

Comparative Analysis between Community and Occupants' Rating Systems for Sustainable Urban Communities (SUC)

Mianda Khattab*, Salah El Haggar, Ahmed El Gendy

Environmental Engineering Program, The American University, Cairo, Egypt
Email: *miaz@aucegypt.edu

How to cite this paper: Khattab, M., El Haggar, S. and El Gendy, A. (2022) Comparative Analysis between Community and Occupants' Rating Systems for Sustainable Urban Communities (SUC). *Journal of Environmental Protection*, 13, 881-894.
<https://doi.org/10.4236/jep.2022.1311056>

Received: October 15, 2022

Accepted: November 18, 2022

Published: November 21, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Overpopulation globally is an addressed issue impacting human lives, marine lives, and the surrounding ecosystem; it is adding pressure on the available resources that should be optimized to suit the needs. Yet with improper management of resources and monitoring of daily activities, the environment will be further negatively impacted. With overpopulation higher urbanization rates are noticed with the demand of seeking better health facilities, better education, better jobs and better well-being; this progression is driving more demand into the infrastructure sector to be able to accommodate the growth rates. Hence, the need to having sustainable communities aiming at optimizing the resources used, working towards more feasible, environmentally friendly and cost-effective communities with a better occupant's experience is in action. Sustainable development goals (SDG) are vital goals developed by the United Nations Development Program (UNDP) in 2015 to address and guide through 17 interconnected global goals serving the previously mentioned trend. Out of the 17 goals, Sustainable Cities and Communities (goal #11) and Good Health and Well-Being (goal #3) are the focus of this paper directed towards holding a comparative analysis between the community scale commonly known and mostly used rating system Leadership of Energy and Environmental Design (LEED-Cities and Communities) (USA) versus similar rating systems like Tarsheed-Communities (Egypt) and Estidama-Pearl (UAE) rating systems meeting sustainable development goal #11. Conjointly, another complimenting comparative review of the occupant's health and wellbeing rating systems, such as Fitwel (USA) and Well (USA) are studied under sustainable development goal #3; however, they are focused on a building scale assessment. Living Community Challenge (LCC, USA) rating system linking community rating system with health & wellbeing credits was first issued in 2006, yet is it not cost effective neither easy to apply acting as a primary step

while being affordable, accessible, and easy to implement. The objective of this paper is to highlight the pros and gaps under both categories of studies of community rating system and occupants' health & wellbeing rating systems based on scientific content and commercial acceptance and do-ability. This comparison is done via comparing credits and sections within each rating system type; this will support in addressing the focal points needed for an integrated rating system between both categories that will serve in meeting SDG Sustainable Cities and Communities (goal #11) and Good Health and Well-Being (goal #3).

Keywords

Sustainable Communities, Sustainable Community Rating Systems, Occupant's Health & Well-Being Rating System, SDG#3 (Good Health and Well-Being), SDG#11 (Sustainable Cities and Communities)

1. Introduction

Since 1987, sustainable development concept, identified as an objective including a set of sustainability acts to ensure current resources optimization in usage without compromising the future generations needs [1] [2], has been a point of discussion raised by the United Nations (UN) under a study measuring the human impact on the surrounding environment & how the surrounding environment is impacting the human health in return. This aim is addressed since 1992 with the Earth Summit in Rio de Janeiro but by time, with different human activities & changes in the surrounding environmental ecosystem, several amendments took place to further save the environment, optimize the use of resources & enhance humans living experience & exposure [1] [2]. The construction sector is one of the major focal areas since it is a fast-moving division globally contributing directly to living development and economic growth; and with the rise of population rates around 1.1% which contributes to almost 83 million persons with approximately 56% of which are moving to or living in urban areas as of 2020 [3] [4] [5]. Alongside with the COVID-19 pandemic that hit the world, with the less reliance on transportation and aviation, more dependency on staying at home/indoor activities and work new regimes; the construction sector like others, has a new redefinition of human occupancy comfort levels, affordability, and clean energy. It is projected that the construction sector globally is projected to increase by 35% in the next 10 years, from 2021 with an appetite for smart infrastructure on the long run [6] [7] [8].

