Land suitability analysis for food logistic providers: A meta- analysis

Article *in* Land Degradation and Development · July 2024

DOI: 10.1002/ldr.5198

CITATIONS
0

READS
66

8 authors, including:

Mahdad Pour
University of Liège
5 PUBLICATIONS **15** CITATIONS
SEE PROFILE

Thomas Dogot
University of Liège
77 PUBLICATIONS **443** CITATIONS
SEE PROFILE

Philippe Lebailly
University of Liège
206 PUBLICATIONS **1,904** CITATIONS
SEE PROFILE

David López-Carr
University of California, Santa Barbara
7 PUBLICATIONS **151** CITATIONS
SEE PROFILE

Received: 20 December 2023 | Revised: 11 April 2024 | Accepted: 28 April 2024

DOI: 10.1002/ldr.5198

RESEARCH ARTICLE

WILEY

Land suitability analysis for food logistic providers: A meta-analysis

Mahdad Pour[1] | Thomas Dogot[1] | Philippe Lebailly[1] | David Lopez-Carr[2] | Hossein Azadi[1]

[1]Department of Economics and Rural Development, Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium

[2]Department of Geography, University of California, Santa Barbara, California, USA

Correspondence
Mahdad Pour, Department of Economics and Rural Development, Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium.
Email: mahdad.pour@student.uliege.be

Abstract

Land suitability analysis is a process to specify the suitability of a particular area according to its inherent characteristics. Inefficient land suitability leads to inefficient exploitation of natural resources, destruction of land resources, poverty, and even social harm. In this regard, land suitability assessment is important to support transportation planning and demand for construction. This study aimed to systematically review the mutual impacts of land logistics and land suitability. This study applied a meta-analysis to integrate the results of 36 original papers published between 1990 and 2024. The findings showed there were mutual impacts of land logistics and land suitability. In this regard, demand for highway construction significantly affects warehousing ($B = 6.30$; $p < 0.99$) and distribution and transportation ($B = 4.23$; $p < 0.99$) according to Table 3. In addition, warehousing ($B = 7.35$; $p < 0.95$) and distribution and transportation ($B = 2.11$; $p < 0.90$) have significant effects on demand for highway construction based on Table 4. The temporal effect of logistics land development has the most positive influence on natural resources and environmental tolerance (4.49). The spatial effects of land suitability and food logistic providers have respectively the most positive impacts on inventory control and demand for highway construction in European countries. Policymakers should consider the global issue of land suitability according to its advantages. First, the greatest advantage of land suitability is that it gives more accountability to the officials and decision makers. Second, land suitability provides the basis for distribution and transportation and inventory control effectively controls storage costs. Thirdly, warehousing, due to land suitability, ensures a regular supply of goods in the market.

KEYWORDS

construction, development restrictions, highway construction, natural resources and environmental tolerance, spatiotemporal effects

1 | INTRODUCTION

Land suitability analysis is essential to support transportation planning and more effective communication with spatial planning to attain a balance between transportation and environmental protection (Son et al., 2023). An essential foundation for enhancing the scientific nature of spatial planning is the capacity to tolerate resources and the environment, as well as the analysis of land suitability (Ronchi et al., 2020). The maximum measure and ability of a regional resource and an environmental system to tolerate various social and economic activities are referred to as natural resources and environmental tolerance. The tolerance volume addresses sustainable development needs

in a given period and space at a particular socio-economic and production level (Mondejar et al., 2021; Zeng et al., 2022). The research on tolerance capacity contributes to ecology, and primary studies focus on individual tolerance capacities, including land (Petersen-Rockney et al., 2021), water assets (Xin et al., 2022), and agricultural tolerance capacity (Gul et al., 2022). According to the outstanding prominent environmental issues, the assessment of tolerance capacity is gradually generalized to the comprehensive assessment of the environment (Dong et al., 2020).

