood management	4
	Educational, health, cultural, and humanitarian services	03	Disaster preparedness and safety	1.874
	Population change rate due to births, deaths, and internal migration	03	Social welfare and culture	1.497
	Q3 .Economic aspect	Total: 3.83	**QUD3 .The Economy**	Total: 3.58
	Gross Domestic Product (GDP) per capita	01	Developments in transport and logistics management	2.5
	The ratio of taxes collected to Wilaya budget + Ratio of labor supply to demand	3.5	Population growth and economic recovery programs	4.75
	Emissions Commerce	04	Development of communications and energy systems	3.5
Environmental Load (L)	**Environmental Load (L)**	Total: 3.29	**Environmental Load (L)**	Total: 3.43
	CO_2 emissions from energy sources	3.661125 Tons	CO_2 emissions for the transport sector + residential sector + green areas	3.75 t.co2/person-yr
	CO_2 emissions from non-energy sources	0.088875 Tons	CO_2 emissions after countermeasures	3.5625 t.co2/person-yr

Source: Authors, 2023

The results show that there is a marked disparity between Sidi Abdallah and Algiers in various environmental, social, and economic indicators, reflecting the diversity of challenges and opportunities that each city faces based on its unique urban context.

In terms of environmental indicators: Algiers shows a good performance in environmental aspects with an overall score of 2.27, focusing on the management of water resources, recycling, and green spaces, with high scores in water recycling and the percentage of green roofs and walls. In contrast, Sidi Abdallah scored lower in this aspect with an overall score of 1.375, indicating the need to improve the management of environmental resources and increase efforts to preserve the environment.

In terms of social indicators: Algiers received an overall score of 3.33, reflecting a strong interest in social aspects such as the residential environment in terms of quality and safety, neighborhood management, and community engagement. Sidi Abdellah came close with an overall score of 3.29, with a focus on community services and urban management. This close performance shows that both cities are interested in social aspects, but with different focuses to suit the needs of each city.

In terms of economic indicators: On the economic side, Sidi Abdallah recorded a better performance with an overall score of 3.58, an indicator of active economic develop-

ment and progress in transport and logistics management, as well as economic growth programs. Algiers received an overall score of 2.83, indicating that there are economic challenges that need to be addressed to improve the city's economic performance.

In terms of environmental load: The Environmental load shows similar results between the two cities with a slight difference, with Algiers receiving an overall score of 3.29 and Sidi Abdallah receiving a score of 3.43. This reflects a difference in carbon emissions and the effective management of these emissions, indicating balanced efforts to minimize environmental impact in both cities.

Comparing the efficiency of the built environment (BEE) of the two cities:

- Calculation of the efficiency of the built environment for the city of Algeria:

Q score=(Q1+Q2+Q3)/3

Q score=(1.375+3.33+2.83)/3

Q score= 2.51

- Calculate the environmental load (L):

We have it: L score = 5 - (L scale / 25)

So that: L scale =100* $\frac{1}{1+exp^{(-\alpha*(x-m))}}$

x: Average level of CO_2 emissions in Algeria

m: The average amount of CO_2 emissions in the world

Coefficient α = (1/8) * ln7 = 0.2432 α

from which: x = 3.75 t.co2

m = 4.97 t.co2

So: L scale = 100 * $\frac{1}{1+exp^{(-0.2432*(3.75-4.97))}}$, L scale =43.54 (used in BEE calculation)

Hence: L score = 5 - (43.54/25), L score 3.29 (used in radar chart)

Finally, we obtain the Built Environment Efficiency (BEE) for the city of Algiers according to the following formula:

$$BEE = \frac{25*(Q\ score\ -1)}{L\ scale} = \frac{25*(2.51-1)}{43.54} = \frac{37.75}{43.54} = 0.86$$

In the same way, we calculate the efficiency of the built environment (BEE) and the environmental load of the new city of Sidi Abdallah:

QUD score= 3.04

L scale = 45.80

L score = 3.168

Finally, we obtain the Built Environment Efficiency (BEE) for the city of Sidi Abdallah:

$$\text{BEE} = \frac{25*(Q\ score\ -1)}{L\ scale} = \frac{25*(3.04-1)}{45.80} = \frac{51}{45.80} = 1.13$$