This trend implies that there is a lot of potential in the construction sector focusing on a wide range of building types like residential, commercial & open space facilities mainly driven by green communities' concept. To follow the growth rate trend while abiding to the sustainable development goals and sustainability pillars, there must be a guideline or framework guiding through focused efforts in optimizing cost effectiveness, improving quality & enhancing

lives meeting the 3 main sustainability pillars of sustainability, economically viable, socially acceptable, and environmentally friendly. Accordingly, several rating systems have been developed like LEED-Cities and Communities (UNDP, USA), Tarsheed-Communities (Egypt Green Building Council (EGBC), NGO, Egypt), Estidama-Pearl Community (Abu Dhabi Urban Planning Council (ADUPC), UAE) and many others focused entirely on buildings or focused on both buildings and communities. Each rating system considers variant categories of credits under different sections as described later in the paper. On the other side, a few lifestyle rating systems have been introduced like Fitwel Building Rating System (US Center of Disease Control (CDC) and Prevention, USA) and Well Building Rating System (US, International Well Being Institute (WBI)) covering more credits on how to have a healthy daily activity preventing any negative impact on the surrounding environment if not, contributing to positively and environmentally impacting the surrounding environment; these rating systems are studied further in this paper for comparison. Even though both occupant's rating systems are issued on a building scale, yet they are taken as an example of concept study in this paper to be implemented on a community scale which reflects different types of building clusters. Lastly, these rating systems segments led to an inspiration of having a sustainable joint building and occupant's lifestyle rating systems integration named Living Community Challenge (LCC, USA) first issued in 2006.

The main objective of this paper is to hold a comparative analysis among different community rating systems like Leadership in Energy and Environmental Design (LEED-Cities and Communities), Tarsheed-Communities and Estidama-Pearl Community; with the Occupant's Health and Wellbeing rating systems like Well Building and Fitwel Building intending to having an integrated rating system uniting SDG goal #11 (Sustainable Cities and Communities) and SDG goal #3 (Health and Well-being) [9] similar to the Living Community Challenge (LCC) but with more simpler application credits & cost effective reflection leading to a full implementation to sustainable activities from infrastructure till day to day living lifestyle.

1.1. Sustainable Community Rating Systems

Rating systems are mostly either for a building rating system, a community rating system or a stand-alone facility rating system like those for hospitals, schools, commercial malls and others; regardless the country of origin and focus of the previously mentioned, these frameworks act as an infrastructure guide for investors, developers, contractors, consultants and stakeholder to meet sustainability measures with optimization of resources that comes to an end with the development completion & project delivery. There are many examples of focus on the community rating systems out of which are LEED-Cities and Communities, Tarsheed-Communities and Estidama Pearl-Community which are the focus of study in this paper. **Table 1** provides an overview summary on the chosen community rating systems of comparative study purpose of this paper.

Table 1. Overview summary on the community rating systems.

	LEED-Cities and Communities [10] [11]	Tarsheed-Communities [12]	Estidama-Pearl Community [13] [14]
Established In	USA	Egypt	UAE
Date of Establishment	1998	2018	2010
Max. number of credits	110	100	22+
Levels of Certification	Certified (40 - 49 points)	Bronze (40 - 49 points)	1 pearl (all mandatory credits)
	Silver (50 - 59 points)	Silver (50 - 59 points)	2 pearls (all +65 extra)
	Gold (60 - 79 points)	Gold (60 - 69 points)	3 pearls (all +85 extra)
	Platinum (80+ points)	Platinum (70+ points)	4 pearls (all +115 extra)
Categories	Natural System Ecology, Water, Energy, Materials, Quality of Life, Innovation, Transportation	Energy, Water, Habitat	5 pearls (all +140 extra) Integrated Development Process, Natural Systems, Precious Water, Livable Communities, Resourceful Energy, Stewarding Materials and Innovating Practice
Applicable For	New Community and Existing Community	New Community and Existing Community	New Community and Existing Community
Application Cost (registration, precertification and certification)	For silver, gold, platinum members/non-organizations without expedited review: Registration (\$2500 for silver, fold, platinum level members) + precertification (\$8000), Certification is based on area [15]	Registration is EGP 20,000 (\$1000) and certification is based on area	No fees are associated for the review of projects under the Pearl rating system