The extant literature on the selection of logistics service providers includes studies of companies in different spheres, i.e., the self-driven industry (Lagorio et al., 2020), agriculture (Akbari et al., 2024; Paciarotti & Torregiani, 2021), food product (Jagtap et al., 2021; Paciarotti & Torregiani, 2021; Tsang et al., 2021), consumer electronics (Cichosz et al., 2020), service delivery (Restuputri et al., 2020), and defense industry (Mahoney et al., 2024). In this regard, there are financial benefits that allow for the negotiation of better shipping costs by choosing a joint supplier (Gaudenzi et al., 2020; Guida et al., 2021). Managers' decision-making processes for evaluating, selecting, and providing logistics services are based on various criteria and selecting high-quality raw material suppliers. Service levels and operational capabilities have the highest effect on a decision-making process (Chen et al., 2020; Rahardjo et al., 2023). Furthermore, the service levels of the joint supplier, quality, and cost have the most impact on the decision-making process for import and export services (Dang et al., 2022; Song et al., 2021), whereas, for e-commerce, the most important criteria are accountability and quality of services (Mahdikhani & Yazdani, 2020). Logistics service providers who are qualified and suitable should be selected to store and transport the products (Jagtap et al., 2021; Kumar et al., 2020). A higher value added is paid to the specialist logistics services provider since it might give the company a competitive edge. It is noteworthy that the goods sector of the food industry will expand significantly over the next few years and will require the services of a logistics service provider for storage and transportation (Shcherbakov & Silkina, 2021). In this context, food logistics providers that manage packaged shipments with multi-temperature requirements should be given more attention (Tsang et al., 2021). Food logistics providers must address the characteristics of e-commerce, including time-critical delivery, fragmented orders, and high product variety, for multi-temperature joint distribution (Nagarajan et al., 2022; Paciarotti & Torregiani, 2021). The use of traditional planning for product delivery by food logistics providers is insufficient as it only reduces the travel cost (Tsang et al., 2021) while food quality and arrival time should also be considered (Casino et al., 2021).

Land suitability refers to the suitability of a certain type of land for a specific type of use, which is needed in a certain period and space for different functions (i.e., agricultural production, urban building, and environmental protection) (Ayhan et al., 2020; Azadi et al., 2023; Mohammed et al., 2020). To improve the precision of spatial planning, land suitability analysis based on environmental tolerance capacity has become a novel style (Amato et al., 2020). There are a few studies (e.g., Miani et al., 2023; Min et al., 2021; Raad & Rajendran, 2024; Ustaoglu & Aydınoglu, 2020) on appropriate evaluations to support transportation planning and logistics providers. Furthermore, there is no consideration of land suitability in terms of environmental constraints and transport infrastructure requirements or the role of food logistic providers in it. The study of land suitability is necessary to enable the identification of the main limiting factors for agricultural production and enable decision-makers to develop agricultural management that increases land productivity. Therefore, studying land suitability in the sense of identifying areas that are most suitable for specific uses such as agriculture and other uses is valuable for logistics providers. These studies can focus on various aspects of land suitability, like natural resource and environmental tolerance, demand for highway construction, and building construction and development restrictions. In this regard, building construction and development restrictions can be seen as an obstacle to logistics activities including transportation and warehousing while development is an entire process that includes the construction phases. However, previous studies (e.g., Min et al., 2021; Raad & Rajendran, 2024; Ustaoglu & Aydınoglu, 2020) have not considered the mutual analysis of the land suitability and logistics providers. The novelty of this study is quantifying the mutual impacts of land suitability and logistics providers. In addition, the findings of this study can present the spatiotemporal effects caused by the mutual effects of land suitability and logistics providers. For example, these mutual effects of land suitability and logistics providers are greater in which years and continental regions. Hence, the results of this study can be helpful for policymakers in the field of land and logistics services to make appropriate decisions. Accordingly, the main objective of this paper is to review the articles that estimated the mutual impact of logistics land use decisions and land suitability aspects (e.g., the natural resources and environmental tolerance, the demand for highway construction, and the building construction and development restrictions). On the basis of this, the following research questions have been raised:

1. How does land suitability (i.e., natural resources and environmental tolerance, demand for highway construction, and building construction and development restrictions) impact logistics providers?
2. How do the land use decision logistics influence land suitability aspects?
3. What spatiotemporal patterns are revealed by the analysis of land suitability and the land use decision logistics?

