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The Path Forward: Insights of Urban Agriculture and Sustainable Development From Bibliometric Analysis and Systematic Literature Review

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Abstract: ***In a world that is quickly urbanising, urban agriculture is viewed as an essential component of environmentally responsible urban development. Since this is the case, it is necessary to have a comprehensive framework for evaluating the performance of urban agriculture in terms of urban sustainability. In order to provide an explanation for the publication trend, prominent authors and publications, and significant study areas in the subject of urban agriculture and sustainable development, this work makes use of bibliometric analysis. The bibliometric study provides policymakers with significant insights that can be used to build evidence-based policies that support the growth, development, and sustainability of urban agriculture. Current research trends in the field of urban agriculture and sustainable development are elucidated by our comprehensive review of the relevant literature. As an additional benefit, the study provides researchers with the opportunity to determine potential future research topics in the field of urban agriculture and sustainable development.***
Keywords: urban agriculture, sustainability, systematic review, bibliometric analysis

I. INTRODUCTION

The practice of urban agriculture is increasingly gaining traction in cities worldwide, with practical uses in both emerging and established economies. In the context of urban expansion and population growth, the integration of agriculture assumes paramount importance in addressing long-term concerns related to food security, environmental preservation, and community engagement. Urban agriculture generally encompasses the growing of plants and the raising of animals in urban centres and its environs. Urban agriculture refers to the cultivation of crops, vegetables, herbs, fruit, flowers, orchards, parks, forestry, fuelwood, livestock, aquaculture, and bee-keeping within a city district or on its immediate outskirts (Gittleman, 2009). The notion of urban agriculture originated in the mid-nineteenth century and has been increasingly popular in cities worldwide due to rapid urbanisation (Bhat and Paschapur, 2020; Kalesh & Markose, 2019).

Urbanisation, considered a key measure of economic progress, has caused people to cluster in major cities. Uncontrolled urbanisation, stemming from industrialisation, leads to demographic migration to urban areas (Devi, 2017). Today, cities worldwide are grappling with the challenge of accommodating their growing populations. Furthermore, it is projected that by 2050, 68 percent of the global population would reside in urban areas (UN, 2018). Urban population growth of this nature exerts pressure on the ability of cities to absorb new population, resulting in recurrent socio-economic disparities, social isolation, severe poverty, high unemployment rates, slums, unaffordable housing, unfavourable environmental conditions, and unsustainable environmental footprints (UN-Habitat, 2022). Urbanisation can therefore present significant challenges to the attainment of sustainable development in cities.

The objective of sustainable development is to facilitate favourable economic and social progress while reducing environmental deterioration, therefore safeguarding the rights and possibilities of future generations and supporting comparable endeavours in other regions (Dalal-Clayton & Bass, 2012). Accordingly, it can be asserted that the concept of sustainable development is founded upon three fundamental principles, specifically, "economic sustainability," "social sustainability," and "environmental sustainability" (Mensah, 2019). The integration of environmental, social, and economic factors into every facet of decision-making is a fundamental component of sustainable development. Synthesising economic, social, and environmental goals while taking into account their effects on different socio-economic groups and future generations is a complex task (OECD, 2001). The resolution of such challenges cannot be approached in a haphazard or fragmented fashion. Therefore, the achievement of sustainable development requires a comprehensive strategy that combines and connects several development processes. urban agriculture can therefore be employed as a strategy to ensure sustainability (Ebissa. et al., 2023).

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In the pursuit of sustainability, cities face several challenges such as addressing the nutritional needs of the urbanised population and promoting participatory agriculture practices (Ebenso et al., 2022). The conventional agricultural system, which heavily depends on extensive, industrialised farming techniques, requires significant land utilisation, substantial water resources, and chemical inputs. These activities contribute to the destruction of forests, deterioration of soil quality, contamination of water, and release of greenhouse gases, therefore exacerbating the issues arising from climate change (Srinivasan & Yadav, 2023). Consequently, urban agriculture is encouraged to make use of available areas in both public and private domains, including streets, schools, colleges, parks, gardens, rooftops, and walls, with the goal of enhancing the sustainability of cities (Hara et al., 2018; Kyoi, 2023; Rao - 2022). The environmental, social, and economic aspects of urban agriculture have been evaluated to determine its contributions to urban sustainability. Urban agriculture, when considered from a social standpoint, encompasses the enhancement of food security, nutrition, and health for populations living in urban poverty and marginalisation (Agarwal & Sinha, 2017). The economic aspect of urban agriculture include the generation of employment opportunities, provision of training and support for businesses, expansion of markets for farmers, economic benefits due to reduced food costs, savings for municipal agencies, and enhanced house values (Golden, 2013). Urban agriculture offers prospects for optimising space utilisation in cultivating diverse crops and enhancing biodiversity and habitat for pollinators (De Oliveira Alves & De Oliveira, 2022). Furthermore, it aids in the regulation of the microclimate, enhancement of resource efficiency, and mitigation of carbon emissions (Sany´e-Mengual et al., 2018, 2019). Under these circumstances, urban agriculture is gaining popularity as a method for achieving sustainable urban development (Zasada et al., 2020).

The primary objective of this study is to offer a thorough framework for assessing the performance of urban agriculture from the standpoint of urban sustainability. The objective of this study is to document the impact of urban agriculture practices on sustainable development in previous research and to identify the remaining research gaps using bibliometric analysis.

The subsequent sections of this paper are structured in the following manner: The initial portion provides a comprehensive elucidation of the technique, source of study, and architecture of bibliometric analysis. The subsequent section focusses on conducting a systematic review of leading research papers.

II. DATA AND METHODOLOGY

The present study uses bibliometric analysis and systematic literature reviews for the study. As a convenient package, R programming is great for visualising literature review data for analysis. In addition, it is exceptional for demonstrating results using a graphical interface that aids in knowledge network clarification, displays the evolution of knowledge, highlights current research directions, and confirms knowledge discovery. (Harikumar & Muthumeenakshi,2023). The methodology and study objectives are described in Table 1. The study offers essential data on annual publications, citations, publication efficiency, authors, nations, and search keywords in the research field, along with co-occurrence and bibliographic coupling analysis.

Table 1 showing research objectives and methods

	Research Objectives	Research Methods
Bibliometric Investigation	To examine the direction of connectedness of urban agriculture and sustainable development.	Publication trend
	To identify the top nations, important publications, and authors about urban agriculture and sustainable development.	Citation analysis
	To find out the theoretical design of keywords urban agriculture and sustainable development.	Co-occurrence Analysis
Systematic Analysis	To understand the role of urban agriculture in sustainable development	Systematic Literature Review

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III. DISCOVERING THE SOURCE OF STUDY AND RELATED RESEARCH

The study uses the Scopus database to explore the bibliometric analysis in the current research. The search keyword contains 'Urban Agriculture and Sustainable Development', and the outcome consists of 3013 documents. After removing duplications, the last search output consisted of 555 documents. Which is taken as the sample size of the study. Scopus has the broadest coverage of urban agriculture related peer-reviewed research, a quick update cycle, and the ability to inspect and analyse data (Goodell et al., 2021). Hence, the Scopus database was used.

The period chosen for the study is 2010 to 2023, as the selected period shows mass literature in the relevant field. It will help the study to analyse the overall trend in urban agriculture and sustainable development. The keyword used to extract the relevant articles is 'urban agriculture and sustainable development'. The architecture for retrieving the relevant literature employed in bibliometric investigation is depicted in figure 1.

