The Systematic Review of Ecosystem Services in Peri-Urban Area

I Gede Astra Wesnawa[1], I Made Gunamantha[2]

{astra.wesnawa@undiksha.ac.id[1], made.gunamantha@undiksha.ac.id[2]}

Universitas Pendidikan Ganesha, Indonesia[1,2]

Abstract. Understanding and addressing the study of peri-urban areas has attracted growing attention over the past decade. Numerous studies have focused on peri-urban changes, policies, drivers, and the effects of peri-urban development. However, less emphasis has been placed on reviewing the ecosystem services linked to peri-urbanization literature. Therefore, the systematic review synthesized a qualitative study to investigate the current discussion of the peri-urban area and identified a knowledge gap regarding the ecosystem services in the peri-urban area. The result revealed that four initial ecosystem services significantly changed, including provisioning, regulating, supporting, and cultural services. The primary findings of the study indicate that provisioning and supporting services remain robust, whereas regulatory and cultural services have diminished. Strategic policies for eradicating environmental problems and resource utilization issues in peri-urban areas start with the mapping of ecosystem services in peri-urban.

Keywords: Ecosystem Services, Peri-urbanization, Peri-urban Area; Systematic Review

1. Introduction

The global urbanization process is progressing rapidly, and by 2030, more than sixty percent of the world's population is expected to live in urban areas, as reported by the United Nations (2015). Despite the increasing urbanization of the global population, our reliance on diverse natural ecosystems remains significant. In a symbiotic association, urban centers invariably rely on expansive rural regions to fulfill the diverse essential requirements of their inhabitants. Similar to the inclusion of humans within the realm of nature, it is also plausible to regard cities as integral components of a broader global ecosystem network.

Within the 20th century, there has been a notable trend of population concentration in urban areas on a world view [1]. The phenomenon of urban growth and expansion fosters the integration of agricultural and non-agricultural activities within spatial boundaries, leading to a gradual transformation of rural land into more urban. This process poses a significant environmental challenge with diverse and far-reaching consequences [2], [3]. Peri-urban areas are characterized by the presence of conserved ecosystems, including forested hills, protected forests, primary agricultural lands, and significant wetlands. It is indisputable that peripheral ecosystems serve as vital providers of ecosystem services to urban residents [4], [5]. The peri-urban area can be characterized as a multifaceted territorial space encompassing various economic, environmental, and social dimensions.

ICLSSE 2023, June 01, Singaraja, Indonesia

DOI 10.4108/eai.1-6-2023.2341375

Nevertheless, the peri-urban ecosystem is currently facing a significant threat due to the expansion of urban areas, resulting in substantial alterations to its spatial characteristics [6], [7]. The threats encompassed in this study consist of various factors such as habitat loss, habitat fragmentation, issues related to natural resource management, and impacts on cultural systems [8]–[10]. Hence, land utilization alterations threaten the role of natural ecosystems in influencing various aspects of human existence. Peri-urban ecosystems may, in certain instances, terminate to make a meaningful contribution to public health [4], [11], livelihoods [12], [13], and social equity [14], [15].

In an effort to combat global environmental change, the importance of preserving ecosystem services has received considerable attention in recent years. Consequently, numerous frameworks for categorizing and evaluating ecosystem functions and services have been created (Millennium Ecosystem Assessment, 2005). Significant alterations to the provision of ecosystem services in peri-urban regions have resulted from the modification of land use, which has a profound effect on the natural and semi-natural environments of these regions [6], [17], [18].

The alterations in spatial configuration within the peri-urban region have a dual effect on both the internal dynamics of energy and material flow within the ecosystem, as well as the provision of specific ecosystem services by the peri-urban area. The escalating concentration of population and economic activity in peri-urban regions, characterized by a lack of planning and difficulties in regulation, leads to environmental degradation and a decline in peri-urban ecosystem services. Hence, the examination of ecosystem services in peri-urban areas represents a noteworthy concern in the field of urban planning.

The primary objective of this review article is to conduct an analysis of the ecosystem services offered by peri-urban ecosystems and to examine the significance of these services in relation to the overall well-being of local inhabitants. The objective of this review is to ascertain the services available in peri-urban areas and evaluate their capacity in a systematic manner. The initial focus of our discourse centers around peri-urban ecosystems and the alterations observed in their provision of ecosystem services. Next, we examine the capabilities of the ecosystem services presently present in peri-urban regions. This study seeks to propose recommendations and identify potential directions for future research concerning peri-urban ecosystem services, building on the insights gathered from the literature review.

2. Method

This review paper utilizes four categories of ecosystem services (ES) as the foundation for the study. These categories include supporting services, provisioning services, regulatory services, and cultural services (Millennium Ecosystem Assessment, 2005). To investigate peri-urban ecosystem services, a selection of seven ecosystems was made, including street trees, parks, forests, agriculture, rivers, seas, and wetlands. The significance of these seven ecosystem services (ESs) in addressing the sustainable development challenges encountered by peri-urban areas and their vulnerability to the peri-urbanization process guided their selection.