In the continuation of this study, the applied method is reported in part 2 (i.e., the Methodology section). The third part presents the results of the study. Part 4 offers the discussion, and eventually, and part 5 concludes the study.

2 | METHODOLOGY

The present study is a type of systematic review and meta-analysis that applied the Preferred Reporting Items for Systematic Reviews and Meta-Analyses standards (Parums, 2021).

2.1 | Choosing the topic and locating the articles

A systematic search was initially conducted to find relevant articles from Google Scholar and SID search engines from 1990 to 2024, which was followed by a thematic analysis process on keywords. The first stage was to recognize keywords based on the topic being studied, i.e., "land suitability," "environmental tolerance," "highway construction," and "building restrictions." The next stage was to consider other keywords to get more certain articles up to the maximum searchable extent. Other keywords, i.e., "warehousing," "distribution," "transportation," "inventory control," and "accountability" were selected due to the aim of this review. A combination of keywords related to land suitability spheres were offered consecutively, as follows:

1. Land suitability OR environmental tolerance OR highway construction OR building restrictions.
2. Land suitability OR environmental tolerance OR highway construction OR building restrictions AND warehousing OR distribution OR transportation OR inventory control OR accountability.

After the initial search, detected records were rigorously screened using the inclusion and exclusion criteria defined in the next subsection. In this regard, two researchers independently screened the titles and abstracts of the original articles for further investigation and confirmed each other's assignments. In case of disagreement between the two researchers, a third researcher was used to resolve the issue.

2.2 | Choosing articles, inclusion criteria, and included articles

The process for including/excluding articles is shown schematically in Figure 1. As shown in the figure, the first step was the initial search