Table 1 is a summary overview on the community rating systems of focus in this paper based on the high reliance and reference on from new projects and local availability. The table shows the date of the rating system establishment, number of certification levels, categories, and cost for applying. Currency conversion rates are based on 2022 market.

1.2. Occupants' Rating Systems

The role of the aforementioned community rating systems ends by the time the development ends and the project is delivered. But what about the occupant's comfort level focusing on the day-to-day activities and building up and running lifecycle assessment afterwards? This is where occupants' lifestyle rating systems came in place acting as citizens day to day activities facilitations and accessibility guide like annual water testing for better water access assurance or even intensifying the access to health and wellness areas through gym zones, community activities in parks for example or even community gatherings in the community center. Fitwel (USA, United States Centers for Disease Control (USCDC)) and Well (US, International Well Being Institute (WBI)) are the known examples for occupants' rating systems. **Table 2** provides an overview summary on the avail-

able occupant's rating systems of comparative study purpose of this paper.

An integration between both community & occupants' rating systems is highly needed for several reasons including bettering environmental sustainability through the construction phase but also supporting with the up and running day-to-day community activities plus more cost-effective community and rating systems reflection with an easy-to implement strategy. An introduction with the same concept is held through the Living Community Challenge (LCC) which is a USGBC and Canada Green Building Council initiative however, as of date it is not applied in many projects due to its application complexity and high cost with a gap of awareness. LCC is also studied in this paper grouped with the occupant's health & wellbeing table of comparison.

The community and the occupants' rating systems do not substitute one another; however, they complete the objective of one another. Hence, the following sections will collaboratively show the difference between the rating systems and will also propose a closed cycle integration of frameworks.

1.3. Comparative Analysis between Community and Occupants' Rating Systems

Table 2 is a summary overview on the occupants' rating systems of focus in this paper based on the high reliance and reference on from new projects and local availability. The table shows the date of the rating system establishment, number of certification levels, categories, and cost for applying. Currency conversion rates are based on 2022 market. It is noticed that Fitwel and Well rating systems are designed for Occupants Health and Well-being while LCC is designed for community integration with occupants' health and wellbeing but due to its complexity and high cost it is not in favor of use.

Table 2. Overview summary on the occupants' health and wellbeing rating systems.

	Fitwel [16] [17]	Well [18]	LCC Community [19]
Established By	US Centers for Disease Control and Prevention (US CDC)	International Well Building Institute (IWBI)	United States Green Building Council (USGBC) and Canada Green Building Council
Date of Establishment	2016	2014	2006
Max. number of credits	144	100	22+
Levels of Certification	(90 - 104 points—Single Star), (105 - 124 points—Two Star), (125+ Three Star)	Bronze (40), Silver (50), Gold (60), Platinum (80+)	All imperatives under the needed petal plus Water or Energy or Materials petal
Categories	Air, Water, Community, Movement, Materials	Air, Water, Light, Community, Thermal Comfort, Mind, Nourishment, Movement, Sound, Materials	Water, Energy, Equity, Materials, Health and Happiness, Beauty and Spirit, Place
Application Cost (registration and certification)	Community fee: (\$500-Registration), \$14,000 for the first 20 acres [15]	\$2500 enrollment fee + \$0.16/sq ft starting \$6500 [9]	For community registration: \$5000. Certification is based on area footage [20]

A comparison criterion and scoring rubric are designed to ease the analysis between the community rating systems and occupants’ health and lifestyle rating systems [21]. Each rating system will be analyzed based on 2 main categories: A) Scientific Assessment, which studies and compares the scientific and technical information within the rating system content to meet the Environmental sustainability pillar plus the Net Zero Concept approach under Water, Energy, Waste and Carbon Emissions.