These challenges encompass various issues such as climate change, environmental pollution, biodiversity loss, and the health and well-being of the population. This selection is supported by previous studies conducted by [19]–[23]. Furthermore, our objective is to locate a number of extensive research investigations that examine the correlation between ecosystem services (ES) and peri-urbanization, employing findings from prior literature reviews conducted by [23]–[25]

A descriptive review was undertaken to gather, organize, and examine numerical data from peer-reviewed scientific publications. This data was structured to represent the frequency of topics, authors, or methods identified in the existing literature [26]. Consequently, we comprehensively searched English-language publications in Scopus and Web of Science databases.

Our search queries incorporated the seven chosen environmental stressors, utilizing appropriate synonyms for each term, along with the term 'peri-urban' and the overarching term for peri-urbanization. Employing the broad search term "peri-urbanization" aligns with our research objectives, which involve characterizing ecosystem service assessments in peri-urban areas. This approach prevents us from restricting our investigation to specific forms or manifestations of peri-urbanization. It is crucial to recognize that the conclusions drawn from this research are dependent on the particular attributes of the data collection methodology utilized. Although we strive for inclusivity in our search terms, it is important to acknowledge that alternative terms may have an impact on the selection of publications in our sample. In addition, our analysis is limited to scholarly articles published in English, sourced exclusively from the Scopus and Web of Science databases, as illustrated in Figure 1.

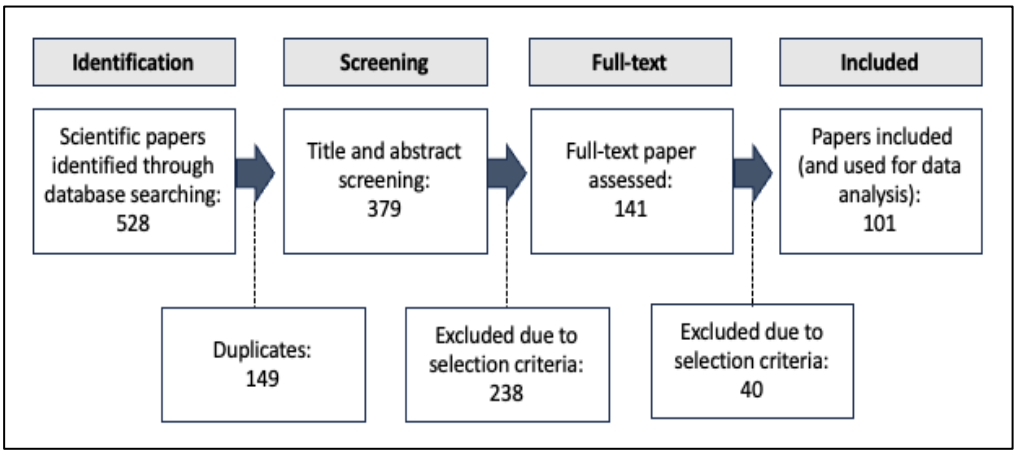

Fig 2.1. Review of scientific paper selection process

The search concluded in July 2023 and yielded a total of 528 scientific publications that underwent peer review. In the final count, publications that were duplicated due to the use of multiple search strings were excluded. Reviewing the titles and abstracts of peer-reviewed publications constituted the initial step. Studies were then chosen based on specific inclusion criteria. These criteria included: (1) the study needed to present data related to the ecosystem services of peri-urbanization, either through discussion or modeling, and (2) the study should provide new primary data, excluding review articles and papers that were conceptual or opinion-based. In the subsequent phase, a more comprehensive examination of the remaining publications was conducted, wherein the complete texts were subjected to an identical set of inclusion criteria. The process of conducting a two-step screening yielded a total of 101 publications that were deemed suitable for data extraction and subsequent analysis.

In each analysis, we systematically identified and collected all indicators, which are variables or proxies utilized to define the ecosystem service, as reported in the results section of the publications. The present analysis was conducted using the ecosystem service cascade framework created by the United Nations Millennium Ecosystem Assessment in 2005. This

framework is widely acknowledged as a prominent indicator framework for assessing ecosystem services.

3. Results and Discussion

3.1 Current peri-urban ecosystems

An ecosystem is a collection of species that interact with each other and their surrounding non-biological environment in order to support and maintain life, as stated by [19], [27]. An ecosystem is an assemblage of living and non-living organisms that engage in reciprocal interactions with one another and the environment in which they exist. Nonetheless, the demarcation between distinct ecosystems is often lacking in precise definition. According to Ravetz et al. (2013), the term "peri-urban" can be implied either as a singular ecosystem or as a collective of multiple distinct ecosystems, such as agricultural ecosystems, park ecosystems, and river ecosystems. These examples can be found in the context of peri-urban ecosystems.

As a means of preserving clarity and coherence, the term "peri-urban ecosystem" has been used as an all-encompassing descriptor that encompasses all naturally occurring green and blue spaces. This has been done in order to ensure that all information presented is consistent. There were found to be seven unique natural ecosystems located around urban areas. The ecosystems that are found in urban environments are comprised of a diverse collection of components, some of which are as follows: street trees, lawns and parks, urban forests, cultivated lands, wetland areas, lakes and seas, and rivers. Despite the continuous transformation of peri-urban regions into developed land, predominantly influenced by human activities, it is critical to acknowledge that these seven ecosystems persist in providing a diverse array of valuable services. This is something that should be taken into consideration. The analysis of the systematic review are summarized in Table 1, which details the benefits that have been derived from the peri-urban ecosystem.

