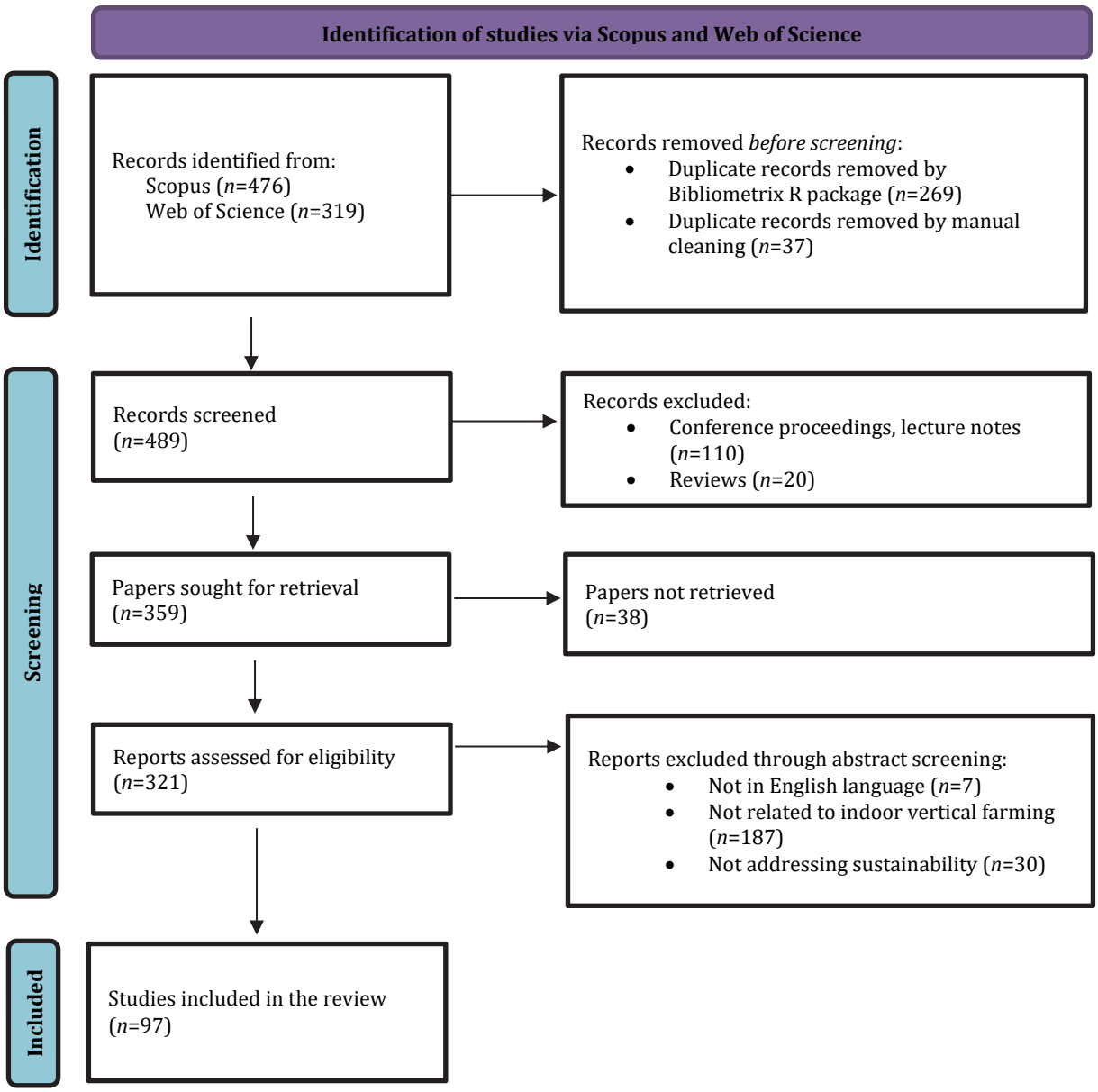
SUPPLEMENTAL INFORMATION



SUPPLEMENTAL INFORMATION – FIGURE S1. Related to Systematic scoping review.