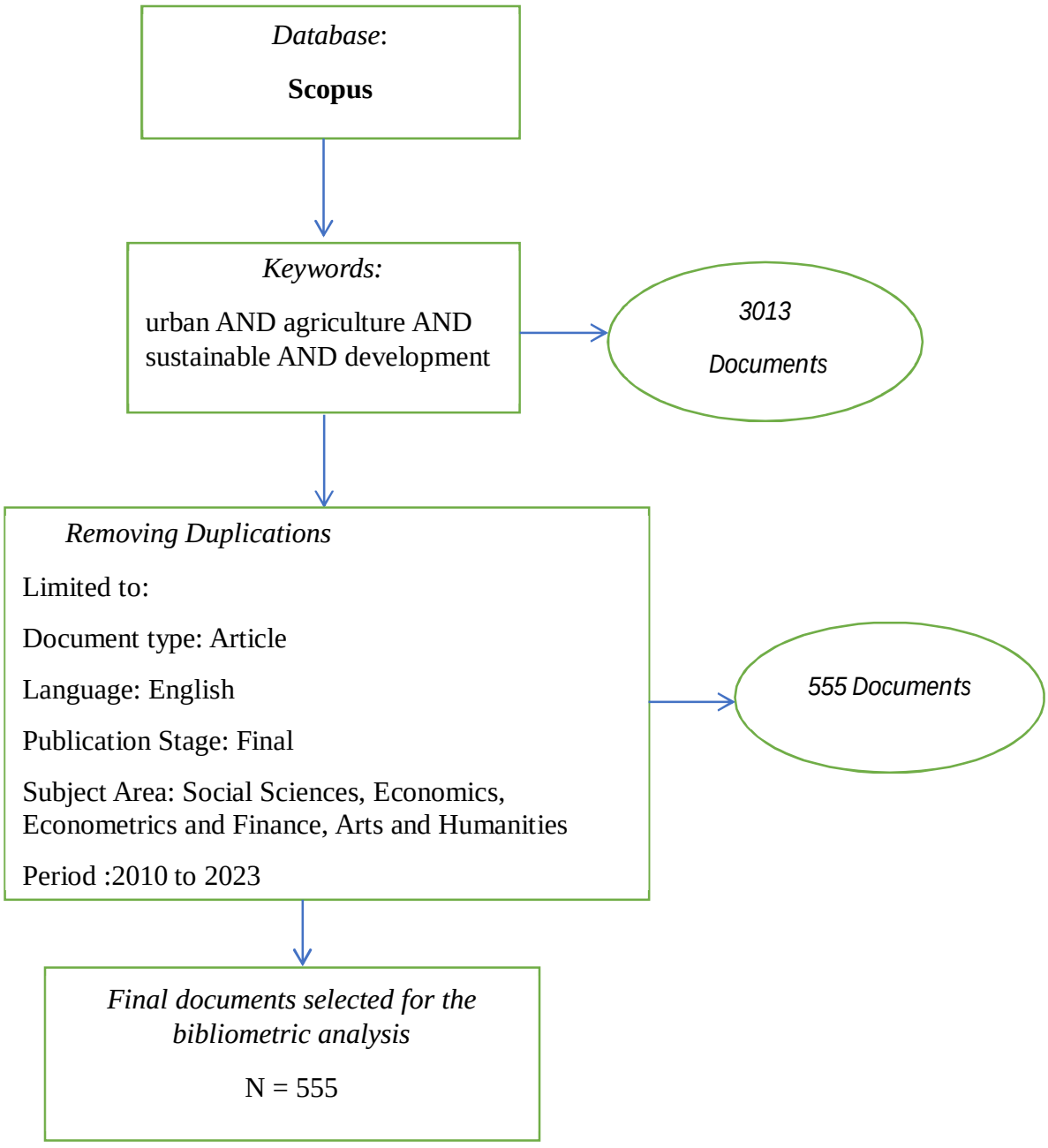


Figure 1 Showing the architecture of the study

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Volume 12 Issue IX Sep 2024- Available at www.ijraset.com

IV. APPLICATION OF BIBLIOMETRIC ANALYSIS

The software used for bibliometric analysis is R programming, as it is powerful in secondary data visualisation. The application of "biblioshiny" permits researchers to plot multiple results in tabular and graphical manners with a graphical interface (Harikumar & Muthumeenakshi, 2023). The quantitative description of the study is provided in Table 2, which includes important particulars related to publications in the same field. After removing duplications, the research articles were limited to 555 produced by 1776 authors, where 25 are relevant authors who have published more than 25 articles in the same area. The annual growth rate of published papers per year was 14.27 percent, and the average number of citations per paper was 21.44.

Table 2 Descriptive statistics

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2010:2023
Sources (Journals, Books, etc)	209
Documents	555
Annual Growth Rate %	14.27
Document Average Age	5.08
Average citations per doc	21.44
References	31596
DOCUMENT CONTENTS	
Keywords Plus (ID)	2420
Author's Keywords (DE)	1992
AUTHORS	
Authors	1776
Authors of single-authored docs	72
AUTHORS COLLABORATION	
Single-authored docs	74
Co-Authors per Doc	3.53
International co-authorships %	26.85
DOCUMENT TYPES	
article	555

A. Annual Production Trend

A thorough examination of the development, progress, and present trends in studies related to urban agriculture and sustainable development is provided by the annual scientific production of research articles. Figure 2 shows the number of articles published from 2010 to 2023. An exponential increase in published articles related to urban agriculture and sustainable development has been observed since 2016, following the adoption of the Sustainable Development Goals (SDGs) as a strategy by the United Nations in 2015 to address poverty, food security, economy, prosperity, ecosystem, climate, harmony, and equality (Srinivasan & Yadav, 2023)

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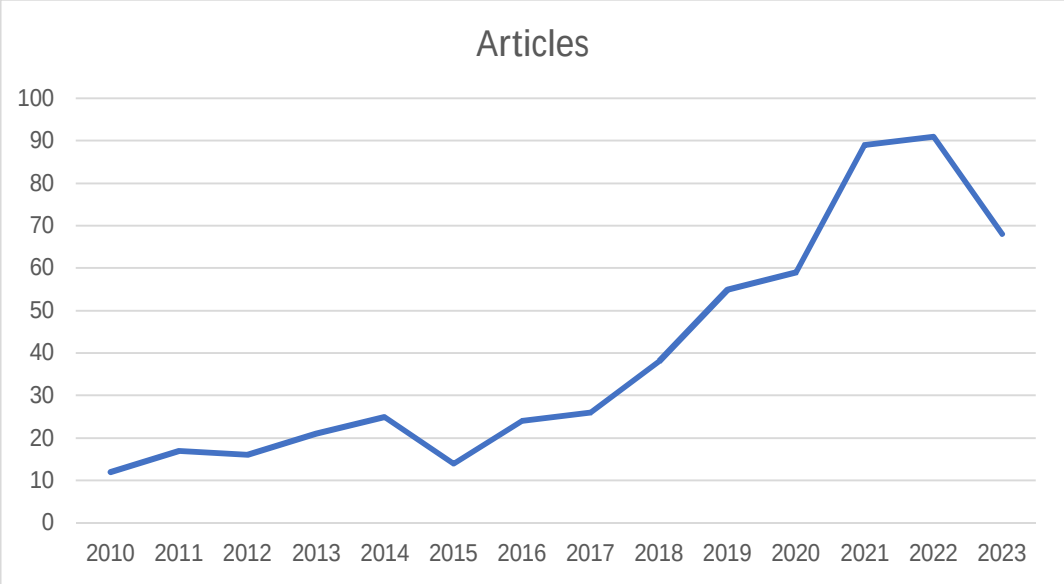


Figure 2 Annual production trend.

B. Leading Countries in the scientific production of articles

With 372 articles between the period 2010 and 2023, China dominated the research on urban agriculture and sustainable development. The USA is the next largest contributor with 196 papers, followed by Italy with 133 articles. For the same period, there were only 88 papers published in India. This could be due to differences in the infrastructure for research, the availability of money, the priorities of policy, and cultural considerations (Srinivasan & Yadav, 2023). To enhance research on urban agriculture and sustainable development in countries like India, it is crucial to establish dedicated research centers, provide funding opportunities, conduct capacity-building programs, invest in data collection and analysis, promote interdisciplinary collaborations, advocate for supportive policies, and create knowledge-sharing platforms. The top nations that made contributions to urban agriculture and sustainable development are shown in Figure 3.