Table 3.1. The advantages of peri-urban ecosystem services

Peri-urban ecosystem service	Main ecosystem function involved	Benefits to people	References
Street trees	Street trees are typically solitary plants that are enclosed by paved surfaces.	Decrease the risk of negative mental health	(Taylor et al., 2015; Burley, 2018)
		Reduce urban air pollution	(Kessler et al., 2013; Koyota et al., 2020)
		Better thermal comfort improvement	(Yang et al., 2018; Wang et al., 2018)
Parks	Green spaces that are managed and consist of a variety of vegetation, including grass, larger trees, and parks. Additionally, playgrounds and golf courses are categorized within this group.	Social justice	(Gomez et al., 2016; Baur et al., 2010)
		Lead to the neighborhoods' economic vitality	(Park et al., 2019; Gu et al., 2020)
		Urban heat island mitigation	(Barrett et al., 2014; Almeida et al., 2018)
Forest	Urban forests are denser tree stands in less	Maintaining the social and ecological viability	(Moricca et al., 2018; Lawrence et al., 2012)

	managed areas compared to parks.	Serving the needs of the broader natural environment	(Gwedla et al., 2019; Johnson et al., 2020)
Cultivated land	Gardens and cultivated land are utilized to cultivate a variety of foods.	Economic	(Li et al., 2017; Rondhi et al., 2018; Niu et al., 2011)
		Ecological	(Li et al., 2017; Zhao et al., 2018)
		Food production	(Li et al., 2017; Chen et al., 2018; Niu et al., 2011)
Rivers	Rivers/streams refers to flowing water	Provide water and food	(Addo-Bediako et al., 2020; Low et al., 2018; Larson et al., 2015)
		Transportation and trading	(Angriani et al., 2018; Deffner & Haase, 2018; Andreopoulos & Damigos, 2017)
		Recreational purposes	(Gilvear et al., 2013; Hsu et al., 2020)
Wetlands	Wetlands comprise an assortment of marshlands and swamps.	Education and recreation	(Teng et al., 2012; Hassall et al., 2014)
		Pollutants removal	(Teng et al., 2012; Ghermandi et al., 2010)
		Flood control and climate change mitigation	(Ghermandi et al., 2010; Pinke et al., 2017; McLaughlin & Cohen, 2013; Lin et al, 2018)
Sea	Lakes/sea includes the open water areas	Learning and well-being	(Kelly, 2018; Helmreich et al., 2011; Sigwart et al., 2021)
		Fishery	(Badescu et al., 2010)

Based on the literature review findings, street trees, despite their small-scale nature, offer numerous advantages to residents, particularly as ecosystem services that contribute to a tranquil and pleasant environment for motorists traversing roadways [29], [30]. Additionally, they play a role in preventing the impacts of air pollution [31], [32] and enhancing environmental temperatures [33], [34]. The presence of green parks in peri-urban areas can be considered a manifestation of social justice, as it provides an inclusive space for people to engage in various activities without encountering obstacles [35], [36]. Additionally, these parks serve as venues for community economic endeavors [37], [38] and contribute to mitigating Urban Heat Island effects [38], [39]. Forest areas play a vital role in preserving the socio-ecological aspects of peri-urban communities [40], [41], while also fulfilling the requirements of the broader natural environment [42].

Even though agriculture has been neglected, it still provides significant benefits to the economy, ecology, and food security of the population [43]–[47], which includes not only peri-urban area residents but also city residents. Rivers provide fluid services. Aside from being a provider of water and food sources [48]–[50], rivers can also act as a medium of transportation [51]–[53] and recreation [54], [55]. Wetland is one of the ecosystem services that is frequently overlooked but has important and valuable values, such as serving as a field learning laboratory [56], [57] and neutralizing pollutant substances [10], [56], [58]–[60]. The sea continues to provide coastal residents with a source of income, particularly through fish catches [61]–[64]. However, ongoing and rapid peri-urbanization is beginning to reduce the benefits of ecosystem services. The more developed a peri-urban area is, the greater the threat to ecosystem services, particularly in terms of health, welfare, service delivery, and community resilience.

3.2 The influence of peri-urbanization on ecosystems services changes

The phenomenon of peri-urbanization or extended urbanization has been conceptualized differently in various international literatures. It has been referred to as a "widespread city", characterized by a dispersed urban form, as well as "torn apart urbanism", highlighting the fragmentation and spatial disintegration of urban areas [28], [65], [66]. Additionally, it has been recognized as a region that contributes to the future expansion of cities, leading to their increasing size. According to Vizzari (2011) and Yu et al. (2018), The proliferation of urban systems has typically led to the development of peri-urban landscapes that exhibit a mixture of natural, artificial, and semi-natural habitats (Heider et al., 2018). Furthermore, peri-urbanization also promotes the development and expansion of peri-urban areas. The expansion of peri-urban areas results in outward growth towards the rural hinterland, leading to significant land utilization and consumption alterations within these regions. Over time, the process of urban expansion will integrate the area into the urban fabric, consequently leading to alterations in the provision of ecosystem services.