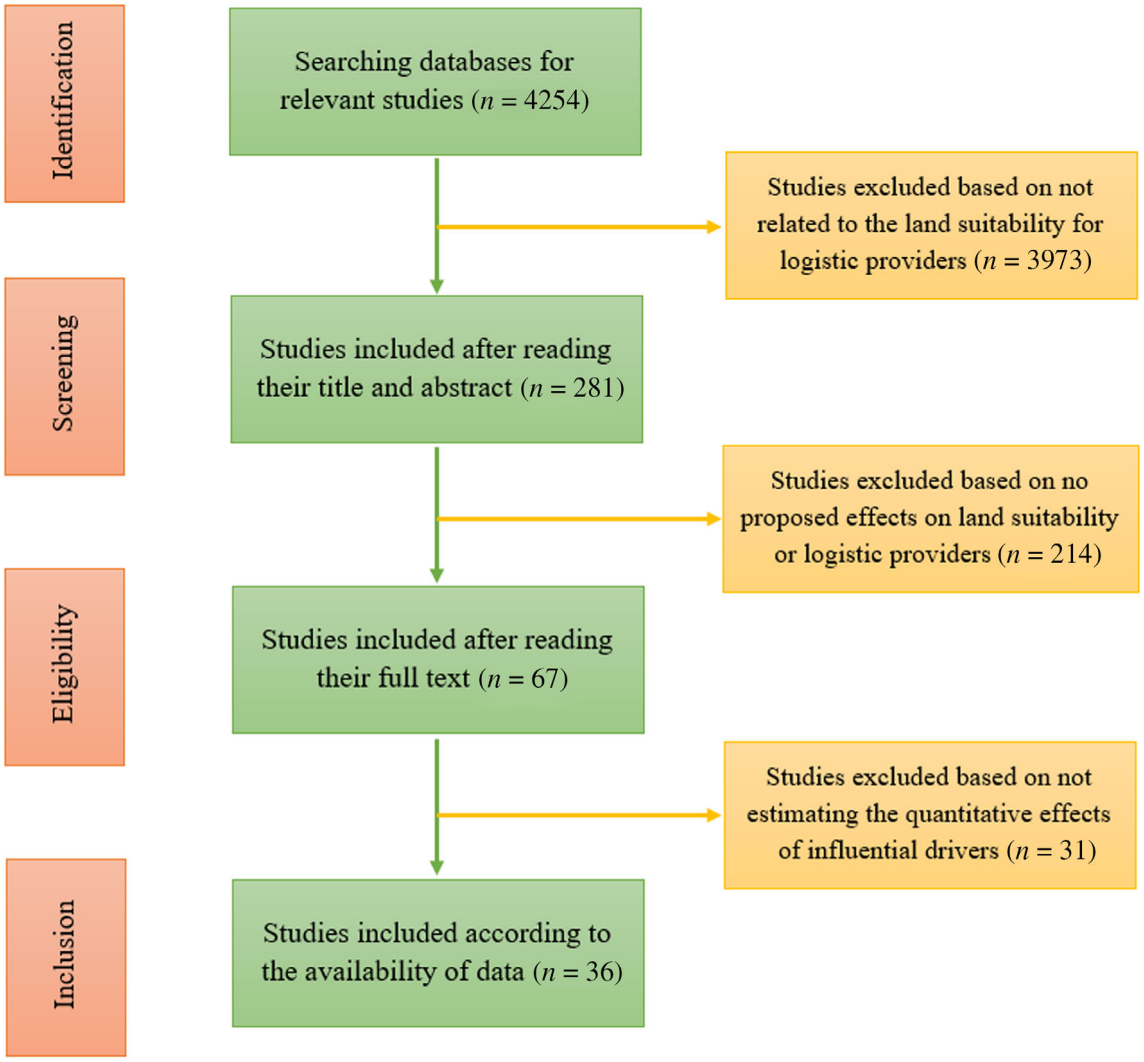

FIGURE 1 The Preferred Reporting Items for Systematic Reviews and Meta-Analyses process. Adapted from Mengist et al. (2020) and O'Leary et al. (2016). [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 The factors considered in the meta-regressions.

Factor	Variable	Type of variable	Definition
Main scenarios			
Land suitability	Natural resources and environmental tolerance	Dependent and independent	The maximal measure and ability of a regional resource and an environmental system to tolerate various social and economic activities
	Demand for highway construction	Dependent and independent	When ease of transportation and access to remote areas is important
	Building construction and development restrictions	Dependent and independent	A set of rules and standards for the design and construction of buildings
Logistic provider	Warehousing	Dependent and independent	Storing products that will be sold or distributed later
	Distribution and transportation	Dependent and independent	The systematic process of picking up products, categorizing them based on the location of their destination, and giving them to the receiver
	Inventory control	Dependent and independent	The process of ensuring that the right amount of product supply is available
	Accountability	Dependent and independent	Accepting responsibility for the quality of service
Spatiotemporal characteristics			
Time	Year of data gathering	Independent	Original articles printed between 1990 and 2024
Space	Africa	Independent	Original articles performed in the African continent
	America	Independent	Original articles performed in the American continent
	Asia	Independent	Original articles performed in the Asia continent
	Europe	Independent	Original articles performed in the Europe continent
	Oceania	Independent	Original articles performed in the Oceania continent
Complemented factors			
Type of article	ISI publication	Independent	Original articles published in an ISI journal
Methodology applied	Appropriate method	Independent	Original articles applied a methodology to capture heterogeneity

Source: The findings of the study.

considering several inclusion criteria: (1) the mutual impacts of land suitability and food logistic providers must be estimated based on regression models, (2) quantitative results assessing the effect of land suitability on food logistic providers and vice versa, and (3) English articles in peer-reviewed journals till January 2024. In this step, the number of original articles reached 4254. The second step was the progressive search considering several exclusion criteria: (1) obvious errors, e.g., statistical inaccuracies or plagiarism, (2) use of qualitative methods without inferential statistics/analysis, and (3) the dissertation from which the article was extracted to avoid duplicate data. In this step, the number of articles narrowed down to 67 articles. The third step was presenting the effects of land suitability/ food logistic providers measurement unit (should be expressed as a percent change in the dependent variable), based on which 36 primary articles were selected for meta-analysis. Finally, the collected articles are in the temporal period from 1990 to 2024 and the study area is in the five continents of Africa, America, Asia, Europe, and Oceania (Table 1).

2.3 | Meta-analysis model specifications

Three sets of factors related to the original articles were included in the meta-analysis as meta-regressions including the main scenarios (i.e., the mutual impacts of land suitability and food logistic providers expressed in percentage), spatiotemporal characteristics (including time pattern, i.e., the publication year of collected data, and space pattern, i.e., the study area), and complemented factors (that is type of article, i.e., ISI publication or working paper, and methodology applied, i.e., captured heterogeneity) to explain the quality of original articles.