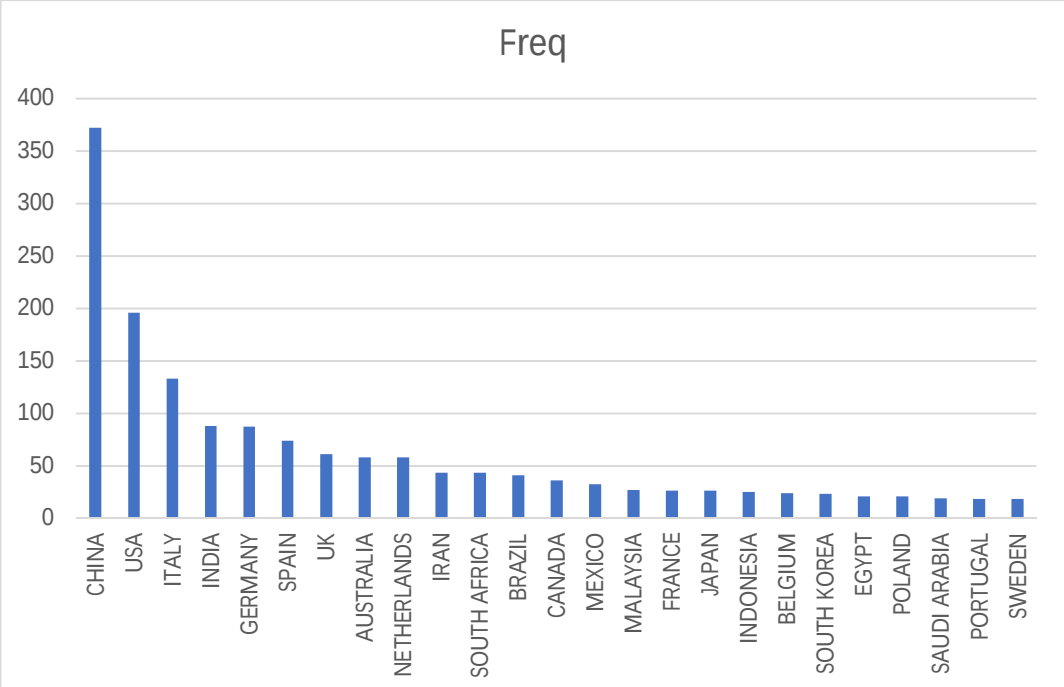


Figure 3 Leading Countries in the Scientific Production of Articles

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C. Leading Countries in Citation of Articles

The country with the most article citations is China (2020), followed by the USA (1348) and Italy (1128). Despite being the country that contributed the most to this field of study after China, the United States, and Italy, there were only 187 citations in all for works from India. This is because of factors including awareness level, policy emphasis, collaboration opportunities, and research focus. The top countries in citation of articles are shown in Table 3.

Table 3 Leading countries in the citation of Articles

Country	Total citations
CHINA	
USA	2020
ITALY	1348
UNITED	1128
KINGDOM	1003
GERMANY	556
BELGIUM	502
SPAIN	465
AUSTRALIA	414
GHANA	269
SWEDEN	256

D. Leading Authors in Publication

A good insight into authors who made a significant contribution to the publication on urban agriculture and sustainable development can be found in Table 4. Liu Y S is the most relevant author, with 47 publications in urban agriculture and sustainability, followed by McClintock with 45 articles, chase with 42 articles and Liu Y with 40 articles A noticeable trend in this analysis is that most researchers have worked in the field of sustainable urban development.

Table 4 Leading authors in publication

Authors	**Articles**
LIU Y S	47
MCCLINTOCK N	45
CHASE A F	42
LIU Y	40
ZASADA I	38
ZHANG Y	38
ORSINI F	37
SANYE-MENGUAL E	37
LOVELL S T	34
MOUGEOT L J A	32
OSTROM E	32
SMIT J	32
LI X	31
SPECHT K	31

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E. Three Field plot Analysis

We look at the major research areas, countries, and influential publications to enhance the scope of bibliometric analysis. A three-field map that shows the relationships between nations, research areas, and journals based on a Sankey diagram. The rectangle nodes' height varies in direct proportion to how frequently they appear. Figure 4 shows the threefold study of urban agriculture and sustainable development, with nations on the right side, the name of the research publication on the left side, and keywords in the middle. According to the graph, the key areas of research are urban agriculture, sustainable development, and sustainability, with most of the research being contributed from the USA, China, and Italy**.** However, comprehensive research is still lacking in critical areas like food security and climate change.

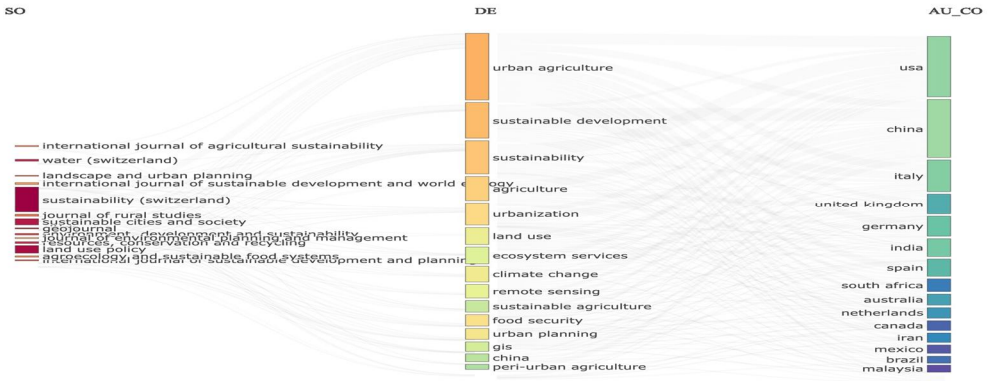


Figure 4 showing three field plot analyses.

F. Leading Publication

Researchers and academics can exchange fresh knowledge and ideas by publishing them in scholarly publications. By determining the best influential publications participating in a specific topic of research, scientists can select the most pertinent and excellent publications to publish their findings. The active journals for publishing studies on urban agriculture and sustainable development are shown in Figure 5. Approximately 209 journals published 555 research articles in total between the years 2010 and 2023. With 123 papers in this area of study, sustainability (Switzerland) was the most active journal. The prominent research journals according to the classification of Bradford Law are listed in Table 5, which divides the research publications into 3 zones. Among the 209 research journals, 4 journals are located within zone 1, 43 journals are placed within zone 2, and 162 journals are located within zone 3.

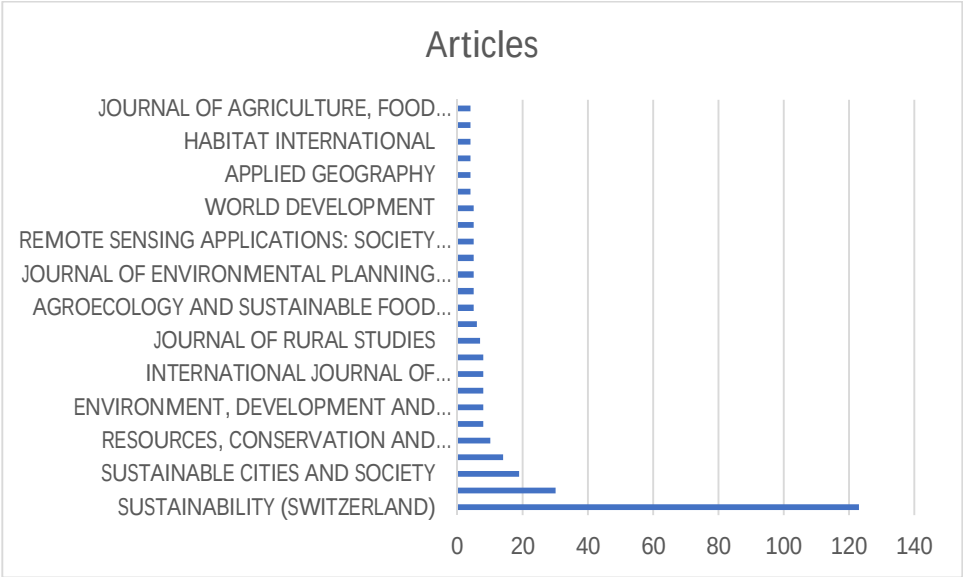


Figure 5 Showing leading publications.

Table 5 Top research journals according to Bradford Law.