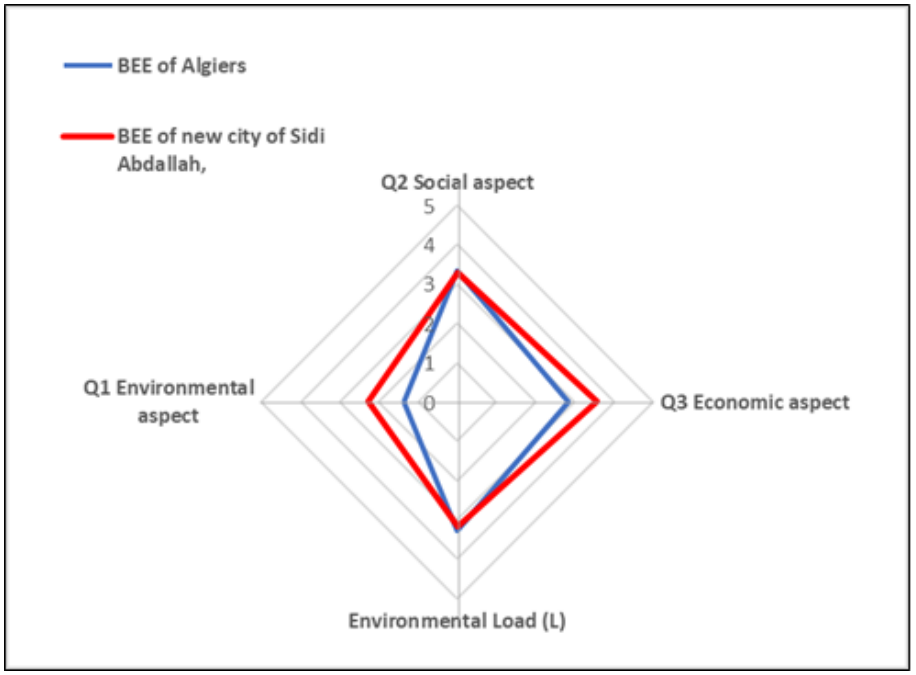

Fig. 3. Comparison of the efficiency of the built environment for the new city of Sidi Abdallah and the Wilaya of Algiers (Source: Authors, 2023)

Figure 3 shows that the efficiency of the built environment in the new city of Sidi Abdallah exceeds the efficiency of the built environment in Algiers in terms of environmental and economic indicators, while the results show a convergence of performance in social terms. This environmental and economic advantage of Sidi Abdallah reflects its ability to provide a more sustainable and efficient urban environment that can effectively contribute to the development of Algiers. The new city offers an urban model that helps to minimize the environmental impact and maximize the efficient use of resources, thereby increasing the attraction of population and investment in a balanced and sustainable manner.

In addition, the development of Sidi Abdallah contributed to the decongestion of Algiers by relocating a large number of tenants and owners of precarious and tin-roofed houses, such as those in the Bouloghine, Jisr Constantine, and other areas. In addition to improving the living conditions of the inhabitants, this action enabled the authorities to reclaim valuable land that had been occupied by informal constructions. These reclaimed lands have been used to create new public spaces that benefit all residents of the city, improving the quality of life and supporting the sustainable development of the capital.

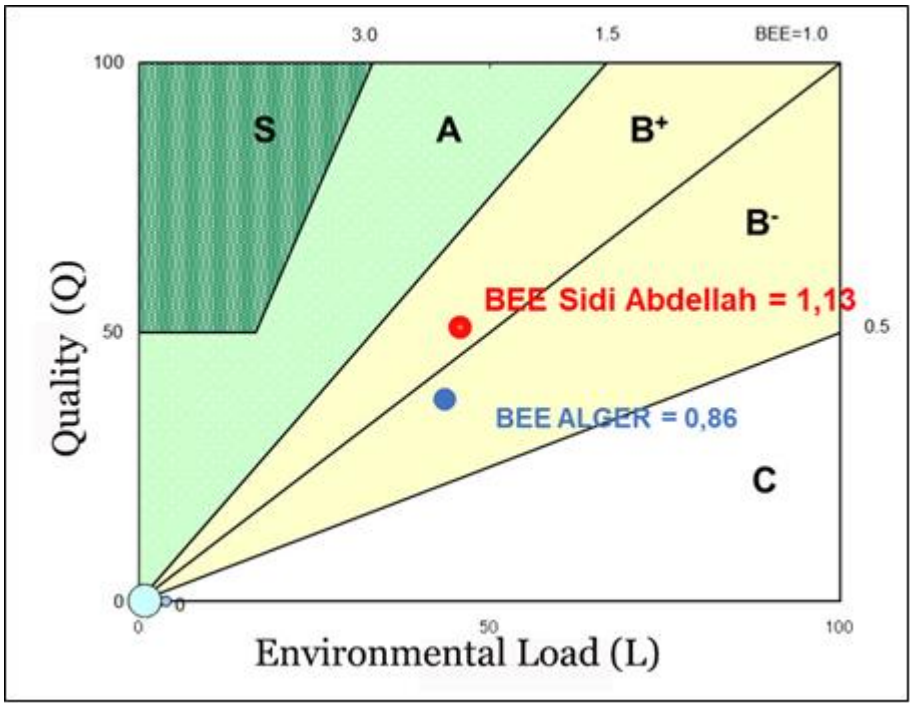

Fig. 4. Charting the efficiency of the built environment for the new Sidi Abdallah and the wilaya of Algiers (Source: Authors, 2023)