In this regard, the explanatory power of the meta-analysis can be increased and extra information not included in the original articles can be extracted. The general form of a meta-analysis model is as follows:

$$M_{ij} = \alpha_0 + \sum \beta_k E_{ij,k} + \mu_j + \varepsilon_{ij} \quad (1)$$

where M_{ij} refers to the dependent variable i obtained from a given article j, $E_{ij,k}$ is the meta-regressor k and β_k is the parameter associated

with meta-regressor k, which measures its impact on the estimate of the dependent variable, α_0 is the constant, μ_i is a study-specific effect, and ε_{ij} is an error term.

2.4 | Evaluate and perform analysis

This study investigated the average effect sizes (i.e., the effect of land suitability on food logistic providers and vice versa) that extracted from the primary articles indicate either the effect of the land suitability aspect on the logistic provider or the effect of the logistic provider on land suitability. A relatively small number of effect sizes is not unusual in meta-analysis research, but a trade-off must be made between the conceptual homogeneity of the studied data and the number of data points available for meta-analysis. In addition, the relative rarity of original articles on the mutual impacts of land suitability and food logistic providers shows that it is a field of study in need of more research.

Meta-regression can be implemented using the fixed- or random-effect model. The distinction between these two models can be due to different reasons, as follows: (1) the actual effect size in the original articles is assumed to be the same in the fixed-effect model; (2) the correlation among different observations from one or more original articles through the random-effect model using cluster robust variance estimators are explained; and (3) the random-effect model assists make consistent and efficient results compared to a fixed-effect model. Thus, the current study applied the random-effect model to implement the meta-regressions.

This study ensured the quality of the collected articles by avoiding the risk of bias (Minozzi et al., 2022). Meta-analysis studies are susceptible to publication bias because articles with results that contradict the expected direction or lack inferential statistics may overstate the effect. To avoid this problem in this study, Egger's test with funnel plot asymmetry was used to determine potential publication bias in a meta-analysis. This test is a linear regression of the intervention effect, which estimates their standard errors weighted by their inverse variance.

Three econometric models of meta-analysis were tested. First, it started from a simple model considering only the main scenarios. Then the spatiotemporal characteristics were included in the second model. In the third model, complemented factors were also added. Finally, the model with more significant statistical characteristics was selected. The Stata version 17 (Stata Corp, College Station, TX, USA) was applied to estimate models.

3 | RESULTS

According to the statistical description and addressing the research questions, this section was organized as follows: descriptive statistics, land suitability impacts on food logistic providers, food logistic providers' impact on land suitability, and spatiotemporal patterns revealed by analysis.

3.1 | Descriptive statistics

The original articles capture various land suitability including the natural resources and environmental tolerance, the demand for highway construction, and the building construction and development restrictions (Table 2). The articles classified in the category of natural resources and environmental tolerance refer to the maximum capacity of the region to tolerate various social and economic activities. In the category of building construction and development restrictions, the most usual restrictions refer to the availability of resources and project costs, scope, and time. Across the studied articles, more studies focused on the demand for highway construction (15 articles). The two types of land suitability including the natural resources and environmental tolerance and the building construction and development restrictions consist of 10 and 11 articles, respectively.

The spatiotemporal patterns of the 36 selected articles are indicated in Figure 2. Accordingly, the studies were conducted on continents of Africa, America, Asia, Europe, and Oceania during five 6-year periods (i.e., 1990–1996; 1997–2003; 2004–2010; 2011–2017; 2018–2024). Most of them (16 articles; 33%) were conducted in Asia and half of those studies (50% of Asian articles) were related to the recent period from 2018 to 2024. Then, 13 studies (27%) were conducted in Europe in three periods including 2004–2010, 2011–2017, and 2018–2024. Studies on the impacts of land suitability and logistics providers have been conducted in all continental regions after 2018, and in Africa, the focus has been on studies conducted in the last 6 years.