Search string Scopus = (TITLE-ABS-KEY (sustainab* AND "vertical farm*") OR TITLE-ABS-KEY (sustainab* AND "plant factor*") OR TITLE-ABS-KEY (sustainab* AND "controlled environment agriculture")) AND PUBYEAR > 2012 AND PUBYEAR < 2024.
Search string Web of Science = WOS: 4: #3 OR #2 OR #1;
where:
1: TS = (sustainab*) AND TS = ("vertical farm*") AND PY = (2013–2023);
2: TS = (sustainab*) AND TS = ("plant factor*") AND PY = (2013–2023);
3: TS = (sustainab*) AND TS = ("controlled environment agriculture") AND PY = (2013–2023).

Source: Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71 For more information, visit: http://www.prisma-statement.org/.

SUPPLEMENTAL INFORMATION – TABLE S1. Examples of extraction of sustainability features from sustainable IVF papers, Related Systematic scoping review. En = environmental sustainability framing; ec = economic sustainability framing; so = social sustainability framing; enso = socio-environmental sustainability framing; enec = environmental-economic sustainability framing; ecso = socio-economic sustainability framing; enecso = socio-environmental-economic sustainability framing

Sustainability features	Example of sample text	Framing	Source	DOI
Environmental performance	"Notable other differences included the higher sentiment in Singapore towards optimal use of space through vertical stacking. Regarding VF, the highest sentiment scores were found for sentences related to increased yield for salad greens and herbs (Sentence 18), controlled growing conditions in nutrient-rich water (Sentence 7), supply of fresh products harvested less than 24 h earlier (Sentence 14), location in/near cities to reduce of transport-related carbon emissions and secure food supply (Sentence 17), protection of the environment (Sentence 2) and returning agricultural land to nature (Sentence 19) received the highest sentiment scores overall."	en	Ares et al. (2021)	10.1111/joss.12832
	"Overall, the largest environmental performance improvements come from the replacement of conventional gardening soil with residual materials for the growing media, i.e., recycled paper, compost and brewers' spent grains, reducing the GHG emissions from the entire system annually by over 60%. The impacts from fertilizers can also be reduced by employing biofertilizers, reducing fertilizer GHG emissions by over 66%."	en	Martin and Molin (2019)	10.3390/su11154124
Resource efficiency	"Food security, high yields, no or reduced pesticides or herbicides requirements, low transportation costs, year-round production, water use efficiency, and resilience to climate change are some of the principal benefits of indoor vertical farms."	en	Paucek et al. (2023)	10.1038/s41598-023-29027-8
	"The results from the KPIs suggest that the vertical farm has better water use efficiency, GHG emissions, and energy use efficiency compared to other studies in the literature. The results of this study provide insights into the environmental performance and resource use of vertical farms, which can be used for comparisons and validation of claims in the industry, and to provide empirical evidence to this developing field."	en	Martin et al. (2023)	10.1016/j.spc.2023.06.020
Water saving	"This work showed that high-tech conditioned urban farms can be more sustainable than conventional unconditioned greenhouses for crop production under Mediterranean climates. In fact, depending on the farm structure and its envelope properties (e.g., WWRs, materials), resource-efficiency of different typologies of urban farms can vary significantly. While in terms of water use, we reach efficiency gains of a factor of four to five in the conditioned hydroponic farms (due to water efficiency of soilless cultivation) in comparison with conventional facilities, much more electricity is used (due to climate control) than in the conventional system."	enec	Benis et al. (2017)	10.1016/j.jclepro.2017.01.130
	"The principles of hydroponics are also practiced in so-called vertical farms where food is grown in layers in an indoor facility where light and humidity can be controlled. Furthermore, vertical farms are capable of growing more food per unit area than traditional farming, as well as using less water, land and chemicals."	en	Blom et al. (2022)	10.1016/j.jclepro.2022.134443
Land use	"While disused warehouses may be available and land reclamation might be possible, in the main this cannot be regarded as a large-scale solution."	enec	Benke and Thomkins (2018)	10.1080/15487733.2017.1394054
	"Furthermore, vertical farms are capable of growing more food per unit area than traditional farming."	en	Blom et al. (2022)	10.1016/j.jclepro.2022.134443