Figure 4 shows the classification of the built environment efficiency (BEE) of cities into five bands: (S) excellent, (A) very good, (B^+) good, (B-) average, and (C) poor. This categorization shows how sustainable cities are based on the efficiency of their built environment. Band (S) cities are considered highly sustainable and achieve the highest standards of eco-efficiency, reflecting a clear commitment to sustainability and quality of life. Band (A) cities are also sustainable but may need some improvement to reach Band (S) levels (Yoshino, 2024).

Cities in Bands (B), (B-), and (C) are cities that are striving for sustainability but face challenges that require improving quality (Q) or reducing environmental load (L). These cities need to implement effective strategies to improve their environmental practices and minimize negative environmental impacts to achieve higher levels of sustainability. This categorization helps cities to prioritize their environmental and development priorities and encourages them to improve their performance to better achieve their sustainability goals.

For the Wilaya of Algiers, its built environment achieved an efficiency score of BEE = 0.86, placing it in the B- band, indicating that it needs to improve its quality (Q) and reduce its environmental load (L) to achieve a higher level of sustainability. The Wilaya of Algiers is trying to achieve this goal by adopting several measures to promote sustainability, including a policy of creating new cities based on sustainable development principles, such as the new city of Sidi Abdallah.

The new city of Sidi Abdallah, designed and developed according to sustainability standards, has achieved an efficiency score of BEE = 1.13, placing it in the B^+ range, a better rating compared to Algeria's wilaya. This advanced rating reflects Sidi Abdallah's ability to achieve a better balance between environmental quality and minimizing environmental load, making it a model for sustainable urban development as Algiers seeks to promote efficiency and sustainability in its urban fabric.

Conclusion

This study demonstrated that the use of the CASBEE tools in the assessment allows for direct and effective intervention in the planning and urban development processes of cities, as these tools allow for the reading and analysis of the different indicators and aspects of the city, which helps to accurately identify strengths and weaknesses. Through this in-depth understanding, stakeholders can develop targeted and specific strategies aimed at enhancing strengths and addressing weaknesses, helping to steer urban development towards sustainability more effectively and efficiently. In addition, the CASBEE tools provide a comprehensive framework for assessing a city's environmental, social, and economic performance, balancing these aspects and enhancing its ability to achieve sustainable development in the medium to long term.

To achieve sustainable urban development, new cities that are established in specific regions must be designed and developed according to urban sustainability standards, which include environmental, social, and economic aspects, taking care not to deplete natural resources, ensuring the preservation of the environmental balance and improving the quality of life of the inhabitants. Achieving a sustainable new city requires the application of a set of effective tools and systems that help guide, measure, and monitor the development process within this city, ensuring a balance between urban development and environmental preservation, and avoiding repeating the mistakes of the past that led to the creation of shrine cities that suffer from problems and worsen the situation of their mother cities. To achieve these objectives, the definition of the assessment system and the indicators and their weightings is a complex process influenced by several factors, including the need to maintain the principle that the system is consistent, the need to ensure that the indicators are appropriate to local realities and conditions, and the need for accurate and reliable data, which requires the establishment of a national information base for cities and municipalities that can be revised and updated on an ongoing basis. Therefore, the rating system needs to be flexible and subject to periodic review to adapt to ongoing changes in local data. With a thoughtful and organized approach to planning, new cities can provide integrated environments that support sustainable growth and meet the needs of the population without compromising the quality of life or causing future urban crises.

The research on CASBEE-City is of great international importance as a tool for assessing sustainability and guiding urban development. It offers a standardized and adaptable framework for evaluating urban sustainability, making it applicable to cities worldwide. This contributes to the global promotion of green cities by assessing the efficiency of the built environment in terms of resource use, energy efficiency, and waste management. Furthermore, these findings can be used by governments and urban planners in different countries to develop regulatory frameworks that support

sustainable urban planning and development in line with international environmental and climate conventions.

Conflicts of Interest: The authors declare no conflict of interest.

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