Sources	Rank	Freq	cumFreq	Zone
SUSTAINABILITY (SWITZERLAND)	1	123	123	Zone 1
LAND USE POLICY	2	30	153	Zone 1
SUSTAINABLE CITIES AND SOCIETY	3	19	172	Zone 1
WATER (SWITZERLAND)	4	14	186	Zone 1
RESOURCES, CONSERVATION AND RECYCLING	5	10	196	Zone 2
CITIES	6	8	204	Zone 2
ENVIRONMENT, DEVELOPMENT AND SUSTAINABILITY	7	8	212	Zone 2
GEOJOURNAL	8	8	220	Zone 2
INTERNATIONAL JOURNAL OF SUSTAINABLE DEVELOPMENT AND PLANNING	9	8	228	Zone 2
LANDSCAPE AND URBAN PLANNING	10	8	236	Zone 2
JOURNAL OF RURAL STUDIES	11	7	243	Zone 2
INTERNATIONAL JOURNAL OF AGRICULTURAL SUSTAINABILITY	12	6	249	Zone 2
AGROECOLOGY AND SUSTAINABLE FOOD SYSTEMS	13	5	254	Zone 2
INTERNATIONAL JOURNAL OF SUSTAINABLE DEVELOPMENT AND WORLD ECOLOGY	14	5	259	Zone 2
JOURNAL OF ENVIRONMENTAL PLANNING AND MANAGEMENT	15	5	264	Zone 2
LAND DEGRADATION AND DEVELOPMENT	16	5	269	Zone 2
REMOTE SENSING APPLICATIONS: SOCIETY AND ENVIRONMENT	17	5	274	Zone 2
URBAN ECOSYSTEMS	18	5	279	Zone 2
WORLD DEVELOPMENT	19	5	284	Zone 2
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT	20	4	288	Zone 2
APPLIED GEOGRAPHY	21	4	292	Zone 2
CHINA AGRICULTURAL ECONOMIC REVIEW	22	4	296	Zone 2
HABITAT INTERNATIONAL	23	4	300	Zone 2
ISPRS INTERNATIONAL JOURNAL OF GEO-INFORMATION	24	4	304	Zone 2
JOURNAL OF AGRICULTURE, FOOD SYSTEMS, AND COMMUNITY DEVELOPMENT	25	4	308	Zone 2

G. Co-occurrence Network Analysis

To identify the most significant study areas in this field, keyword co-occurrence analysis is also important. The thickness of the node indicates the overall prevalence at which each keyword occurred in the research on urban agriculture and sustainable development. The co-occurrence network analysis is shown in Figure 6. From the figure, it is very clear that the keywords with more time occurrences are “sustainable development”, “urban agriculture,” and “Sustainability”. This suggests a strong relationship or association between these concepts in the research literature or discussions related to urban agriculture and sustainability. The frequent co-occurrence of these keywords can highlight the interconnectedness of sustainable development goals, urban agriculture practices, and the overarching theme of sustainability in academic research, policy documents, or other relevant sources.

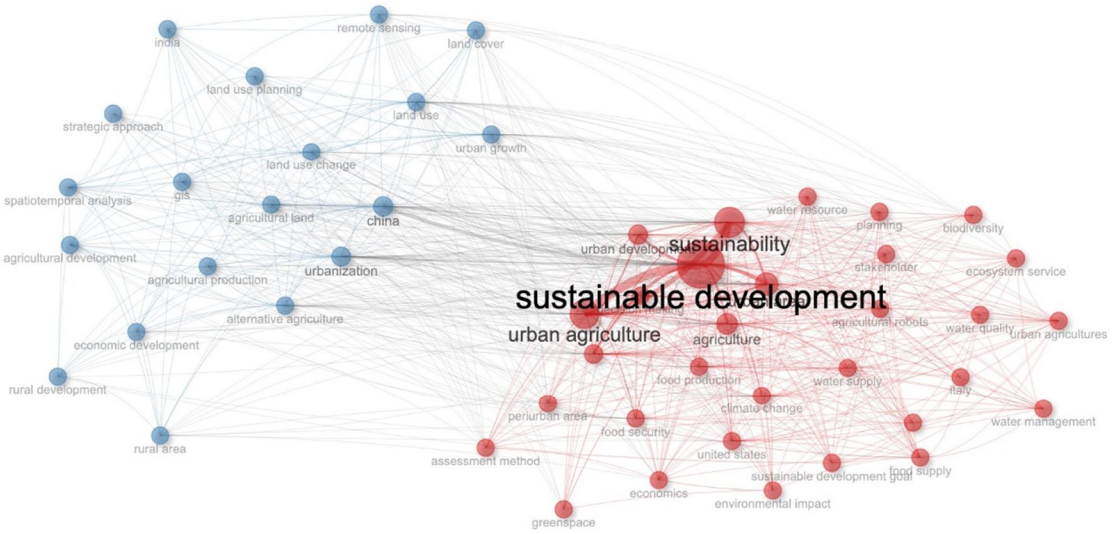


Figure 6 Co-occurrence network analysis.

H. Trend Topics

Identifying trend topics involves finding out the important topics of interest. All keywords used in the publication between 2010 to 2022 were applied to construct a map of the most popular subjects in the field of urban agriculture and sustainable development. Figure 7 illustrates the network of important research subjects; it is evident from the figure that urban agriculture and sustainable development have gained popularity since 2020. Even in 2022, it's a hot topic. The node's size indicates the frequency of keywords that have been used very recently. This distinction enables us to find out the direction of future research trends. By identifying these newly introduced keywords, we gain insights into the emerging research areas and can anticipate the potential trajectory of future studies.

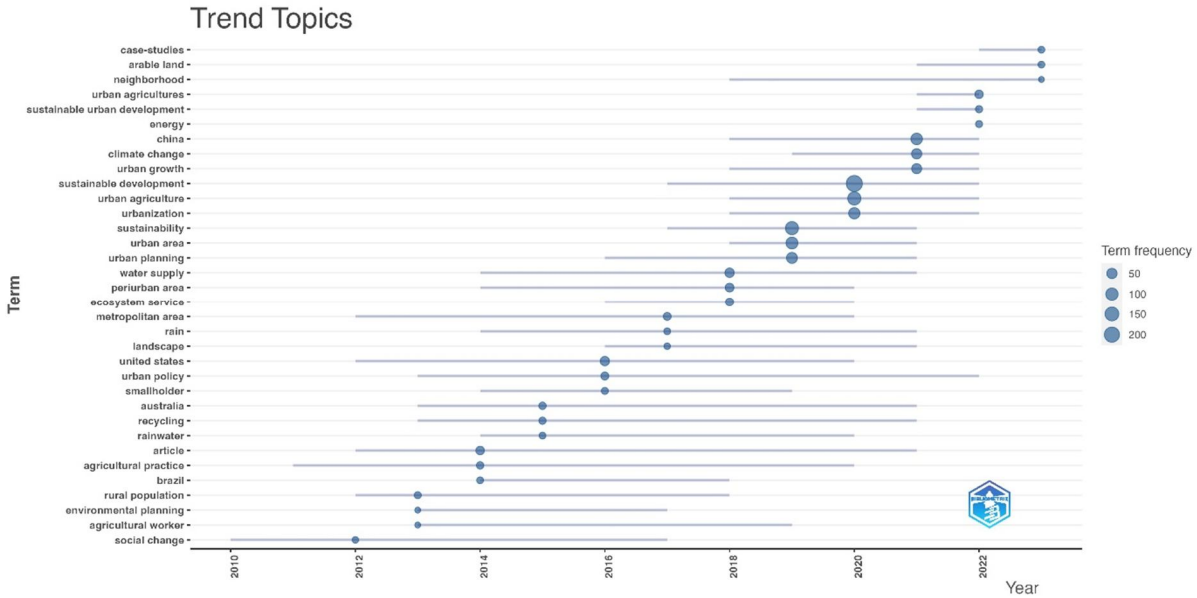


Figure 7 Trend Topics.

V. SYSTEMATIC REVIEW

In this section, a systematic review of recent and relevant works in the field of urban agriculture and sustainable development is presented. This could provide a broad understanding of the present trend in the area of urban agriculture and sustainable development to the researchers. Table 7 reflects the systematic review of research papers published recently. It will help the researchers to identify the research gap in urban agriculture and sustainable development