Productivity	"In reality, the yield at a given location is considerably affected by the skills of the production manager of the PFAL, the greenhouse, and the open field. The yields in the open field and the greenhouse are also affected by the weather and climate, while the yield in the PFAL is not affected by these factors at all."	enec	Kozai (2022)	10.3390/su11236724
	"Food security, high yields, no or reduced pesticides or herbicides requirements, low transportation costs, year-round production, water use efficiency, and resilience to climate change are some of the principal benefits of indoor vertical farms."	ec	Zhang et al. (2018)	10.3390/su10124429
Cost	1. "The potential income streams and profitability of sustainable onion production using vertical farming and hydroponic systems are promising, especially when compared to conventional farming methods. The use of hydroponic technology in onion production can lead to higher yields and quality of onions, which can result in higher prices and profitability. Furthermore, the potential for diversification of income sources in vertical farming can further increase profitability and sustainability. The integration of different crops in the same space can help reduce risk and generate additional income streams for the farm. This can help onion farmers to not only achieve financial stability but also to be more resilient to market fluctuations and other economic challenges." 2. "The results showed that the initial investment cost for setting up a hydroponic system was higher than the cost of setting up a conventional onion production system. The estimated capital costs for setting up a hydroponic system were around $ 100,000 per acre, compared to $ 50,000 per acre for conventional systems. However, the operating costs of a hydroponic system were significantly lower compared to conventional onion production systems. " 3. "(...)the optimization of the financial viability of sustainable onion production using vertical farming and hydroponic systems requires a holistic approach that takes into consideration the various factors that affect production costs, market prices, and income streams."	ec	Armas et al. (2023)	10.37385/jaets.v4i2.2040
	"For all cases, the mini-PFAL operation is economically viable. Even for Case I for which the rate of return is lowest, it is estimated to be 22%, higher than the market interest rate of 5% . It is remarkable that the cost structure differs greatly among the three business models. In Case I, the “mini-PFAL in the premises of supermarket” model, the investment-related cost dominates over the production cost, whereas in Case III, the latter dominates over the former."	ec	Lu et al. (2022)	10.1016/B978-0-323-85152-7.00002-1

Energy saving	1. "Indeed, energy consumption is a significant cost of indoor vertical farms and can be used as an measure for their sustainability levels. Many research groups and institutes focus on developing innovative technologies and optimizing the lighting recipes in order to reduce the energy footprint of vertical farms and create a more sustainable and cost efficient type of farming. Even if the demand for purchased energy is much higher in indoor vertical farms than in greenhouses, the energy efficiency of the former is significantly higher(Graamans et al., 2017)." 2. "Notwithstanding the promising benefits that are linked with indoor vertical farming, there are also important challenges in the further implementation of this farming system in the future. It is of vital importance further improvements on the efficiency and effectiveness of the equipment that will lead to a significant decrease of the energy demand of the systems. By achieving the reduction of energy demand, it will add extra value in the environ-mental sustainability of the system but also it would also make it more appealing for the public, the investors and the industry and will increase the viability and profitability."	enecso	Avgoustaki and Xydis (2020)	10.1016/bs.af2s.2020.08.002
	"The waste heat energy provided by the data centre has been shown to eliminate the need for a dedicated heating system in the vertical farm. There was an average energy saving of 36.6% versus a vertical farm relying entirely on its own climate control system. The energy costs associated with operating a vertical farm are a commonly referenced risk associated with the profitability of a vertical farm."	enso	Borland et al. (2023)	10.3390/en16186704
Clean energy	"There is no requirement for long-distance transportation due to localized production and no need for farm machinery such as tractors, trucks, or harvesters. There are no seasonality issues because continuous crop production occurs all-year round and can be programmed to match demand. An economic benefit may arise from reallocation of large rural farms to energy production from solar and wind sources."	enso	Benke and Thomkins (2018)	10.1080/15487733.2017.1394054
	"The energy-autonomous PFAL with a battery backup unit will be commercialized in the near future for use with electricity generated by solar energy, wind power, biomass, or geothermal energy since the cost of electricity generated by such renewable energies has recently become less expensive than that generated by fossil fuels and nuclear power in many regions in the world."	enso	Kozai (2022)	10.1016/B978-0-323-85152-7.00016-1
Food quality	"Since vertical farms can theoretically be placed anywhere in the urban network, they allow local, nutritious and fresh consumption for consumers."	so	Avgoustaki and Xydis (2020)	10.1016/bs.af2s.2020.08.002
	"Producing food in cities can enhance urban food security and healthy nutrition of its population, as products are expected to be sold locally, increasing the accessibility of fresh food."	so	Paucek et al. (2023)	10.1038/s41598-023-29027-8
Food security and resilience	"Vertical farming creates the possibility of year-round produce as well as providing healthy, local food with instant access, hereby hugely improving food security."	ecso	Blom et al. (2022)	10.1080/22423982.2022.2025992
	"Using the same area of vertical farm as arable land, the land area would feed an average of 19 people their daily calories and an average of 22 people their fruit and vegetables."	so	Borland et al. (2023)	10.3390/en16186704