Ecosystem services refer to the diverse benefits that humans derive from ecosystems, including the provision of essential resources like food, water, and raw materials, the regulation of climate and prevention of floods, the provision of recreational opportunities and spiritual enrichment, and the facilitation of nutrient cycling and soil creation. These ecosystem services have experienced modifications. The notion of change in peri-urban ecosystem services refers to the modification or conversion of services that are impacted by the growth of urban areas.

Moreover, changes to peri-urban ecosystems can have a variety of effects on these services. Initially, it is essential to recognize that urban expansion frequently results in the conversion of natural landscapes, such as farmland, forests, and wetlands, into built environments that include housing and infrastructure. The modification of land use has the potential to affect the availability of ecosystem services, particularly by reducing water infiltration and amplifying surface runoff as a result of reduced vegetation coverage. In addition, urbanization results in the fragmentation and destruction of natural habitats, which can lead to a decrease in local biodiversity. Diminishing biodiversity can detrimentally impact ecosystem functionality and diminish the provision of vital services, such as pollination, pest regulation, and nutrient circulation. Moreover, it should be noted that urban areas frequently have a greater propensity for pollution and waste production than the countryside. The discharge of water from urbanized regions has the potential to transport contaminants into adjacent ecosystems, thereby degrading water quality and posing a threat to the survival of aquatic organisms and the ecological functions of these ecosystems.

Furthermore, urban areas have the potential to generate "heat islands," resulting in modified climate patterns within their immediate vicinity. These alterations have the potential to affect the accessibility of water resources, modify the growth patterns of vegetation, and exert an influence on the occurrence of extreme weather events, thereby impacting a wide range of ecosystem services. Finally, the process of urbanization has the potential to modify the manner in which individuals engage with peri-urban landscapes. One illustrative instance involves the transformation of natural landscapes into urban environments, which diminishes the availability of recreational activities and hampers the ability to establish spiritual connections with nature.

The deduction is that widespread peri-urbanization will result in a decrease in the supply of ecosystem services in peri-urban areas. The reason for this phenomenon is attributed to the expansion of urban areas, which exerts considerable pressure on the peri-urban landscape, resulting in the reduction of certain ecosystem services provided by the peri-urban region [69], as illustrated in Table 2.

Table 3.2. Current peri-urban ecosystem services

ES Category	Street tree	Parks	Forest	Cultivated land	River	Wetland	Sea
Supporting services	V	V	V	V	V	V	V
Provisioning services	V	V	V			V	V
Regulatory services		V				V	
Cultural services				V			V

The index clearly indicates that peri-urban areas exhibit a significant lack in the provision of ecosystem services, specifically in terms of regulatory and cultural services. Despite the continued availability of supporting and provisioning services, it is imperative to address the two primary ecosystems: cultivated land and rivers. The interrelationship between the economy, society, land, and ecosystems in peri-urban areas presents a promising avenue for innovative research in applied science, specifically within geography, sociology and artificial environment [4]. This interplay has significant implications for ecosystem conditionand individuals' psycological well-being. It is concluded that peri-urban nature have the potential to exert a positive influence on the neighborhood areas [70].

The occurrence of fast urbanization and population expansion has led to complex difficulties in peri-urban areas. These challenges necessitate a comprehensive and interdisciplinary approach to effectively tackle issues pertaining to sustainability, livability, productivity, infrastructure, climate change, energy consumption, water supply, wastewater disposal, and biodiversity [71]. In order to effectively navigate and respond to these transformations, urban planners, policymakers, and stakeholders must take into account the significance of ecosystem services when formulating decisions related to development. Effectively mitigating the adverse effects of urbanization on peri-urban ecosystems can be achieved through the implementation of green infrastructure, preservation of green spaces, and promotion of sustainable land use practices. These measures are crucial for maintaining these ecosystems' services to both human communities and the environment.

4. Conclusion

The study's findings suggest that the peri-urban process is characterized by substantial environmental degradation, ineffective planning regulations, and an inability to enhance the living conditions of impoverished populations. Nevertheless, the provision of these services in peri-urban areas is compromised due to the escalating expansion of urban areas, pollution, and the exploitation of resources. The findings of the review indicate that the gradual shift from peri-urban regions has led to the proliferation of artificial landscapes and a significant decline in natural ecosystem services, particularly those provided by cultivated lands and rivers. This paper provides an analysis of the current trend and dynamics of peri-urban ecosystem services. Nevertheless, this analysis is partially devoid of bias, as it is driven by the researcher, whose interpretation is required. To maximize the efficacy of the strategy, additional methods should be employed to facilitate and strengthen the comprehension of experts. The overall perspective on peri-urban ecosystem services can be utilized to refocus environmental studies to produce a more resilient and sustainable peri-urban area.

References

[1] United Nations, “World Urbanization Prospects: The 2014 Revision,” Department of Economic and Social Affairs, Population Division. Accessed: Feb. 25, 2021. [Online]. Available: https://esa.un.org/unpd/wup/publications/files/wup2014-report.pdf

[2] T. Firman, “Rural to urban land conversion in Indonesia during boom and bust periods,” *Land use policy*, vol. 17, no. 1, pp. 13–20, Jan. 2000, doi: 10.1016/S0264-8377(99)00037-X.