Table 7 Showing the systematic review

Authors	Title	Journal	Key Research Outline	Findings
Mensah J.K.	Urban agriculture, local economic development and climate change: conceptual linkages	International Journal of Urban Sustainable Development	To study the potential of urban agriculture (UA) in improving urban local economies and urban micro-climate	Urban agriculture could boost local economic development (LED), build resilient urban settlements, and promote social inclusiveness, but with social challenges.
Mensah J.K.	Stimulating and developing sustainable urban local economies: The role of urban agriculture	Development Southern Africa	To examine the role of urban agriculture in the urban local economy in a developing country, Ghana	If properly supported, urban agriculture can improve the local economy because of its multiple benefits of employment, income, and improved livelihood and food security.
Mourad M.M.; Mohamed Kamel R.; Mofeed Ibrahim R.	Determining the levels of urban agriculture to meet the desired goals of urban development	HBRC Journal	To determine the impact of urban agriculture levels (UALs) on achieving the urban agriculture goals (UAGs)	Economic goal and Agricultural development goal have been achieved as a major goal in medium- to large-scale urban agriculture level. Environmental goal, social goal and esthetic goal have been achieved in the small-scale urban agriculture level. Finally, Humanitarian goal has been achieved clearly at the micro-scale urban agriculture level.
Idpo S.; Widhianthini; Arisena G.M.K.; Sukewijaya I.M.; Krisnandika A.A.K.	Status of agriculture resources sustainability and agricultural policy in Denpasar city, province of Bali, Indonesia	African Journal of Food, Agriculture, Nutrition and Development	To analyses the status of agricultural resources sustainability and formulate a strategy for sustainable agricultural policy in Denpasar City	An assessment of Denpasar City's agricultural sector revealed that the ecological and economic aspects were the weakest in terms of sustainability. While the social, institutional, and technological aspects were somewhat better, there's still room for improvement. To address this, policymakers have proposed a range of strategies. These include maintaining productive rice fields and arranging potential home gardens as an alternative to urban farming development, flood control to protect agricultural land, promoting urban farming with eco-friendly technologies, and providing economic incentives for farmers. Additionally, the plan includes strengthening agricultural support services and developing a program focused on sustainable food production zones.
Lee S; Shin S; Lee H; Park M S	Which urban agriculture conditions enable or constrain sustainable food production?	International journal of agricultural sustainability	To identify the conditions for development of UA through a systematic review of UA case studies	Urban agriculture (UA) is driven by several factors. Necessities like rising food prices, joblessness, food safety or quality concerns, economic or food crisis concerns, and environmental and social concerns can all push communities toward UA. However, successful UA also requires ability - factors like motivated participants, sufficient labor, household size, and commitment of UA participants. Also, the factors constraining the implementation of UA such as farmers' poor health, lack of farming knowledge, urban farmers' vulnerability or dependency, lack of acceptance and involvement of urban farmers were identified. Finally, opportunity plays a role. Technical, economic, environmental, governance, and socio-cultural factors are all crucial for UA to flourish.
Anwar M.M.; Breuste J.H.; Ahmad A.; Aziz A.; Aldosari A.A.	Quantifying the Impacts of Urbanization on Urban Agriculture and Food Security in the Megacity Lahore, Pakistan	Sustainability (Switzerland)	To provide the basic formulation and theoretical knowledge for sustainable urban agriculture by analyzing	Urbanization causes large-scale damage to agricultural land in the area, and loss of biodiversity, which threaten food security by converting natural land into built-up areas. The urban agriculture is a fundamental environmental activity to ensure food security by

			the impact of urbanization on urban agriculture and food security	increasing food production for locals and improving urban biodiversity.
Kanosvamhira T.P.	How do we get the community gardening? grassroots perspectives from urban gardeners in Cape Town, South Africa	Journal of Cultural Geography	To offer a bottom-up perspective on how to improve engagement in urban agriculture activities across communities in South Africa	Urban agriculture offers multi-dimensional benefits. If properly incorporated into policy and practice, it could contribute toward Sustainable Development Goal 11 (sustainable cities and communities). But several factors—poor access to resources and inputs, poor soils, water restrictions, and social stigma—discourage engagement in urban agriculture. Therefore, increasing urban agriculture uptake requires multifaceted solutions and should combine efforts from all major stakeholders, particularly the state, civil society, and urban gardeners.
Ejigu A.K.; Yeshitela K.	Integrating resource-oriented sanitation technologies with urban agriculture in developing countries: measuring the governance capacity of Arba Minch City, Ethiopia	Frontiers in Sustainable Cities	To assess the capacity of Arba Minch City to adopt resource-oriented sanitation technology and integrate it with urban agriculture	The study found that Arba Minch city faces challenges in integrating ecological sanitation (ecosan) with urban farming. Weaknesses include a lack of monitoring past projects, scattered policies, and limited public sector involvement. There's also no single government body overseeing the system. The study recommends a more joined-up approach that considers both governance and community participation.
Riaño-Herrera D.A.; Varela-Martínez D.A.; Chenet J.G.; García-García D.A.; Díaz-Verus S.D.; Rodríguez-Urrego L.	Driving sustainable urban development: Exploring the role of small-scale organic urban agriculture in Bogotá, Colombia: A case study	Sustainable Cities and Society	To highlights the role of small-scale organic urban agriculture in driving sustainable urban development	Urban agriculture is effectively contributing to the achievement of sustainable development goals such as poverty eradication, zero hunger, health and well-being, sustainable cities and communities, responsible production and consumption, and climate action.
Alberti M.A.; Blanco I.; Vox G.; Scarascia-Mugnozza G.; Schettini E.; Pimentel da Silva L.	The challenge of urban food production and sustainable water use: Current situation and future perspectives of the urban agriculture in Brazil and Italy	Sustainable Cities and Society	To evaluate how issues related to water sources for urban agriculture have been addressed in the scientific literature from two different socioeconomic and environmental realities, Brazil and Italy	Innovative production systems like container farming, aquaponics and indoor agriculture, as well as cultivation of fruit trees, wild edible plants, and varieties with low water requirements, can represent water-saving options.
Alves D.D.O.; de Oliveira L.	Commercial urban agriculture: A review for sustainable development	Sustainable Cities and Society	To explore the economic, social, and environmental factors that contribute to commercial urban agriculture as a response to sustainable development.	Urban agriculture is driven by economic benefits like job creation, lower food costs, and improved access for residents. It also has environmental advantages, promoting land use efficiency, biodiversity, and climate improvement. With its potential for sustainable food production, urban agriculture is seen as a crucial tool for addressing global challenges.
Dobele M.; Dobele A.; Zvirbule A.	Multifunctionality of urban agriculture and its characteristics in Latvia	Rural Sustainability Research	To identify the main functions of urban agriculture and to evaluate their significance in Latvia	There are 14 functions of urban agriculture, which were classified into 5 groups: political, economic, social, environmental, and technological. The most significant functions of urban agriculture in Latvia are social (promotion of social cohesion and public health, education and maintaining traditions and values) and technological innovations.
Hosseinpour N.; Kazemi F.; Mahdizadeh H.	A cost-benefit analysis of applying urban agriculture in sustainable park design	Land Use Policy	To study the financial benefits urban agriculture in creating sustainable cities.	Using urban agriculture in city landscapes can have high profitability and low risks.
Nie J.; Kiminami A.; Yagi H.	Exploring the Sustainability of Urban Leisure Agriculture in Shanghai	Sustainability (Switzerland)	To analyze the sustainability status of 22 urban leisure farms in Shanghai using the IDEA (Indicateurs de Durabilité	Farms' average sustainability scores indicates that that urban leisure agriculture in Shanghai has high sustainability at the economic scale (46.5), followed by the socioterritorial scale (32.5) and the agroecological scale (25.72). However, the overall sustainability of

			des Exploitations Agricoles) method for sustainability indicators	urban leisure agriculture in Shanghai was low, which indicates that Shanghai's urban agriculture still needs to be strengthened for sustainability.
Mireri C.	Environmental and public health risks of urban agriculture in Kisumu city, Kenya	African Journal of Food, Agriculture, Nutrition and Development	To determine the environmental and public health risks of crops grown in the privately owned land within Kisumu City, Kenya	There are low traces of heavy metals in the crops and those found in the soils, vegetables and fruits are within the WHO/FAO permissible standards. No traces of cadmium and chromium were found in the sampled crops. So, farm produce from such parcels of land is safe for human consumption. Therefore, it is possible to undertake safe urban farming on privately – owned land in the city for the benefit of the residents. Necessary measures should be taken by the City authority to promote urban farming, including land use zoning and control of waste disposal into the farms. Other measures include regular monitoring of urban farming for quality and safety concerns.
Tapia C.; Randall L.; Wang S.; Aguiar Borges L.	Monitoring the contribution of urban agriculture to urban sustainability: an indicator-based framework	Sustainable Cities and Society	To present an indicator-based framework for the evaluation of urban agriculture contribution to urban sustainability	Urban agriculture contributes to food security, provides health benefits for the population, fosters social inclusion and enhances perceived wellbeing. Urban agriculture also provides a valuable resource for urban regeneration.
Croce S.; Vettorato D.	Urban surface uses for climate resilient and sustainable cities: A catalogue of solutions	Sustainable Cities and Society	To shed light on the role of urban surfaces in fostering climate resilient and sustainable cities	The use of urban surfaces might lead the development of multiple opportunities for improving the existing urban environments and supporting not only environmental, but also social and economic resilience.
Pedro A.A.; Görner A.; Lindner A.; Wende W.	"More Than Fruits and Vegetables" Community garden experiences from the Global North to foster green development of informal areas in Sao Paulo, Brazil	Research in Urbanism Series	To evaluate the performance of urban community gardens in order to verify their potential for implementation in the slums of Sao Paulo, Brazil.	urban gardening has the potential to counteract spatial pressures in informal areas by creating green spaces, improving food quality, raising environmental awareness and, in general, ensuring a higher quality of life.
Steenkamp J.; Cilliers E.J.; Cilliers S.S.; Lategan L.	Food for thought: Addressing urban food security risks through urban agriculture	Sustainability (Switzerland)	To analyze four best practice examples of urban agriculture in the Global South to uncover its potential to address food security associated risks and contribute to sustainable development objectives	Urban planning that ignores food security creates problems like food deserts and malnutrition. Urban agriculture (UA) initiatives, supported by policy and legislation can make cities more sustainable (as in both the Belo Horizonte and Rosario cases). The Belo Horizonte and Rosario cases highlight how through short supply chains post-harvest losses can be reduced, and waste can be minimized through redistribution to food banks and charity organizations because food waste and losses are a significant feature of the globalized food supply chain. The Cape Town case also highlighted how food that is lost can be reabsorbed into the supply chain by using it as input supplies for production in the form of compost. Finding land for UA is a challenge. The Rosario case highlights that cities can map vacant land for production. The Johannesburg case highlights how rooftops can be made part of vacant land mapping. The Belo Horizonte case highlights how trees and permaculture can be used to address soil erosion on sloping land or act as windbreaks in the Cape Town case. The Rosario case also showed how UA can be used to improve the local climate.
Zasada I.; Weltin M.; Zoll F.; Benninger S.L.	Home gardening practice in Pune (India), the role of communities, urban environment and the contribution to urban sustainability	Urban Ecosystems	To investigate whether and to which extent home gardening practices in urban residential environments contribute to urban sustainability.	Home gardens offer surprising benefits for cities. While economic gains and food production might be modest, they excel in boosting urban biodiversity and creating green spaces. Interestingly, Gardening practice and sustainability contribution is rather determined by the