Consumer acceptance	"Socio-demographic and psychographic characteristics can underlie differences in attitudes towards novel food technologies (Siegrist and Hartmann, 2020). However, a deeper understanding of the individual determinants of attitudes towards VF and the characteristics of prospective buyers of produce from VF is lacking. The present study is situated in this knowledge gap, and it explores attitudinal and socio-demographic differences between potential buyers and non-buyers of VF-grown produce."	so	Ares et al. (2023)	10.1111/joss.12832
	1. "As hypothesised, most participants in the present research held positive attitudes to VF (Table 4; Figure 3). That is, when informed about VF, they responded positively to this novel type of agriculture and food technology." 2. "Negative attitude to this possible financial consequence of growing fresh produce in VF systems has also previously been reported as being disliked by consumers."	so	Jaeger et al. (2023)	10.1016/j.jclepro.2023.137752
Waste	"By connecting these used batteries, an inexpensive battery backup system can be installed in the PFAL and many other electricity-driven systems. The reduction in storage capacity of used batteries by 30% will not cause any problem in those systems."	enso	Kozai (2022)	10.1016/B978-0-323-85152-7.00016-1
	"Through symbiotic development, the results point to the potential to improve the environmental performance of these systems. This is achieved by employing residual streams for growing media, bio-based fertilizers and reducing transportation of raw materials. Overall, the largest environmental performance improvements come from the replacement of conventional gardening soil with residual Sustainability 2019, 11, 6724 15 of 18 materials for the growing media, i.e., recycled paper, compost and brewers' spent grains, reducing the GHG emissions from the entire system annually by over 60%."	enso	Martin and Molin (2019)	10.3390/su11154124
Food safety	"Countries such as South Africa, Seychelles, Egypt, Mauritius, Morocco, Tunisia, Algeria, Cape Verde, and Nigeria showed the best prospective for indoor vertical farming implementation. These are African countries where the integration of vertical farming into the urban areas may help reduce poverty, contribute to food safety and increase its contextual sustainability."	so	Paucek et al. (2023)	10.1038/s41598-023-29027-8
	"Meanwhile, vertical farms may be able to increase the productivity rate in highly urbanized areas that can lead to improvements in the food security of the community."	so	Avgoustaki and Xydis (2020)	10.1016/bs.af2s.2020.08.002