B) Commercial Assessment, which studies the commercial and marketing stand points as shown in the next section to meet the Social and Economic sustainability pillars. The scoring levels are based on the Low, Medium and High; and they are being translated into quantitative values for ease of correlation and overall comparison as shown in **Table 3**.

Category A: Scientific Assessment points of comparison:

Energy Section, Water Section, Waste Section, Air, Net Zero Concept, Ecology, Technology Integration, and Innovation

Category B: Commercial Applicability Assessment points of comparison:

Applicability (User friendliness, ease of access of information, results, popularity as in how many projects are already certified, how many stages are there until certification, technical content reflection), Cost, Development (is the rating system constantly improved and up to date to meet the changing needs and technology?), Pre-Certification Required during the application process, Practicality (sections of comparison, process used to input the project progress and results, does the rating system follow quantitative/prescriptive based or qualitative/performance-based criteria, complexity of applying level, life cycle assessment).

1.4. Comparative Analysis Applied on the Rating Systems of Study

Starting with the scientific comparison for the community rating systems with the previously mentioned categories of study reflecting the rating systems score cards section & divisions as shown in **Table 4**.

For the Energy category, Pearl Community has the highest rating as it includes more specified credits (total of 42) with more correlation to energy conservation and efficiency targeting along the community plus the mentioning of smart technology integration for better energy management. LEED-Cities and

Table 3. Comparative analysis scoring rubric.

<u>Scoring Rubric</u>	<u>Proposed Points</u>
Low	1
Medium	2
High	3

*The above proposed scoring rubric and proposed points are just a measurement of reflection for quantitative measure for ease of correlation reflecting low score, medium/average standard score or high score to benchmark with.

Table 4. Scientific assessment on the community rating systems.

Category	LEED-Cities and Communities	Tarsheed-Communities	Estidama-Pearl Community
Energy	High	Medium	High
Water	Medium	High	High
Waste	High	High	Medium
Air Quality	High	High	Medium
Net Zero Concept	Medium	High	Low
Ecology, Technology and Innovation	High	Medium	High
Total	16	16	14

Communities has a high rating as well under different needed measurements from Pearl Community as it includes (31 credits) while also Energy and GHG emissions plus Low Carbon Economy which can link under the Net Zero Carbon. Tarsheed-Communities has a Medium as it includes the basic needs for energy conservation in a community yet missing a correlation with GHG, Carbon Economy. Yet, it mentions couple of credits examples that a user can easily refer to like window-to-wall ration, roof and window glazing, external shading devices and wall insulation.

For the Water category, LEED-Cities and Communities has total of (12 credits) and the main addition over the other rating systems is the smart integration and water management points and a WWTP credits. Pearl Community has (37 credits) assigned to this section and it is encouraging for alternative water sources and color-coding water pipes for example that shall be recycled for other use if not used under district cooling system; this is supporting the net zero water concept integration. Tarsheed-Communities, has assigned credits encouraging for on-community wastewater treatment to reduce the need of potable water to meet the needed demands to approach the net zero water concept plus applying assigned credits for the use of treated wastewater for irrigation by treating 100% of the generated greywater on-community. Also, Tarsheed rating system includes a credit to install proper rainwater harvesting and AC condensate collection and reuse.

For the Waste category, LEED-Cities and Communities considered the waste management under construction activity pollution and under materials and resources section with a smart waste management systems credits reflection. Pearl Community has the construction and operation of waste management under the Stewardship Materials section and the good point is that it is divided as organic, hazardous, construction and operational waste management. Tarsheed-Communities has the Solid Waste Management plan as a prerequisite under the Habitat section and it is focused on SWM to approach net zero waste.