The criterion of "printing an article in an ISI journal" was used to assess the quality of the articles. As a result, 33 research works (91.67%) have been published in ISI-indexed journals. Furthermore, only two articles applied pool data models to incorporate unknown heterogeneity in research outcomes.

3.2 | Land suitability impacts on food logistic providers

Factors affecting logistics land use decisions meta-regressions are displayed in Table 3. R^2 ranges from 0.33 to 0.73 in Table 3, which indicates the proportion of the variation for the impacts of the logistic providers explained by explanatory variables. According to the results, the variable of natural resources and environmental tolerance has significant effects on the three logistic provider impacts including

TABLE 2 Outline of the studies according to land suitability.

Land suitability	Number of original articles
Natural resources and environmental tolerance	10
Demand for highway construction	15
Building construction and development restrictions	11

Source: The findings of the study.

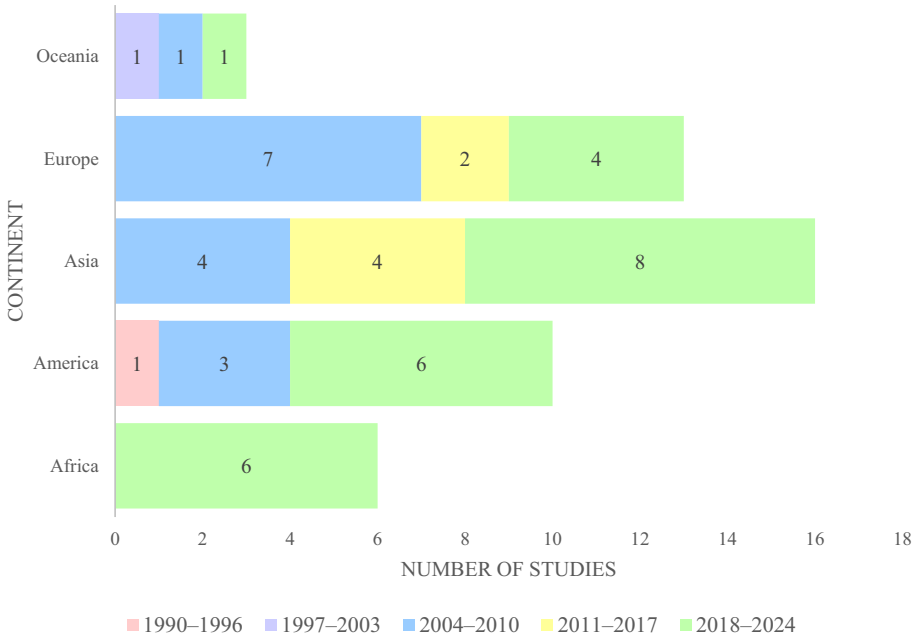

FIGURE 2 The spatiotemporal patterns of the selected articles. *Source*: The findings of the study. [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Variables and factors affecting logistics land use decisions meta-regressions.

		Food logistic providers impact			
Factor	**Variable**	**Warehousing**	**Distribution and transportation**	**Inventory control**	**Accountability**
Land suitability	Natural resources and environmental tolerance	2.27 (4.39)	0.78*** (0.23)	2.57* (1.53)	3.59** (1.50)
	Demand for highway construction	6.30*** (1.70)	4.23*** (1.12)	2.23 (4.91)	5.58 (8.08)
	Building construction and development restrictions	−1.34*** (0.45)	−1.63 (1.82)	−3.87** (1.95)	−4.23 (7.39)
Time	Year of data gathering	3.67*** (0.36)	3.85** (1.72)	2.58** (1.11)	3.68*** (0.79)
Space	Africa	−1.89 (3.95)	1.61 (1.51)	−1.23 (2.68)	−1.22 (2.04)
	America	1.56 (1.18)	2.38 (3.25)	1.14 (1.61)	1.49 (2.40)
	Asia	8.82*** (1.25)	4.36* (2.71)	1.78 (1.28)	1.53 (2.34)
	Europe	2.47*** (0.68)	2.31** (1.21)	9.01*** (2.78)	8.89*** (1.38)
	Oceania	6.79 (5.87)	4.21 (5.37)	6.94 (6.23)	4.12 (5.23)
Type of article	ISI publication	7.39** (3.41)	4.13 (3.53)	7.27*** (3.33)	2.31 (3.63)
Methodology applied	Appropriate method	1.03 (2.17)	1.81 (4.25)	1.36 (1.23)	1.93 (2.91)
R^2		0.73	0.47	0.51	0.33
Number of observations		28	29	21	11