Local and community development	"In terms of socio-economic benefits, the respondents agreed that sustainable onion production could provide employment opportunities and stimulate local economic activity and entrepreneurship. However, they only moderately agreed that it could result in higher income for farmers and producers."	so	Armas et al. (2023)	10.37385/jaets.v4i2.2040
	"By growing food in the neighborhood, residents would not only have access to a year-round supply of healthy foods, but would also have the assurance that their food is grown locally and, because there are few costs incurred in transportation, it would be available at lower prices."	so	Besthorn (2013)	10.1080/0312407X.2012.716448
Quality jobs	"Therefore, one could understand that mass deployment of IVFs within cities could minimise the operational costs, decrease CO_2 emissions e since for a large number of leafy products the production will take place in cities - and increase the number of agriculture-based jobs offered in the urban environment."	so	Avgoustaki and Xydis (2021)	10.1016/j.biosystemseng.2021.09.006
	"In terms of socio-economic benefits, the respondents agreed that sustainable onion production could provide employment opportunities and stimulate local economic activity and entrepreneurship. However, they only moderately agreed that it could result in higher income for farmers and producers."	so	Armas et al. (2023)	10.37385/jaets.v4i2.2040
Integration with existing infrastructure	1. "Engineers believed that an old building could be retrofitted to meet the needs of the vertical farm, while architects believed that a new building was required." 2. "The findings indicate that vertical farming is a concept that is in its technical infancy but does hold promise for future cities. Further research can help pursue this idea further. This includes developing multifunctional designs with input from engineers, architects, and vertical farming technology providers simultaneously in order to help design future structures that can adapt to 21st century needs, developing pilot programmes where real time data can be collected and analyzed in order to examine where opportunities and barriers exist compared to conventional produce, developing a larger energy model that can take more factors into account (ventilation, waste, etc.), and conducting a techno economic study that incorporates construction and maintenance costs."	so	Al-Chalabi (2015)	10.1016/j.scs.2015.06.003
	"Social workers, working in concert with community members, may have knowledge of specific sites in neighborhoods that would be optimal for the farm. If social workers were involved, the likelihood of a positive cooperative relationship between residents and community developers would be greatly enhanced. Perhaps the city could offer a change in zoning laws that would permit easier access to a neighborhood vertical farm."	ecso	Besthorn (2013)	10.3390/agronomy12123182
	"This paper attempts to determine if there could be a potential symbiotic relationship in energy usage between data centres and vertical farms and to quantify any reduction in overall energy consumption and carbon emissions."	enec	Borland et al. (2023)	10.3390/en16186704
	"Vertical Farming (VF) is another form of BIA that consists of raising crops indoors in multistory buildings within the urban context, in new constructions or abandoned buildings."	ecso	Benis et al. (2017)	10.1016/j.jclepro.2017.01.130

Year-long production	"The yields in the open field and the greenhouse are also affected by the weather and climate, while the yield in the PFAL is not affected by these factors at all. The high yield in the PFAL is mainly due to: (1) year-round production (longer total cultivation periods per year); (2) use of multitiers; (3) shortened cultivation periods or enhanced growth due to an optimal environment throughout the cultivation period; and (4) no reduction in the yield due to pathogenic diseases, insects, or disastrous weather events such as typhoons."	so	Kozai (2022)	10.3390/su11236724
	"Food security, high yields, no or reduced pesticides or herbicides requirements, low transportation costs, year-round production, water use efficiency, and resilience to climate change are some of the principal benefits of indoor vertical farms."	so	Paucek et al. (2023)	10.1038/s41598-023-29027-8
Fresh local food	"Their produce is harvested and packed daily, while meeting the food industry's requirements of safety and hygienic control. Every day, 20,000 heads of lettuce are shipped to supermarkets, retailers, restaurants, and food service companies (for bento lunch boxes, sandwiches, sushi, etc.) mainly in the Kanto region (i.e., the Greater Tokyo Area that encompasses seven prefectures) and the Chubu region (i.e., the central region including Shizuoka, their local area)."	so	Hayashi (2020)	10.1016/B978-0-12-816691-8.00030-3
	"Many of the firms also found the modular systems to be beneficial in their marketing by increasing transparency and awareness for vertical farming methods and products. Nearly all firms motivated the development and use of these systems to contribute to more sustainable food provisioning. Location was found to be a key aspect in both the sustainability and quality of the products, e.g., linked to the proximity to users and "freshness" of the product."	so	Martin and Bustamante (2021)	10.3389/fsufs.2021.787281
Shorter food chains	"The approach of producing food closer to where it is consumed has provoked increasing interest over the last years as it is claimed to considerably decrease fossil fuel consumption, improve food security, provide jobs locally, cut transportation costs and enhance energy efficiency in buildings as discussed by Gould and Caplow (2012) or Benis and Ferrao (2016). BIA includes soilless culture methods, such as hydroponic cultivation, a technology that does not use any land, requires around ten times less water than conventional agriculture, and leads to significantly higher yields in smaller areas (Barbosa et al., 2015) ".	enso	Benis et al. (2017)	10.1016/j.jclepro.2017.01.130
	"Many of the firms also found the modular systems to be beneficial in their marketing by increasing transparency and awareness for vertical farming methods and products. Nearly all firms motivated the development and use of these systems to contribute to more sustainable food provisioning. Location was found to be a key aspect in both the sustainability and quality of the products, e.g., linked to the proximity to users and "freshness" of the product."	so	Martin and Bustamante (2021)	10.3389/fsufs.2021.787281
Training and learning	"For the general production of plants, the students can be considered a key element. Training and part/full-time employment can motivate them to get involved in the process. This will enable them to create a strong sense of community and belongingness."	so	Zhang et al. (2018)	10.3390/su10124429