For the Air category, Tarsheed-Communities and LEED-Cities and Communities have the highest recommended reflection. Even though Tarsheed-Communities doesn't include Air as a separate category in the rating system unlike as

it mentioned the Air quality yet the impact of a credit on air quality and thermal comfort is mentioned under different sections like reflective roofs, air tightness, light pollution, construction activity pollution prevention and District cooling and heating plant.

For the Net Zero, LEED-Cities and Communities doesn't reflect much on the net zero concept embedded within the rating system; however, there is LEED-Zero which is an optional rating system that fully aligns for them but needs an integration. Tarsheed-Communities is built with the vision of the net zero wastewater, zero pollution and zero solid waste; hence it has the highest rating. Pearl Community has no specific mentioning to the net zero concept application, yet the UAE government have a national motive to achieve zero emissions by 2050 as recommended by WBGC yet it is not reflected into the rating system.

For the Ecology, the three community rating systems have assigned credits for greenery areas, healthcare facilities and clinics, on-community harvesting or organic food and recreational facilities credits. Plus, Tarsheed-Communities are encouraging the use of native plants that can easily adapt to the environment and will rely differently of water than non-native ones. This will link under the water and energy section plus overall community cost assessment.

For the Technology integration, awareness and education, Pearl Community has clearly stated under smart grid technology and has a technology reflection under the LCA section plus it is also encouraging renewable energy technology usage under the Energy section. LEED-Cities and Communities has also mentioned about smart technology integration under the Water, Energy and Transportation section while giving examples of the technology that can be of use plus smart waste management systems. Tarsheed-Communities has mentioned a different angle of on-site WWTP to reduce the reliance on the potable water; however, it didn't reflect much on the technology integration or smart implementation. This can be more included under innovation for better community proposals based on local availability.

After comparing under scientific commercial scores, **Table 5** reflects the commercial comparative points under the community rating systems as well.

Table 5. Commercial assessment on the community rating systems.

Category	LEED-Cities and Community	Tarsheed-Communities	Estidama Pearl-Community
Complexity to apply	Medium	Medium	Medium
	Low	High	High
Cost: to recommend	Recommendation, High Cost	Recommendation, Low Cost	Recommendation, Low Cost
Development	High	Medium	Medium
Practicality	Medium	Medium	High
Precertification	Medium	Low	Low
Total	10	10	9

For the Rating System Complexity, they all score the same however the weighed points vary. So, under LEED-Cities and Communities it is applicable to be applied in different countries specially with the presence of local certified representatives to guide through. However, with some technology implications to be added to the project to meet the credits, this can be an additional cost burdening the investor. Tarsheed-Communities is simple to understand however, since it is relatively new, not so many local representatives are available in the country or origin nor in different locations globally. Pearl is easy to understand and apply plus just like LEED-Cities and Communities it offers a pre-certification to be a Pearl Consultant which shall come in place once there are representatives available for guidance and support in the UAE and outside. Popularity, LEED-Cities and Communities has a higher score as it is more introduced and commercially known globally looking at the total number of certified and under certification projects vs their global locations or origins. Tarsheed-Communities is more of a work in progress to be more known specially locally in Egypt, its country of origin. Pearl is commonly known across UAE yet not so globally.

For the Cost, LEED-Cities and Communities has the least score as it is the highest of all with too many costs implications at different steps like preregistration and another at final certification. Tarsheed-Communities has the optimum and most cost-effective cost implication. Lastly, Estidama Pearl is on low-cost recommendation as it doesn't require any initial cost for certification applying which can increase the demand with no financial commitment or accountability. Thus, lowering the selection criteria for the applicants.

For the Development, LEED-Cities and Communities is constantly adding on and improving its versions and recently it issued LEED Zero, giving it a different edge than the other 2 rating systems. Tarsheed-Communities holds few version updates for the community rating system alone. Pearl is not noticed for much versions or differentiators in infrastructure apart from building and community. However, it has an edge of providing an open access online calculators for Water, Energy and Waste.