[3] B. Surya, A. Salim, H. Hernita, S. Suriani, F. Menne, and E. S. Rasyidi, “Land Use Change, Urban Agglomeration, and Urban Sprawl: A Sustainable Development Perspective of Makassar City, Indonesia,” *Land (Basel)*, vol. 10, no. 6, p. 556, May 2021, doi: 10.3390/land10060556.

[4] I. Douglas, “Environmental Change in Peri-Urban Areas and Human and Ecosystem Health,” *Geogr Compass*, vol. 2, no. 4, pp. 1095–1137, Jul. 2008, doi: 10.1111/j.1749-8198.2008.00122.x.

[5] Z. Xia *et al.*, “Integrating perceptions of ecosystem services in adaptive management of country parks: A case study in peri-urban Shanghai, China,” *Ecosyst Serv*, vol. 60, p. 101522, Apr. 2023, doi: 10.1016/j.ecoser.2023.101522.

[6] A. G. Aguilar, “Peri-urbanization, illegal settlements and environmental impact in Mexico City,” *Cities*, vol. 25, no. 3, pp. 133–145, Jun. 2008, doi: 10.1016/j.cities.2008.02.003.

[7] T. T. Danielaini, B. Maheshwari, and D. Hagare, “Defining rural–urban interfaces for understanding ecohydrological processes in West Java, Indonesia: Part II. Its application to quantify rural–urban interface ecohydrology,” *Ecohydrology & Hydrobiology*, vol. 18, no. 1, pp. 37–51, Jan. 2018, doi: 10.1016/j.ecohyd.2017.11.007.

[8] E. Polyzos, S. Kuck, and K. Abdulrahman, “Demographic change and economic growth: The role of natural resources in the MENA region,” *Research in Economics*, vol. 76, no. 1, pp. 1–13, Mar. 2022, doi: 10.1016/j.rie.2022.03.001.

[9] F. Dapilah, J. Ø. Nielsen, and J. N. Akongbangre, “Peri-urban transformation and shared natural resources: the case of shea trees depletion and livelihood in Wa municipality, Northwestern Ghana,” *African Geographical Review*, vol. 38, no. 4, pp. 374–389, Oct. 2019, doi: 10.1080/19376812.2018.1480395.

[10] A. Ghermandi, J. C. J. M. van den Bergh, L. M. Brander, H. L. F. de Groot, and P. A. L. D. Nunes, “Values of natural and human-made wetlands: A meta-analysis,” *Water Resour Res*, vol. 46, no. 12, Dec. 2010, doi: 10.1029/2010WR009071.

[11] L. O’Brien, J. Morris, and A. Stewart, “Engaging with Peri-Urban Woodlands in England: The Contribution to People’s Health and Well-Being and Implications for Future Management,” *Int J Environ Res Public Health*, vol. 11, no. 6, pp. 6171–6192, Jun. 2014, doi: 10.3390/ijerph110606171.

[12] C. D’Alessandro, K. T. Hanson, and G. Kararach, “Peri-urban agriculture in Southern Africa: miracle or mirage?,” *African Geographical Review*, vol. 37, no. 1, pp. 49–68, Jan. 2018, doi: 10.1080/19376812.2016.1229629.

[13] S. Chakraborty, R. Avtar, R. Raj, and H. V. Thu Minh, “Village Level Provisioning Ecosystem Services and Their Values to Local Communities in the Peri-Urban Areas of Manila, The Philippines,” *Land (Basel)*, vol. 8, no. 12, p. 177, Nov. 2019, doi: 10.3390/land8120177.

[14] M. Riechers, M. Strack, J. Barkmann, and T. Tscharntke, “Cultural Ecosystem Services Provided by Urban Green Change along an Urban-Periurban Gradient,” *Sustainability*, vol. 11, no. 3, p. 645, Jan. 2019, doi: 10.3390/su11030645.

[15] X. Ouyang and X. Luo, “Models for Assessing Urban Ecosystem Services: Status and Outlooks,” *Sustainability*, vol. 14, no. 8, p. 4725, Apr. 2022, doi: 10.3390/su14084725.

[16] MEA: Millennium Ecosystem Assessment, “Ecosystems and Human Well-Being: Synthesis,” Washington (DC), 2005.

[17] D. Simon, “Urban Environments: Issues on the Peri-Urban Fringe,” *Annu Rev Environ Resour*, vol. 33, no. 1, pp. 167–185, 2008, doi: 10.1146/annurev.environ.33.021407.093240.