Innovation	1. "Technical features of Spread's Techno Farm include automated cultivation, environmental control technology, water recycling technology, and IoT/AI technology. Automated cultivation saves labor and keeps the cultivation room unmanned and improves hygienic conditions." 2. "808 Factory is planning to develop their third PFAL, a smart 808 factory, where they aim to apply artificial intelligence together with maximum utilization of their big data, fully automated systems, and phenotyping technologies, while building on their expertise in operational techniques. Future goals include establishing their large-scale smart PFAL and expanding smart 808 Factory systems internationally."	ecso	Hayashi (2020)	10.1016/B978-0-12-816691-8.00030-3
	"The options to be considered for the plant factories in this study are the utilization of unused heat, a solid-oxide fuel cell, PV power, improved electric devices such as heat pumps and lighting, insulation, and the installation of all options."	enec	Kikuchi et al. (2019)	10.1016/B978-0-12-818634-3.50265-4

SUPPLEMENTAL INFORMATION – TABLE S2. Calculation of the relative frequency of occurrence per sustainability dimensions of each sustainability feature, related to Framework Development.

Sustainability feature	Code	Absolute frequency				Relative frequency		
		Total	Environ-mental	Economic	Social	Environ-mental	Economic	Social
Environmental performance	ENV	40	40	0	0	100%	0%	0%
Resource efficiency	RES	16	14	7	0	88%	44%	0%
Water saving	WAT	10	10	2	0	100%	20%	0%
Land use	LAN	12	11	5	2	92%	42%	17%
Productivity	PRO	41	4	38	5	10%	93%	12%
Cost	COS	33	0	33	2	0%	100%	6%
Energy saving	ENE	36	14	14	25	39%	39%	69%
Clean energy	CLE	16	7	4	13	44%	25%	81%
Food quality	QUA	11	0	0	11	0%	0%	100%
Food security and resilience	SEC	20	1	2	20	5%	10%	100%
Consumer acceptance	CON	15	0	0	15	0%	0%	100%
Waste	WAS	8	4	1	8	50%	13%	100%
Food safety	SAF	5	0	0	5	0%	0%	100%
Local and community development	LOC	5	0	0	5	0%	0%	100%
Quality jobs	JOB	3	0	0	3	0%	0%	100%
Integration	INT	8	0	3	8	0%	38%	100%
Year-round production	YEA	4	0	0	4	0%	0%	100%
Fresh local food	FRE	10	0	1	10	0%	10%	100%
Shorter food chains	SHO	14	3	2	13	21%	14%	93%
Training and learning	TRA	2	0	0	1	0%	0%	100%
Innovation	INN	21	0	11	21	0%	52%	100%
TOTAL			111	123	168			

Legend: Sustainability features collecting more than 20% of the consensus threshold to be considered as belonging to a given dimension of sustainability.

SUPPLEMENTAL INFORMATION – TABLE S3. Synergies of sustainability features with other systematization efforts, related to Framework Development.