				motivation and socio-demographic factors than the garden itself. This highlights the importance of incorporating home gardens into urban planning to cultivate a more sustainable future for our cities.
Pourjavid S.; Poursaeed A.; Mirdamadi S.M.	Modeling the effectiveness of urban agriculture education courses	Urban Ecosystems	To examine the effectiveness of urban agriculture education courses	Evaluations showed the educational courses on urban agriculture were successful. Participants reacted positively, learned new information, and showed a willingness to apply it. This suggests the courses can effectively improve citizens' knowledge and contribute to better food security and urban environmental management. Policymakers and program planners should strongly consider these courses as an investment in sustainable urban development.
Shariff N.N.M.; Hamidi Z.S.; Osman M.R.	Does small scale sustainable urban agriculture (Sua) alleviate the economic burdens of low-and middle-income households?	Malaysian Journal of Consumer and Family Economics	To investigate available evidence concerning how sustainable urban agriculture (SUA) may alleviate the economic burdens of low-and middle-income households	By adopting SUA, low- and middle-income households can save around RM50-RM200 per month on kitchen provisions. Additionally, SUA utilizes sustainable practices. This, combined with a well-managed program involving various participants, helps ease the economic burden on these communities. Looking ahead, SUA has the potential to be a powerful tool for local authorities, ensuring food security and contributing to achieving the UN's Sustainable Development Goals (SDGs).
Stoyanova Z.	Ecological Aspects of Urban Agriculture in the Context of Sustainability	Economic Alternatives	To assess the ecological aspect of urban agriculture to determine its possibilities for improving the life quality.	Sustainable urban agriculture fosters food security and environmentally friendly practices by using fewer resources and creating green spaces. This local production boosts regional development and creates jobs. Furthermore, it promotes responsible consumption habits by raising awareness of eco-friendly food production methods. Urban agriculture producers themselves champion sustainability through practices like permaculture and composting, reducing reliance on harmful chemicals.
Clerino P.; Fargue-Lelièvre A.	Formalizing objectives and criteria for urban agriculture sustainability with a participatory approach	Sustainability (Switzerland)	To identify sustainability objectives and criteria applicable to professional intra-urban farms	The study identified a set of sustainable objectives and criteria applicable to French professional intra-urban agriculture (PIUA) The objectives are mainly related to external sustainability, highlighting that stakeholders expects PIUA to have many impacts on the sustainable development of cities. In addition, 21 criteria split between agro-environmental, socio-territorial and economic dimensions were identified to reach these objectives. Agro-environmental and socio-territorial criteria were assessed as more important than economic criteria.
Chisita C.T.; Fombad M.	Knowledge Management for Climate Change Adaptation to enhance Urban Agriculture among Selected Organisations in Zimbabwe	Journal of Information and Knowledge Management	To examine knowledge management strategies for climate change adaptation among selected environmental organizations and libraries in Zimbabwe to support urban farming	Knowledge management strategies are critical in supporting climate change adaptation and actualisation of SDG number 13 on climate change in Zimbabwe. The successful implementation of knowledge management strategies for climate change adaptation to enhance urban farming require a coordinated approach involving an interface between government, environmental and climate change organisations, urban farmers, and other key organisations.
El-Essawy H.; Nasr P.; Sewilam H.	Aquaponics: a sustainable alternative to conventional agriculture in Egypt – a pilot scale investigation	Environmental Science and Pollution Research	To discuss the possibility of implementing aquaponics as an alternative to conventional agriculture in Egypt through a comparison between aquaponics and conventional agriculture	Although, on the short term, aquaponics entails relatively high capital and operational expenditure costs compared with conventional agriculture; yet, on the long term, it is more profitable, while saving up to 85% of the water wasted by conventional farming techniques.

Kolagar M.	Adherence to urban agriculture in order to reach sustainable cities; a bwm–waspas approach	Smart Cities	To evaluate the extent of adherence to the urban agriculture policies for sustainable development in Iran's eight densely populated cities.	The promotion of urban agriculture is one of the necessary strategies to stabilize the process of sustainable urban development. Urban agriculture still has a long way to go and should be considered more seriously. Moreover, vertical farming has been suggested as one of the ways of promoting urban agriculture in the country and smoothing the way to sustainable development.
Batitucci T.D.O.; Cortines E.; Almeida F.S.; De Almeida A.A.	Agriculture in urban ecosystems: A step to cities sustainability	Ambiente e Sociedade	To analyze the interactions of agricultural activities and the urban ecosystem	Urban Agriculture provides considerable ecosystem services, generates income, increases biodiversity conservation and fosters social inclusion, functioning as a mechanism for achieving equilibrium among the components of the urban ecosystem.
Van Tuijl E.; Hospers G.-J.; Van Den Berg L.	Opportunities and Challenges of Urban Agriculture for Sustainable City Development	European Spatial Research and Policy	To provide insights into the Opportunities and challenges of UA for sustainable city development.	Urban agriculture (UA) offers a multitude of benefits for sustainable development across social, environmental, and economic aspects. For social development, it improves urban food security, fosters community development, and serves educational purposes. Environmentally, UA promotes greening of cities, mitigates climate change, enhances biodiversity, and reduces pollution. Economically, it generates new income streams, fosters entrepreneurship, and drives innovation. However, legal hurdles, high costs, space constraints, conflicts with other urban functions, and potential health risks from urban-produced food remain challenges.
Grard B.J.-P.; Chenu C.; Manouchehri N.; Houot S.; Frascaria-Lacoste N.; Aubry C.	Rooftop farming on urban waste provides many ecosystem services	Agronomy for Sustainable Development	To assess the ecosystem services provided by productive rooftops	Making rooftops productive using organic waste has the potential to generate many urban ecosystem services such as high-quality fresh vegetables for several years, avoid the use of non-renewable resources such as top soil and peat, provide an opportunity for recycling of urban organic waste, and deliver other ecosystem services such as reducing runoff from roofs without altering the water quality but with a negative effect on runoff water quality in terms of carbon.