[18] I. A. Leitão, C. S. S. Ferreira, and A. J. D. Ferreira, “Assessing long-term changes in potential ecosystem services of a peri-urbanizing Mediterranean catchment,” *Science of The Total Environment*, vol. 660, pp. 993–1003, Apr. 2019, doi: 10.1016/j.scitotenv.2019.01.088.
[19] P. Bolund and S. Hunhammar, “Ecosystem services in urban areas,” *Ecological Economics*, vol. 29, pp. 293–301, 1999.
[20] E. Gómez-Baggethun and D. N. Barton, “Classifying and valuing ecosystem services for urban planning,” *Ecological Economics*, vol. 86, pp. 235–245, Feb. 2013, doi: 10.1016/j.ecolecon.2012.08.019.
[21] M. Demuzere *et al.*, “Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure,” *J Environ Manage*, vol. 146, pp. 107–115, Dec. 2014, doi: 10.1016/j.jenvman.2014.07.025.
[22] D. J. Nowak, S. Hirabayashi, M. Doyle, M. McGovern, and J. Pasher, “Air pollution removal by urban forests in Canada and its effect on air quality and human health,” *Urban For Urban Green*, vol. 29, pp. 40–48, Jan. 2018, doi: 10.1016/j.ufug.2017.10.019.
[23] B. L. Keeler *et al.*, “Social-ecological and technological factors moderate the value of urban nature,” *Nat Sustain*, vol. 2, no. 1, pp. 29–38, Jan. 2019, doi: 10.1038/s41893-018-0202-1.
[24] D. Haase *et al.*, “A Quantitative Review of Urban Ecosystem Service Assessments: Concepts, Models, and Implementation,” *Ambio*, vol. 43, no. 4, pp. 413–433, May 2014, doi: 10.1007/s13280-014-0504-0.
[25] D. La Rosa, M. Spyra, and L. Inostroza, “Indicators of Cultural Ecosystem Services for urban planning: A review,” *Ecol Indic*, vol. 61, pp. 74–89, Feb. 2016, doi: 10.1016/j.ecolind.2015.04.028.
[26] G. Paré, M.-C. Trudel, M. Jaana, and S. Kitsiou, “Synthesizing information systems knowledge: A typology of literature reviews,” *Information & Management*, vol. 52, no. 2, pp. 183–199, Mar. 2015, doi: 10.1016/j.im.2014.08.008.
[27] S. L. Munajati, H. Kartodihardjo, M. B. Saleh, and N. Nurwadjedi, “Ecosystem Services Dynamics in Bogor Regency,” *Indonesian Journal of Geography*, vol. 53, no. 2, Aug. 2021, doi: 10.22146/ijg.64493.
[28] J. Ravetz, C. Fertner, and T. S. Nielsen, “The Dynamics of Peri-Urbanization,” in *Peri-urban futures: Scenarios and models for land use change in Europe*, Berlin, Heidelberg: Springer Berlin Heidelberg, 2013, pp. 13–44. doi: 10.1007/978-3-642-30529-0_2.
[29] M. S. Taylor, B. W. Wheeler, M. P. White, T. Economou, and N. J. Osborne, “Research note: Urban street tree density and antidepressant prescription rates—A cross-sectional study in London, UK,” *Landsc Urban Plan*, vol. 136, pp. 174–179, Apr. 2015, doi: 10.1016/j.landurbplan.2014.12.005.
[30] B. A. Burley, “Green infrastructure and violence: Do new street trees mitigate violent crime?,” *Health Place*, vol. 54, pp. 43–49, Nov. 2018, doi: 10.1016/j.healthplace.2018.08.015.
[31] R. Kessler, “Green Walls Could Cut Street-Canyon Air Pollution,” *Environ Health Perspect*, vol. 121, no. 1, Jan. 2013, doi: 10.1289/ehp.121-a14.
[32] H. Koyata *et al.*, “Factors determining on-site perception of ecosystem services and disservices from street trees in a densely urbanized area,” *Urban For Urban Green*, vol. 58, p. 126898, Mar. 2021, doi: 10.1016/j.ufug.2020.126898.
[33] Y. Yang, D. Zhou, W. Gao, Z. Zhang, W. Chen, and W. Peng, “Simulation on the impacts of the street tree pattern on built summer thermal comfort in cold region of China,” *Sustain Cities Soc*, vol. 37, pp. 563–580, Feb. 2018, doi: 10.1016/j.scs.2017.09.033.
[34] X. Wang, J. Yao, S. Yu, C. Miao, W. Chen, and X. He, “Street Trees in a Chinese Forest City: Structure, Benefits and Costs,” *Sustainability*, vol. 10, no. 3, p. 674, Mar. 2018, doi: 10.3390/su10030674.
[35] E. Gómez and E. Hill, “First Landing State Park: Participation Patterns and Perceived Health Outcomes of Recreation at an Urban-Proximate Park,” *J Park Recreat Admi*, vol. 34, no. 1, 2016, doi: 10.18666/JPRA-2016-V34-I1-7034.
[36] J. W. R. Baur and J. F. Tynon, “Small-Scale Urban Nature Parks: Why Should We Care?,” *Leis Sci*, vol. 32, no. 2, pp. 195–200, Feb. 2010, doi: 10.1080/01490400903547245.