This study	Al-Kodmany (2018)	Bunge et al. (2022)	Csambalik et al. (2023)	Faraji et al. (2023)	Gan et al. (2023)	Kalantari et al. (2018)
Environmental performance (ENV)	Increase bio-diversity; "green technology" reduce harm and improve environmental performance Preserving natural ecological system	Biodiversity loss Ecotoxicity Ozone depletion	Reduction GHG emissions	The possibility of returning to the natural ecological state for the environment; Eliminate the destructive effects of climate change and produce multiple products	Reduction of carbon footprint	Reduction of carbon footprint and the effect of air quality; Reduction of urban heat island; Protect from natural disease; Resilient to climate change
Resource efficiency (RES)	Reduced fertilizers, herbicides, and pesticides	Efficiency	Pesticides free Reduction of resources use	Abandoning the use of chemicals to control pests and growth promoters	Less input of fertilisers and sprays; Efficient use of resources	Reduction of herbicide and pesticide manufacture
Water saving (WAT)	Reducing water consumption for food production by using high-tech irrigation systems and recycling methods; Reducing surface water run off of traditional farms; Making potable water available to more people	Acidification; Eutrophication; Water use		Absence of contaminants in drinking water; Water conservation is about 70 to 95% less than traditional agriculture; Possibility of treating wastewater and ground water and turning it into drinking water	Efficient water use	Reduction of water demands
Land use (LAN)	Needs less space	Land use	Utilization of unfarmed land; Utilization of unused space	Possibility of cultivating agricultural products in all areas	Efficient land use; Use of unused land	Economic opportunity for land scarcity
Productivity (PRO)	Improve productivity; Avoid crop losses due to floods, droughts, hurricanes, over exposure to sun, and seasonal changes; Offer greater yields				Higher production efficiency	More productivity per unit of area

Cost (COS)	Reduce costs: Decrease costs: Avoiding economic loss; Reduce costs; Saving money required to correct environmental damage;	Financial profit; Product price	Investment costs		Lower input costs; Lower transportation costs; Decrease food cost	Minimization of energy cost; Low price of food
Energy saving (ENE)	Reduce energy, packaging, and fuel to transport food	Energy use	High energy demands		Energy use	Energy saving
Clean energy (CLE)	Reducing fossil fuel; Using renewable energy	Fossil fuel depletion				Reduces fossil fuel
Food quality (QUA)	Improve food quality and subsequently consumers' health	Nutritional adequacy	Premium price products Nutritional value			
Food security and resilience (SEC)	Improve food security		Increasing food resilience	Essential food production; Improving the food security situation of the community; Economic benefits	Food security; Food accessibility	Improve food security
Consumer acceptance (CON)		Consumer acceptance; Willingness-to-Pay Willingness-to-Buy				
Waste (WAS)	Recycling organic waste; Save the environment by reducing needed land fills; Turn waste into asset	Food waste; Plastic waste	Minimization of waste and recycling	Less need for packaging, storage and transportation of food		Recycling of organic waste
Food safety (SAF)				Possibility of more control and security in cultivating agricultural products		
Local and community development (LOC)	Create a local community of workers and social networks with farmers; Create opportunities for social interaction; Benefit local people economically		Utilization of local workforce; Local cooperation	Solidarity and popular participation in the production of agricultural products; Creating local markets and producing cuts		Greater community; Leisure Community; Economic growth

Quality jobs (JOB)	Reduce redundant, repetitive work, and save time to do productive and socially rewarding activities; Provides new jobs in engineering, biochemistry, biotechnology, construction and maintenance, and research and development		Highly skilled labor demands	Creating new job opportunities	Job creation; Improve income opportunities	Job opportunity
Integration with existing infrastructure (INT)	Repurposing dilapidated buildings		Integration into buildings			
Year-round production (YEA)	Produce unregarding season; Control product/produce regardless to seasons; Increase accessibility year-round and improve respond to population demand; Fuel economic activities year-round				Production stability	
Fresh local food (FRE)	Improving air quality, improves environmental and people's health; Customers receive "fresher" local food			Ability to enjoy fresh vegetables and food for city dwellers		
Landscape quality[1] (LAS)	Enhance the environment; Remove eye sores and stigma from neighborhoods			Increasing the amount of green space in cities and beautifying the urban environment		New landscape opportunities; Visual amenity
Shorter food chains (SHO)	Reducing food-miles (travel distances); People do not have to commute to work and hence will decrease ecological footprint; Bringing nature closer to city		Reduction of food miles	Closer distance to required facilities and no use of fossil fuels		
Training and learning (TRA)	Encourage higher education and generate skilled workers					Education

Innovation (INN)	Promoting high-tech and green industry; Reducing the activities of traditional farming; Revive economy	Innovative cultivation technologies; Agriculture 4.0

[1] This sustainability feature is described but not directly discussed in the IVF sustainability literature.