To understand the role of urban agriculture in sustainable development a systematic review of 30 articles was conducted. From the evaluation of these past research, the study found that urban agriculture plays a big part in sustainable development. Studies conducted by (Mensah J.K, 2023) on the role of urban agriculture in the urban local economy found that urban agriculture could boost Local Economic Development (LED), build resilient urban settlements, and promote social inclusiveness. Besides, if properly supported, urban agriculture can improve the local economy because of its multiple benefits of employment, income, and improved livelihood and food security. Similarly, (Riano-Herrera et al., 2023) find out that urban agriculture is effectively contributing to the achievement of sustainable development goals such as poverty eradication, zero hunger, health and well-being, sustainable cities and communities, responsible production and consumption, and climate action. (Tapia et al., 2021) also opined that urban agriculture contributes to food security, provides health benefits for the population, fosters social inclusion and enhances perceived well-being. It also provides a valuable resource for urban regeneration. (Stoyanova Z, 2021) also shared similar view that sustainable urban agriculture ensures food security and food resources in an environmentally friendly manner by optimizing and saving the use of natural resources, implementing green practices, creates local employment and encourage the development of the regions. In the words of (Batitucci et al., 2019) urban agriculture provides considerable ecosystem services, generates income, increases biodiversity conservation and fosters social inclusion, functioning as a mechanism for achieving equilibrium among the components of the urban ecosystem. Further, (Mourad et al., 2023) tried to link the achievement of urban agriculture goals with different levels of urban agriculture. Where the small scale of urban agriculture levels came in the lead of supporting the achievement of the social, environmental, and urban esthetic goals, however, the medium- to large urban agriculture level came in the lead of supporting the achievement of agricultural and economic goals. (Idpo et al., 2023) analyses the status of agricultural resources sustainability in Denpasar City and tried to suggest strategies to support the sustainability of the agricultural sector. Their study found that the ecological and economic aspects were the weakest in terms of sustainability.

While the social, institutional, and technological aspects were somewhat better, there's still room for improvement. The study also suggested several strategies to support the sustainability of the agricultural sector in Denpasar City such as maintaining productive rice fields and arranging potential home gardens as an alternative to urban farming development, flood control to protect agricultural land, promoting urban farming with eco-friendly technologies, and providing economic incentives for farmers etc. (Lee et al., 2023) tried to identify the conditions which enable or constrain the development of UA. The information obtained was grouped into the three principles developed by Choguill in 1995– necessity, ability, and opportunity – to demonstrate the conditions that enable or constrain UA. Necessities include enabling conditions such as rising food prices, joblessness, food safety or quality concerns, economic or food crisis concerns, and environmental and social concerns can all push communities toward UA. However, successful UA also requires ability - factors like motivated participants, sufficient labor, household size, and commitment of UA participants. Also, the factors constraining the implementation of UA such as farmers' poor health, lack of farming knowledge, urban farmers' vulnerability or dependency, lack of acceptance and involvement of urban farmers were identified. Finally, opportunity plays a role. Technical, economic, environmental, governance, and socio-cultural factors are all crucial for UA to flourish. A study on the impacts of urbanization on urban agriculture and food security by (Anwar M.M, 2023) revealed that urbanization causes large-scale damage to agricultural land, and loss of biodiversity, which threaten food security by converting natural land into built-up areas. Therefore, urban agriculture is considered as a fundamental environmental activity to ensure food security by increasing food production for locals and improving urban biodiversity. (Kanosvamhira, 2023) tried to find an answer to the question of how to improve engagement in urban agriculture activities across communities in South Africa. His study revealed that urban agriculture offers multi-dimensional benefits, but several factors such as poor access to resources and inputs, poor soils, water restrictions, and social stigma discourage engagement in urban agriculture. Therefore, he suggested multifaceted solutions and combined efforts from all major stakeholders, particularly the state, civil society, and urban gardeners. (Ejigu & Yeshitela, 2023) assessed the capacity of Arba Minch City to adopt resource-oriented sanitation technology and integrate it with urban agriculture. They came out with the findings that a more comprehensive approach to resource-oriented sanitation technology and urban agriculture integration is needed because Arba Minch City's governance capacity to integrate ecological sanitation (ecosan) with urban farming is affected by several factors such as lack of monitoring past projects, scattered policies, and limited public sector involvement. There's also no single government body overseeing the system. (Alberti et al., 2022) tried to address the issues related to water sources for urban agriculture and they opined that innovative production systems like container farming, aquaponics and indoor agriculture, as well as cultivation of fruit trees, wild edible plants, and varieties with low water requirements, can represent water-saving options. (Alves & Oliveira, 2022) explored the economic, social, and environmental factors that contribute to commercial urban agriculture as a response to sustainable development. According to them economic causes are the significant drivers of the development of urban agriculture. Because it has the ability to creates jobs, lower food costs, and improved access for residents. It also has environmental advantages, promoting land use efficiency, biodiversity, and climate improvement. With its potential for sustainable food production, urban agriculture is seen as a crucial tool for addressing global challenges. (Dobele et al., 2022) investigated the multifunctionality of urban agriculture and its characteristics in Latvia. They identified 14 functions of urban agriculture, which were classified into 5 groups: political, economic, social, environmental, and technological. Among these the most significant functions of urban agriculture in Latvia are social and technological innovations. (Hosseinpour N, et al., 2022) conducted a cost-benefit analysis of urban agriculture in creating sustainable cities. He found that using urban agriculture in city landscapes can have high profitability and low risks. (Nie J et al., 2022) tried to to analyze the sustainability status of 22 urban leisure farms in Shanghai using the IDEA (Indicateurs de Durabilité des Exploitations Agricoles) method. The Farms' average sustainability scores indicates that that urban leisure agriculture in Shanghai has high sustainability at the economic scale, followed by the socioterritorial scale and the agroecological scale. However, the overall sustainability of urban leisure agriculture in Shanghai was low, which indicates that Shanghai's urban agriculture still needs to be strengthened for sustainability. (Mireri, 2022) conducted a study in Kisumu City, Kenya to determine the environmental and public health risks of crops grown in the privately owned land. Their finding indicated that urban farming on privately – owned land in the city is safe because there were low traces of heavy metals in the crops and no traces of cadmium and chromium were found in the sampled crops. (Croce S.&Vettorato D, 2021) tried to shed light on the role of urban surfaces in fostering climate resilient and sustainable cities. They are of the view that the use of urban surfaces might lead the development of multiple opportunities for improving the existing urban environments and supporting not only environmental, but also social and economic resilience.

Evaluation of the potential of urban community gardens by (Pedro A.A. et al., 2021) came to the conclusion that urban gardening has the potential to counteract spatial pressures in informal areas by creating green spaces, improving food quality, raising environmental awareness and, in general, ensuring a higher quality of life.

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(Steenkamp et al.,2021) analyzed four best practice examples of urban agriculture like Belo Horizonte, Rosario, the Cape Town and the Johannesburg cases to uncover its potential to address food security associated risks and contribute to sustainable development objectives. Findings of their study shows that the neglect of planners to acknowledge food as one of the essentials of life is one of the reasons why food security associated risks thrive in urban environments. Urban planning that ignores food security creates problems like food deserts and malnutrition. Urban agriculture (UA) initiatives, supported by policy and legislation can make cities more sustainable (as in both the Belo Horizonte and Rosario cases). The Belo Horizonte and Rosario cases were again suggested to solve the issues related to food waste and losses. Similarly, the Cape Town case highlighted how food that is lost can be reabsorbed into the supply chain by using it as input supplies for production in the form of compost. The study identified that the main constraint to the establishment of urban farms that is the availability of land. Here the Rosario case highlights the potential of vacant land mapping in bringing together owners of vacant land and those seeking land for production, and the Johannesburg case highlights how rooftops can be made part of vacant land mapping. The Belo Horizonte case also highlights how trees and permaculture can be used to address soil erosion on sloping land and the Rosario case showed how UA can be used to improve the local climate. (Zasada et al., 2020) tried to investigate the extent to which home gardening practices in urban residential environments contribute to urban sustainability in Pune. Results of the study revealed that sustainability benefits can be expected especially in environmental and socio-cultural aspects, particularly for urban biodiversity conservation and aesthetic green urban spaces, and less expected in economic contributions and food production. According to their study motivation and socio-demographic factors are the important determinants of gardening practice and sustainability contributions. This highlights the importance of incorporating home gardens into urban planning to cultivate a more sustainable future for our cities. The study conducted by (Pourjavid et al., 2020) on the effectiveness of urban agriculture education courses revealed that these courses can be recommended to enhance the knowledge of citizens about urban agriculture which improves food security and urban environmental management. Similarly (Chisita and Fombad, 2020) tried to examine the knowledge management strategies for climate change adaptation among selected environmental organizations and libraries in Zimbabwe to support urban farming. Their study finds out that knowledge management strategies are critical in supporting climate change adaptation and actualisation of SDG number 13 on climate change in Zimbabwe and the successful implementation of knowledge management strategies require a coordinated approach involving an interface between government, environmental and climate change organisations, urban farmers, and other key organisations. (Shariff et al., 2020) investigated whether small scale sustainable urban agriculture alleviate the economic burdens of low-and middle-income households. Their investigation came to the findings that by adopting SUA, low- and middle-income households can save around RM50-RM200 per month on kitchen provisions. Additionally, SUA utilizes sustainable practices. This, combined with a well-managed program involving various participants, helps ease the economic burden on these communities. In future, small-scale sustainable urban agriculture can be used as a coping strategy by local authorities to secure a food supply and serve as a step towards Sustainable Development Goals (SDGs). (Clerino et al., 2020) identified a set of sustainable objectives and criteria applicable to French professional intra-urban agriculture (PIUA). The objectives are mainly related to external sustainability, highlighting that stakeholders expects PIUA to have many impacts on the sustainable development of cities. In addition, 21 criteria split between agro-environmental, socio-territorial, and economic dimensions were identified to reach these objectives. Among these agro-environmental and socio-territorial criteria were assessed as more important than economic criteria. (El-Essawy et al., 2019) discussed the possibility of implementing aquaponics as an alternative to conventional agriculture and they opined that in the long term, aquaponics is more profitable than conventional farming, it saves up to 85% of the water wasted by conventional farming techniques. According to (Kolagar, 2019) the promotion of urban agriculture is one of the necessary strategies to stabilize the process of sustainable urban development but it has a long way to go and should be considered more seriously. Moreover, he suggested vertical farming as one of the ways of promoting urban agriculture and smoothing the way to sustainable development. (Van Tuijl et al., 2018) tried to identify opportunities and challenges of urban agriculture for sustainable city development. They found out that urban agriculture can be beneficial for all pillars of sustainable development. For social development, it improves urban food security, fosters community development, and serves educational purposes. Environmentally, UA promotes greening of cities, mitigates climate change, enhances biodiversity, and reduces pollution. Economically, it generates new income streams, fosters entrepreneurship, and drives innovation. Despite its potential for sustainable city development, several weak points concerning urban agriculture like legal barriers, high costs, a lack of space, conflicts with other urban functions, and health risks regarding food produced on urban farms were also identified. Assessment of the ecosystem services provided by productive rooftops by (Grard et al., 2017) discovered that making rooftops productive using organic waste has the potential to generate many urban ecosystem services such as high-quality fresh vegetables for several years, avoid the use of non-renewable resources such as