[37] X. Gu, Q. Li, and S. Chand, “Factors influencing residents’ access to and use of country parks in Shanghai, China,” *Cities*, vol. 97, p. 102501, Feb. 2020, doi: 10.1016/j.cities.2019.102501.
[38] M. A. Barrett, D. Miller, and H. Frumkin, “Parks and Health: Aligning Incentives to Create Innovations in Chronic Disease Prevention,” *Prev Chronic Dis*, vol. 11, p. 130407, Apr. 2014, doi: 10.5888/pcd11.130407.
[39] C. M. V. B. Almeida, M. V. Mariano, F. Agostinho, G. Y. Liu, and B. F. Giannetti, “Exploring the potential of urban park size for the provision of ecosystem services to urban centres: A case study in São Paulo, Brazil,” *Build Environ*, vol. 144, pp. 450–458, Oct. 2018, doi: 10.1016/j.buildenv.2018.08.036.
[40] S. Moricca *et al.*, “Biotic Factors Affecting Ecosystem Services in Urban and Peri-Urban Forests in Italy: The Role of Introduced and Impending Pathogens and Pests,” *Forests*, vol. 9, no. 2, p. 65, Jan. 2018, doi: 10.3390/f9020065.
[41] A. B. Lawrence, F. J. Escobedo, C. L. Staudhammer, and W. Zipperer, “Analyzing growth and mortality in a subtropical urban forest ecosystem,” *Landsc Urban Plan*, vol. 104, no. 1, pp. 85–94, Jan. 2012, doi: 10.1016/j.landurbplan.2011.10.004.
[42] L. R. Johnson *et al.*, “Conceptualizing social-ecological drivers of change in urban forest patches,” *Urban Ecosyst*, vol. 24, no. 4, pp. 633–648, Aug. 2021, doi: 10.1007/s11252-020-00977-5.
[43] Q. Li, S. Hu, G. Du, C. Zhang, and Y. Liu, “Cultivated Land Use Benefits Under State and Collective Agrarian Property Regimes in China,” *Sustainability*, vol. 10, no. 2, p. 7, Dec. 2017, doi: 10.3390/su10010007.
[44] D. Chen, Q. Yu, Q. Hu, M. Xiang, Q. Zhou, and W. Wu, “Cultivated land change in the Belt and Road Initiative region,” *Journal of Geographical Sciences*, vol. 28, no. 11, pp. 1580–1594, Nov. 2018, doi: 10.1007/s11442-018-1530-9.
[45] M. Rondhi, P. Pratiwi, V. Handini, A. Sunartomo, and S. Budiman, “Agricultural Land Conversion, Land Economic Value, and Sustainable Agriculture: A Case Study in East Java, Indonesia,” *Land (Basel)*, vol. 7, no. 4, p. 148, Nov. 2018, doi: 10.3390/land7040148.
[46] C. Zhao, Y. Zhou, X. Li, P. Xiao, and J. Jiang, “Assessment of Cultivated Land Productivity and Its Spatial Differentiation in Dongting Lake Region: A Case Study of Yuanjiang City, Hunan Province,” *Sustainability*, vol. 10, no. 10, p. 3616, Oct. 2018, doi: 10.3390/su10103616.
[47] H. Niu, G. Fang, H. Gao, and J. Song, “Cultivated land quantity niche regulation and its environmental effect,” *Transactions of Nonferrous Metals Society of China*, vol. 21, pp. s699–s705, Dec. 2011, doi: 10.1016/S1003-6326(12)61665-3.
[48] A. Addo-Bediako and K. Malakane, “Preliminary Assessment of Chemical Elements in Sediments and Larvae of Gomphidae (Odonata) from the Blyde River of the Olifants River System, South Africa,” *Int J Environ Res Public Health*, vol. 17, no. 21, p. 8135, Nov. 2020, doi: 10.3390/ijerph17218135.
[49] W.-P. Low, M. F. M. Din, F.-L. Chang, S. N. F. B. Moideen, and Y. Y. Lee, “Empirical models of kinetic rate for river treatment analysis of cellulosic materials,” *Journal of Water Process Engineering*, vol. 23, pp. 257–264, Jun. 2018, doi: 10.1016/j.jwpe.2018.04.011.
[50] J. Larson *et al.*, “Differences between main-channel and off-channel food webs in the upper Mississippi River revealed by fatty acid profiles of consumers,” *Inland Waters*, vol. 5, no. 2, pp. 101–106, Apr. 2015, doi: 10.5268/IW-5.2.781.
[51] P. Angriani, Sumarmi, I. N. Ruja, and S. Bachri, “River management: The importance of the roles of the public sector and community in river preservation in Banjarmasin (A case study of the Kuin River, Banjarmasin, South Kalimantan – Indonesia),” *Sustain Cities Soc*, vol. 43, pp. 11–20, Nov. 2018, doi: 10.1016/j.scs.2018.08.004.
[52] J. Deffner and P. Haase, “The societal relevance of river restoration,” *Ecology and Society*, vol. 23, no. 4, p. art35, 2018, doi: 10.5751/ES-10530-230435.
[53] D. Andreopoulos and D. Damigos, “To transfer or not to transfer? Evidence from validity and reliability tests for international transfers of non-market adaptation benefits in river basins,” *J Environ Manage*, vol. 185, pp. 44–53, Jan. 2017, doi: 10.1016/j.jenvman.2016.10.047.