For the Practicality, LEED-Cities and Communities has the highest since it is older than the other rating systems with more global market presence however, LEED-Cities and Communities is not applicable for all the countries. Some credits will fall out of the category due to their irrelevance to the country of use *i.e.*, Stormwater Management and Grid harmonization. Tarsheed-Communities is fairly easy to follow and apply however, it needs more sections diversifications to thoroughly cover waste management, indoor and outdoor air quality and innovation as there is a huge potential for progress in the middle east for starters. Pearl is easy to follow but it is so focused on the UAE so it may not be applicable to use for other countries apart from the Gulf area. Also, Pearl has online Equation's calculations, calculators, and methodology to support the use.

For the Precertification, LEED-Cities and Communities has the highest score as it requires Plan and Design precertification in the planning phase for both

new and existing cities and communities. While for Tarsheed and Pearl, no pre-certification is required.

After comparing between the community rating systems, the next step is to compare between the occupants' health & wellbeing rating systems under the same scientific criterion as shown in **Table 6** & commercial criterion as shown in **Table 7**.

For the Energy, Well rating system indirectly mentioned the energy reflection under the Light section mentioning light control schedule as an example and also, overflow water management system under Water section. While also, mandating to have at least 2 e-vehicles present in any parking that has 400 spaces at least. Fitwel has an example of energy reflection under the workspace where it encourages increasing the workspace access towards natural lighting systems. LCC is the best in terms of having a separate energy section which focuses on Energy reduction and optimization plus encouraging the use of energy systems that supports the entire community rather than a building on its own. Lastly, LCC relies on Net Positive Energy on community acts for energy under water & waste correlation.

Table 6. Scientific assessment on the occupants' rating systems.

<u>Category</u>	<u>FitWel</u>	<u>Well</u>	<u>Living Community Challenge</u>
Energy	Low	Low	High
Water	Medium	Medium	Medium
Waste	High	Medium	Low
Air	Medium	Medium	Low
Net Zero Concept	Low	Low	High
Ecology, Technology and Innovation	Low	Low	High
Total	10	9	12

Table 7. Commercial comparative analysis on the occupants' rating systems.

<u>Category</u>	<u>FitWel</u>	<u>Well</u>	<u>Living Community Challenge</u>
Applicability	High	Medium	High
Cost: to recommend	Medium recommendation	Medium recommendation	Low recommendation
Development	Low	Low	Low
Practicality	Low	Low	Medium
Precertification	Low	Low	Low
Total	8	7	8

For the Water, Well has a Water dedicated section, most of the credits are on regular water accessibility like in Bathrooms, Handwashing and Drinking Water; but an interesting add on are the credits assigned for the non-potable water capture and reuse plus verifying the water quality indicators and monitoring the chemical and biological water quality. Fitwel has an annual water testing commitment and ensuring that water and drinking water are available as needed. LCC is encouraging for a water more resilient and independent community. It has a water section focused on Net Positive Water and Responsible Water Use commitment treatment for community reuse for greywater and black water.

For the Waste, Well has one credit under materials for implementing a waste management plan making it sound like a low priority in the rating system plus several waste and hazardous waste management points. Fitwel has several interests under waste section and waste diversion by reducing or recycling programs for massive education and awareness. In LCC, Net Positive Waste is mentioned under the materials section and that is the only point but considering a net zero integration reflecting a material conservation management plan to reduce waste production and trying to reuse again for industrial or natural nutrient loops.

For the Air, both Well and Fitwel mentioned IAQ and the needed external or outdoor air quality plus the need to decrease the reliance on on-community transportation while increasing the spaces for bicycle lanes and shaded walking zones. Well has an edge of mentioning limits for demand control ventilation threshold points. LCC has a mention on the recommendation for healthy indoor air quality and environment under the Health & Happiness section but no other consideration for air under LCC in a separate section or correlated with other activity related and impacting sections.