Note: The standard errors are shown in parentheses.
*, **, and *** show significance at 0.90, 0.95, and 0.99.
Source: The findings of the study.

distribution and transportation (mean impact: 0.78, significant at 0.99), inventory control (mean impact: 2.57, significant at 0.90), and accountability (mean impact: 3.59, significant at 0.95). Thus, the tolerance capacity of resources and the environment can improve distribution and transportation services by about 1%. Therefore, natural resources and environmental tolerance can improve the structure by which products are classified, transported, and distributed at the destination. In addition, by adjusting the natural resources and environmental tolerance, inventory control is increased by about 3%. Furthermore, such natural resources and environmental tolerance can significantly raise accountability by nearly 4%. In addition, the demand for highway construction has significantly positive impacts on warehousing (mean impact: 6.30, significant at 0.99) and distribution and transportation (mean impact: 4.23, significant at 0.99). Thus,

warehousing has been increased by about 6%, based on the demand for highway construction. In addition, the construction of the highway leads to an increase in the distribution and transportation of goods by about 4%. Therefore, the demand for highway construction can improve the structure by which products are classified, transported, and distributed at the destination. Furthermore, the building construction and development restrictions significantly decrease warehousing (mean impact: −1.34, significant at 0.99) and inventory control (mean impact: −3.87, significant at 0.95). Thus, warehousing has been decreased by about 1% due to the construction restrictions. In addition, inventory control by the building construction and development restrictions is reduced by about 4%. In addition, the type of article shows about 7%, and 7% of the variations in impacts of warehousing, and inventory control (Table 3). Moreover, the variable of the methodology applied is not significant.

3.3 | Food logistic providers' impact on land suitability

Factors affecting land suitability meta-regressions are shown in Table 4. According to Table 4, R^2, displaying the percentage of the variation for the effects of the dependent variables, which was explained by explanatory factors in meta-regressions, goes from 0.37 (in the third column) to 0.71 (in the second column). According to the results, the variable of warehousing has a significant impact on land suitability impact in terms of the demand for highway construction (mean effect: 7.35, significant at 0.95). Therefore, the warehousing of products increases the demand for highway construction by about 7%. In addition, distribution and transportation have a significantly positive impact on the demand for highway construction (mean impact: 2.11, significant at 0.90). Thus, the distribution and transportation of products increase the demand for highway construction by about 2%. In addition, the type of article indicates about 3%, and 1% of the variations in impacts of the natural resources and environmental tolerance, and the demand for highway construction (Table 4). Furthermore, the variable of the methodology applied is not significant.

Figure 3 shows the median effects of food logistic providers on land suitability. In this regard, the median effect of warehousing products on the demand for highway construction (median impact: 3.05, significant at 0.95) is significant. Thus, warehousing products cause a 3% increase in the demand for highway construction. Therefore, logistics service providers can promote increasing the demand for highway construction. Figure 3 confirms the findings presented above by the meta-regression (Table 4). In addition, the median effect of distribution and transportation of products on the demand for highway construction (median impact: 3.35, significant at 0.99) is significant. As a result, product distribution and transportation produce a 3% rise in the demand for highway development. Therefore, logistics service providers can promote increasing the demand for highway construction. These findings confirm the findings presented above by the meta-regression (Table 4).

TABLE 4 Variables and factors affecting land suitability meta-regressions.