topsoil and peat, provide an opportunity for recycling of urban organic waste, and deliver other ecosystem services such as reducing runoff from roofs without altering the water quality.

VI. CONCLUSION

The main objective of this research is to identify the publication trend, important authors, leading publication, Leading countries in the publication of articles, significant study areas and Leading countries in the citation of articles and trend topics in the area of urban agriculture and sustainable development. To analyse the role of urban agriculture in sustainable development, a thorough systematic review of 30 papers was conducted. First, we studied the publication trend to identify the trend in publication of articles. The trend shows that publications rose sharply since 2016, after the adoption of SDGs as a strategy to address poverty, food security, economy, prosperity, ecosystem, climate, harmony, and equality by the UN. The publication trend in leading countries shows that China, the USA and Italy are the top nations in the scientific production of articles as well as in the citation of articles related to urban agriculture and sustainable development. The findings indicate that very few studies have been conducted in India. Therefore, it necessitates a comprehensive study related to urban agriculture and sustainable development in the context of India. Second, we identified important publication and authors and with regard to urban agriculture and sustainable development. Sustainability (Switzerland) is the leading journal in the field of urban agriculture and sustainable development. Third, we examined the key areas of research in this field they are: urban agriculture, sustainable development, and sustainability, with most of the research being contributed from the USA, China, and Italy**.** Fourth, we identified the most significant study areas in this field. According to co-occurrence network research, it is very clear that the keywords with more time occurrences are “sustainable development”, “urban agriculture,” and “Sustainability”. Fifth, we identified the trend topics in the field of urban agriculture and sustainable development. Finally, we performed a thorough systematic review of the recent and relevant papers to understand the current research trend in the area of urban agriculture and sustainable development. We identified that various aspects of urban agriculture concerning sustainable development have been brought into study by different authors. Several studies have highlighted the benefits of urban agriculture, its impact, functions, challenges, etc. with respect to the achievement of sustainable development. Similarly, the role of urban agriculture in overcoming the challenges of urbanisation, climate change adaptation, and providing ecosystem services was discussed by various authors. Additionally, the effectiveness of urban agriculture education courses and knowledge management strategies for climate change adaptation to enhance urban agriculture were also studied.

Even though various studies have emphasized the importance of urban agriculture in achieving sustainable development, a comprehensive study covering the role of urban agriculture in fulfilling the sustainable development goals is still lacking. Therefore, in future research, it is important to consider the contributions of urban agriculture to sustainable development goals more extensively.

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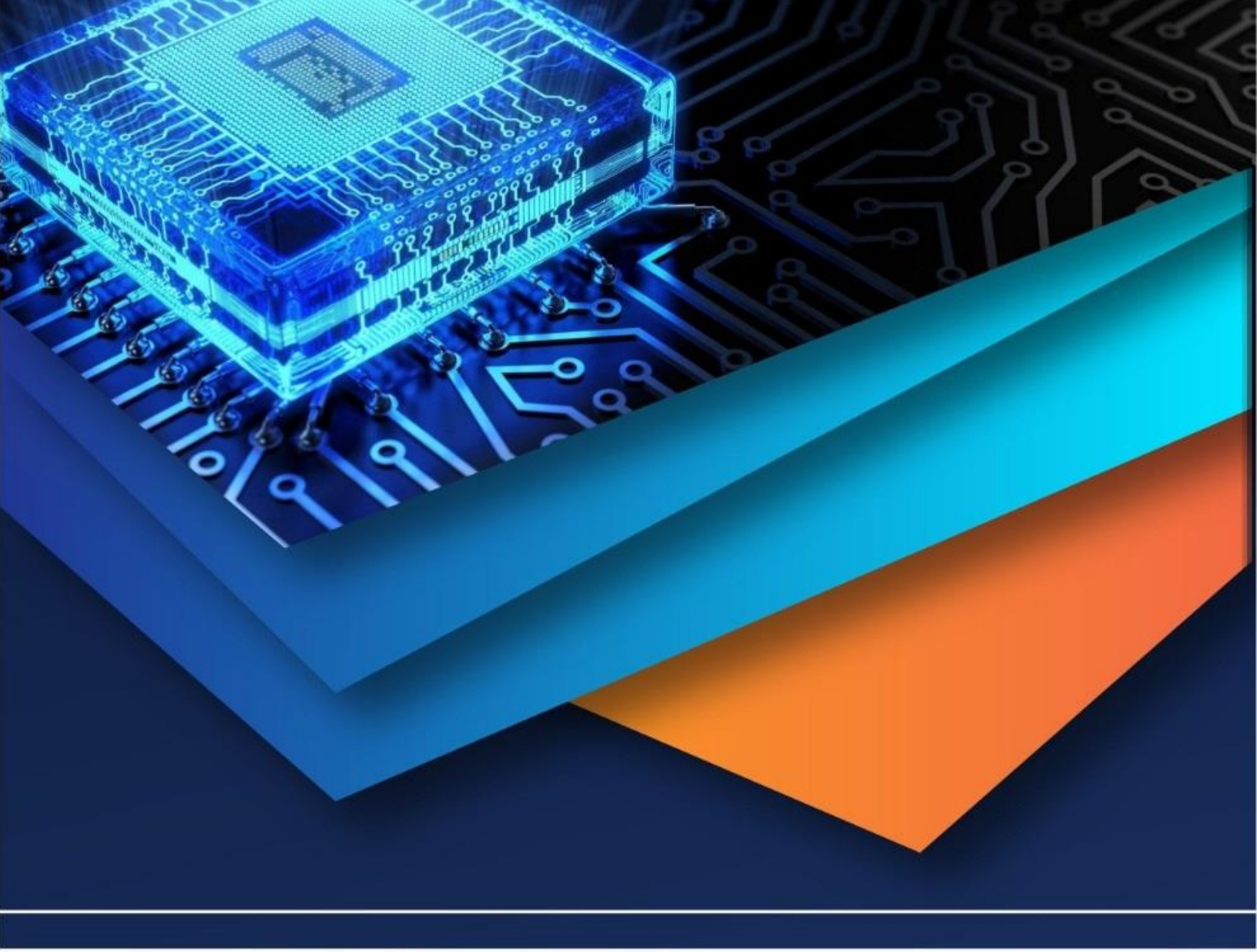
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