For the Net Zero Concept, Well and Fitwel don't have specific mentions for the Net Zero Concept application. However, the LCC has net zero energy, net positive water and net positive waste as aforementioned in the related comparison section above.

For the Ecology, Well has the edge over mind and nourishment section where it specifies the need mental health services, recreational facilities, healthy food availability and nutrition education whilst Fitwel is incentives healthy food accessibility and wellbeing activities [22]. LCC has a Place petal talking about the place ecology plus urban agricultural as a main and the limits to growth constraining any wetlands dimensions and maintaining specific spacing from old-growth forests for example. Also, LCC mentioned Beauty petal for health, beautified external views around the community and including public educational programs. Technology and Innovation, the three rating systems cover these aspects under either innovation and encouraging education and inspiration like in Fitwel or having an integrative community design focused on the main vision like in Well or even equity and inclusion as in LCC; while having an educational innovation initiative too.

For the Applicability, Well has the least of all because it has several gaps to

cover and be more thorough on when it comes to day-to-day activities. However, Fitwel is more elaborative and easier to apply. LCC even though it has several categories, but it is considered complicated to apply and costly. Popularity, one can argue that Fitwel and Well are known in their markets of origin, however, when linked with the methodology, Fitwel has more categories of focus that thoroughly walks the investor through an implementation plan unlike broader points under Well. LCC, is not so popular since it only has 15 certified projects till date from the day of issuance.

For the Cost, Fitwel is the optimum of all specially that the Health and Lifestyle rating system will be an additional cost on the investor apart from the original community rating system certification cost. So Fitwel has the best balance of categories and optimum bearable cost. Well, is a little pricy in comparison to the sections of credits and cost relative to Fitwel. LCC, even though one might consider that it is a double ended sword merging community rating system on a high level with Health and lifestyle; however, its cost is of a higher implication considering it is not well known still or with several success stories references.

For the Development, Fitwel and Well have an equal score as not so many revisions are in place maybe due to their relatively new presence in the market. However, LCC has one issue dated 2017 for Community with a link to Net Zero concept.

For the Precertification, Fitwel has a requirement in the Workspace Natural Daylight System requesting to have a documentation of achieving LEED BD and C credit for daylight or LEED NC Daylight and Views credit. Well community has a health and wellbeing building certification requirement standards or green certification. Also, for the allocated parking spacing, it should abide to any local code/law for the minimum number of spaces. LCC has no specific mentions to any precertification needs.

2. Conclusions

Looking at the scientific and commercial scorings in **Table 8**, LEED-Cities and Communities has equal scoring with Tarsheed-Communities rating systems on the total between scientific and commercial comparison, yet Fitwel is the best when compared with occupants' health rating systems vs Well. Looking at LCC, it has the edge of being an integration between Communities and Occupants' Health and Well Being however, due to its complexity in application and higher cost; so, it is advised to benchmark between the community rating systems and Fitwel taking LCC as a starting point but ensure it is more affordable, simple, practical and easy to implement combined rating system integrating Net Zero concept with SDGs goal #3 (Health and Well-Being) and goal #11 (Sustainable Cities and Communities). Then comes Fitwel rating system which is the second highest recommended after LCC and positioned better and more informative than Well.

Table 8. Total scientific and commercial scoring:

Category\Rating System	LEED-Cities and Communities	Tarsheed-Communities	Pearl-Community	Fitwel	Well	LCC
Scientific	16	16	14	10	9	12
Commercial	10	10	9	8	7	8
Total	26	26	23	18	15	20

LEED-Cities and Communities is positioned better from marketing and awareness standpoint and it is more of a trend. However, there is a need to implement more locally driven rating systems to better reflect on the available needs, resource's reliability, and cost reflection.