[54] D. J. Gilvear, C. J. Spray, and R. Casas-Mulet, “River rehabilitation for the delivery of multiple ecosystem services at the river network scale,” *J Environ Manage*, vol. 126, pp. 30–43, Sep. 2013, doi: 10.1016/j.jenvman.2013.03.026.
[55] C.-H. Hsu, H.-H. Lin, and S. Jhang, “Sustainable Tourism Development in Protected Areas of Rivers and Water Sources: A Case Study of Jiuqu Stream in China,” *Sustainability*, vol. 12, no. 13, p. 5262, Jun. 2020, doi: 10.3390/su12135262.
[56] C.-J. Teng, S.-Y. Leu, C.-H. Ko, C. Fan, Y.-S. Sheu, and H.-Y. Hu, “Economic and environmental analysis of using constructed riparian wetlands to support urbanized municipal wastewater treatment,” *Ecol Eng*, vol. 44, pp. 249–258, Jul. 2012, doi: 10.1016/j.ecoleng.2012.03.009.
[57] C. Hassall, “The ecology and biodiversity of urban ponds,” *WIREs Water*, vol. 1, no. 2, pp. 187–206, Mar. 2014, doi: 10.1002/wat2.1014.
[58] Z. Pinke, M. Kiss, and G. L. Lövei, “Developing an integrated land use planning system on reclaimed wetlands of the Hungarian Plain using economic valuation of ecosystem services,” *Ecosyst Serv*, vol. 30, pp. 299–308, Apr. 2018, doi: 10.1016/j.ecoser.2017.09.007.
[59] D. L. McLaughlin and M. J. Cohen, “Realizing ecosystem services: wetland hydrologic function along a gradient of ecosystem condition,” *Ecological Applications*, vol. 23, no. 7, pp. 1619–1631, Oct. 2013, doi: 10.1890/12-1489.1.
[60] W. Lin, J. Cen, D. Xu, S. Du, and J. Gao, “Wetland landscape pattern changes over a period of rapid development (1985–2015) in the ZhouShan Islands of Zhejiang province, China,” *Estuar Coast Shelf Sci*, vol. 213, pp. 148–159, Nov. 2018, doi: 10.1016/j.ecss.2018.08.024.
[61] C. Kelly, “‘I Need the Sea and the Sea Needs Me’: Symbiotic coastal policy narratives for human wellbeing and sustainability in the UK,” *Mar Policy*, vol. 97, pp. 223–231, Nov. 2018, doi: 10.1016/j.marpol.2018.03.023.
[62] S. Helmreich, “Nature/Culture/Seawater,” *Am Anthropol*, vol. 113, no. 1, pp. 132–144, Mar. 2011, doi: 10.1111/j.1548-1433.2010.01311.x.
[63] J. D. Sigwart, R. Blasiak, M. Jaspars, J.-B. Jouffray, and D. Tasdemir, “Unlocking the potential of marine biodiscovery,” *Nat Prod Rep*, vol. 38, no. 7, pp. 1235–1242, 2021, doi: 10.1039/D0NP00067A.
[64] V. Badescu and R. D. Schuiling, “Aral Sea; Irretrievable Loss or Irtysh Imports?,” *Water Resources Management*, vol. 24, no. 3, pp. 597–616, Feb. 2010, doi: 10.1007/s11269-009-9461-y.
[65] P. A. Widyanarko, “Peri-urbanization: a study from ICT perspective,” *IOP Conf Ser Earth Environ Sci*, vol. 202, p. 012010, Nov. 2018, doi: 10.1088/1755-1315/202/1/012010.
[66] B. J. Shaw, J. van Vliet, and P. H. Verburg, “The peri-urbanization of Europe: A systematic review of a multifaceted process,” *Landsc Urban Plan*, vol. 196, p. 103733, Apr. 2020, doi: 10.1016/j.landurbplan.2019.103733.
[67] M. Vizzari, “Peri-Urban Transformations in Agricultural Landscapes of Perugia, Italy,” *Journal of Geographic Information System*, vol. 03, no. 02, pp. 145–152, 2011, doi: 10.4236/jgis.2011.32011.
[68] D. Yu *et al.*, “Decreased Landscape Ecological Security of Peri-Urban Cultivated Land Following Rapid Urbanization: An Impediment to Sustainable Agriculture,” *Sustainability*, vol. 10, no. 2, p. 394, Feb. 2018, doi: 10.3390/su10020394.
[69] M. Hedblom, E. Andersson, and S. Borgström, “Flexible land-use and undefined governance: From threats to potentials in peri-urban landscape planning,” *Land use policy*, vol. 63, pp. 523–527, Apr. 2017, doi: 10.1016/j.landusepol.2017.02.022.
[70] R. P. H. Snep *et al.*, “How peri-urban areas can strengthen animal populations within cities: A modeling approach,” *Biol Conserv*, vol. 127, no. 3, pp. 345–355, Jan. 2006, doi: 10.1016/j.biocon.2005.06.034.
[71] H. Malano, B. Maheshwari, V. P. Singh, R. Purohit, and P. Amerasinghe, “Challenges and Opportunities for Peri-urban Futures,” 2014, pp. 3–10. doi: 10.1007/978-94-017-8878-6_1.