SUPPLEMENTAL INFORMATION – TABLE S4. List of papers included in the review.

Authors	Title	DOI
Al-Chalabi M	Vertical farming skyscraper sustainability	10.1016/j.scs.2015.06.003
Arabzadeh V; Miettinen P; Kotilainen T; Herranen P; Karakoc A; Kummu M; Rautkari L	Urban vertical farming with a large wind power share and optimised electricity costs	10.1016/j.apenergy.2022.120416
Ares G; Chheang S; Jaeger S	Buying vertically farmed produce comparison of people with lower and higher stated purchase likelihood	10.1111/joss.12832
Ares G; Ha B; Jaeger S	Consumer attitudes to vertical farming indoor plant factory with artificial lighting in China Singapore UK and USA, a multimethod study	10.1016/j.foodres.2021.110811
Armas K; Lorenzo E; Cruz C	Financial viability of business models for engineered vertical hydroponics systems for sustainable onion production in the Philippines	10.37385/jaets.v4i2.2040
Avgoustaki D	Optimization of photoperiod and quality assessment of basil plants grown in a small-scale indoor cultivation system for reduction of energy demand	10.3390/en12203980
Avgoustaki D; Bartzanas T; Xydis G	Minimising the energy footprint of indoor food production while maintaining a high growth rate introducing disruptive cultivation protocols	10.1016/j.foodcont.2021.108290
Avgoustaki D; Xydis G	Indoor vertical farming in the urban nexus context business growth and resource savings	10.3390/su12051965
Avgoustaki D; Xydis G	How energy innovation in indoor vertical farming can improve food security sustainability and food safety	10.1016/bs.af2s.2020.08.002
Avgoustaki D; Xydis G	Energy cost reduction by shifting electricity demand in indoor vertical farms with artificial lighting	10.1016/j.biosystemseng.2021.09.006
Baumont DOF; Ferson S; Dyer R	A collaborative decision support system framework for vertical farming business developments	10.4018/IJDSST.2021010103
Benis K; Reinhart C; Ferrão P	Development of a simulation-based decision support workflow for the implementation of building-integrated agriculture BIA in urban contexts	10.1016/j.jclepro.2017.01.130
Benke K; Tomkins B	Future food production systems vertical farming and controlled environment agriculture	10.1080/15487733.2017.1394054
Besthorn F	Vertical farming social work and sustainable urban agriculture in an age of global food crises	10.1080/0312407X.2012.716448
Blom C; Steegeman P; Voss C; Sonneveld B	Food in the cold exploring food security and sovereignty in Whitehorse Yukon	10.1080/22423982.2022.2025992
Blom T; Jenkins A; Pulselli R; Van DDA	The embodied carbon emissions of lettuce production in vertical farming greenhouse horticulture and open field farming in the Netherlands	10.1016/j.jclepro.2022.134443
Borland P; Mcdonnell K; Harty M	Assessment of the potential to use the expelled heat energy from a typical data centre in Ireland for alternative farming methods	10.3390/en16186704
Broad G	Know your indoor farmer square roots technological food and transparency as publicity	10.1177/0002764220945349
Broad G; Marschall W; Ezzeddine M	Perceptions of high-tech controlled environment agriculture among local food consumers using interviews to explore sensemaking and connections to good food	10.1007/s10460-021-10261-7
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SUPPLEMENTAL INFORMATION – TABLE S5. Example of extraction from the commercial IVF narrative, related to testing with CIVFs.

Agricola Moderna	
Example of sample text	Sustainability feature
"Growing vertically, we save 98% of soil."	LAN
"Hydroponics saves 95% of water compared to traditional methods."	WAT
"We use 100% recyclable packaging that is 70% bio based."	WAS
"Growing near you, the product arrives on the shelves in a day, at km 0."	FRE