Recommendations

With reference to this paper of study, the below recommendations are added for future work and considerations:

- 1) Integrating Community and Occupant's rating systems together based on the best practices and implementations of the current related rating systems mentioned in this paper.
- 2) Including Net Zero concept, initiated by LEED-ZERO and mentioned in other rating systems, for a fully self-sustainable community.
- 3) Adding an awareness/educational plan for the public and the community members sharing in the community sustainability accountability.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Sustainable Development. Sustainability for All. <https://www.activesustainability.com/sustainable-development/do-you-know-when-sustainability-first-appeared>
- [2] Do You Know When Sustainability First Appeared? Sustainable Development, Sustainability for All. <https://www.activesustainability.com/sustainable-development/do-you-know-when-sustainability-first-appeared>
- [3] The Report: Egypt 2020. Construction and Real Estate. 1st July 2021. <https://oxfordbusinessgroup.com/egypt-2020/construction-real-estate>
- [4] O'Neill, A. (2022, July 22) Egypt: Urbanization from 2011 to 2021. Statista. <https://www.statista.com/statistics/455821/urbanization-in-egypt>
- [5] UNCTAD. E-handbook of Statistics 2021. Total and Urban Population. <https://hbs.unctad.org/total-and-urban-population>
- [6] Ellis, D. (2021, September 23) Global Construction to Grow 35% in Next 35 Years. <https://constructiondigital.com/built-environment/global-construction-grow-35-next-10-years>

- [7] Fortune Business Insight. Smart Infrastructure Market Size, Share & COVID-19 Impact Analysis. <https://www.fortunebusinessinsights.com/smart-infrastructure-market-106346>
- [8] UN. Department of Economic and social Affairs, Sustainable Development. Do You Know All 17 SDGs? <https://sdgs.un.org/goals>
- [9] WELL Pricing. <https://www.wellcertified.com/certification/v2/pricing>
- [10] LEED for Cities and Communities. <https://www.usgbc.org/leed/rating-systems/leed-for-cities>
- [11] LEED Certification Fees. <https://www.usgbc.org/tools/leed-certification/fees#cities>
- [12] Egypt GBC. TARSHEED Communities. <https://egyptgbc.org/building-type-details?typeId=4>
- [13] Pearl Community Rating System. 15 September 2022. <https://pages.dmt.gov.ae/en/Urban-Planning/Pearl-Community-Rating-System>
- [14] The Pearl Rating System for Estidama. Community Rating System Design & Construction. Version 1.0. April 2010. <https://pages.dmt.gov.ae/-/media/DE1617B2A0634AC58B42DB511E18ECF4.ashx?newTab=1>
- [15] 2022 FITWEL Pricing. https://assets.ctfassets.net/fuo6knzstk5a/3RyfJbrtjhMSGceTz2EUeJ/b0c1168478bd0dda9ab5abb8e9f1dc78/Fitwel_2022_Pricing_Increase.pdf
- [16] Why Choose Fitwel Certification? <https://www.fitwel.org/certification>
- [17] International Living Future Institute. <https://living-future.org/projectregistration>
- [18] International Well Building Institute (IWBI), WELL Community Rating System. <https://www.wellcertified.com/certification/community>
- [19] Living Building Challenge. https://en.wikipedia.org/wiki/Living_Building_Challenge#:~:text=The%20Living%20Building%20Challenge%20was,became%20its%20CEO%20in%202006
- [20] Living Community Challenge Certification. <https://archive.living-future.org/lcc/certification/#4-certification>
- [21] Rezaallah, A. (2012, May) LEED and BREEAM; Comparison between Policies, Assessment Criteria and Calculation Methods. https://www.researchgate.net/profile/Roham-Afghani-Khoraskani/publication/261079555_LEED_and_BREEAM_Comparison_between_policies_assessment_criteria_and_calculation_methods/links/00b4953393f052c381000000/LEED-and-BREEAM-Comparison-between-policies-assessment-criteria-and-calculation-methods.pdf
- [22] Sterkenberg, Z. (2016, December 14) The New Natural Habitat: How Biophilia and Well Are a Hanging the Way We Work. Ambius, Biophilia Sustainability. <https://www.ambius.com/blog/the-new-natural-habitat-how-biophilia-and-well-are-changing-the-way-we-work>