		Land suitability		
Factor	**Variable**	**Natural resource and environmental tolerance**	**Demand for highway construction**	**Building construction and development restrictions**
Food logistic providers impact	Warehousing	1.06 (9.39)	7.35** (3.61)	0.36 (2.77)
	Distribution and transportation	4.64 (6.74)	2.11* (1.16)	3.48 (7.27)
	Inventory control	1.26 (5.55)	7.16 (6.52)	2.13 (4.46)
	Accountability	1.09 (2.14)	1.18 (1.39)	6.38 (8.34)
Time	Year of data gathering	4.49* (2.54)	1.66*** (0.17)	2.73*** (0.93)
Space	Africa	2.02 (1.86)	3.51 (4.88)	1.44 (0.96)
	America	7.31 (7.37)	4.01 (5.45)	−8.80 (9.20)
	Asia	1.83*** (0.38)	6.46*** (1.80)	−2.59 (1.89)
	Europe	8.14 (6.10)	8.62*** (2.66)	5.95*** (2.08)
	Oceania	−4.55 (3.42)	4.64 (6.68)	4.52 (7.04)
Type of article	ISI publication	3.40*** (0.72)	1.38* (0.74)	2.90 (7.37)
Methodology applied	Appropriate method	2.59 (3.19)	2.86 (5.24)	0.13 (0.52)
R^2		0.58	0.71	0.37
Number of observations		14	17	12

Note: The standard errors are shown in parentheses.
*, **, and *** show significance at 0.90, 0.95, and 0.99.
Source: The findings of the study.

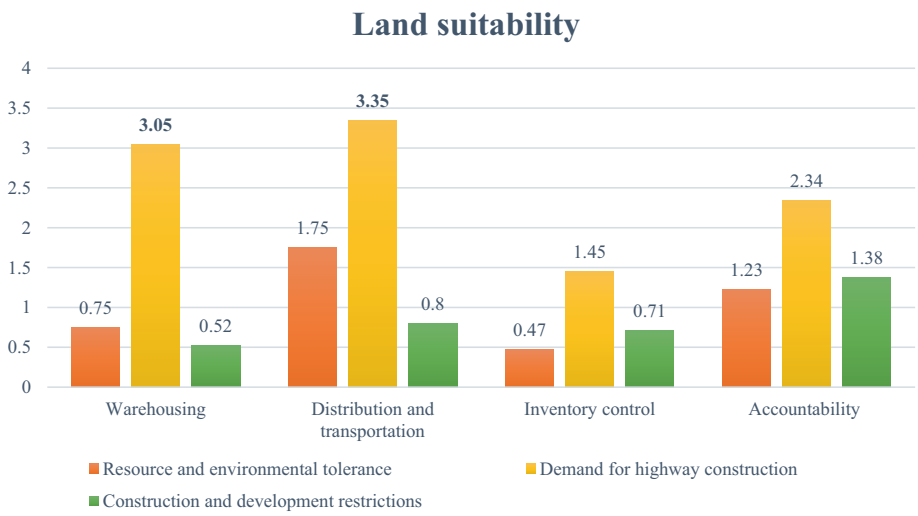

FIGURE 3 The median effects of food logistic providers on land suitability. Bold values are statistically significant. *Source*: The findings of the study. [Colour figure can be viewed at wileyonlinelibrary.com]

3.4 | Spatiotemporal patterns revealed by analysis

The temporal patterns of land suitability impacts were significant for all food logistic providers, in terms of warehousing (mean impact: 3.67, significant at 0.99), distribution and transportation (mean impact: 3.85, significant at 0.95), inventory control (mean impact: 2.58, significant at 0.95), and accountability (mean impact: 3.68, significant at 0.99). This suggests that if the original article had relied on early data from the last 10 years, warehousing, distribution and transportation, inventory management, and accountability would have increased by 4%, 4%, 3%, and 4%, respectively, as a result of land suitability. For spatial impacts, various regions have a significant influence on the types of logistic provider impacts of land suitability. Therefore, studies conducted on land suitability in Asia and Europe show impacts on warehousing (mean impact: 8.82, significant at 0.99 and mean impact: 2.47, significant at 0.99), distribution and transportation (mean impact: 4.36, significant at 0.90 and mean impact: 2.31, significant at 0.95), inventory control (mean impact: 1.78, non-significant and mean impact: 9.01, significant at 0.99), and accountability (mean impact: 1.53, non-significant and mean impact: 8.89, significant at 0.99). Thus, land suitability leads to about 9% and 4% increases in warehousing, and distribution and transportation, respectively, given that the original article was conducted in Asia. In Europe, land suitability causes about 2%, 2%, 9%, and 9% increases in warehousing, distribution and transportation, inventory control, and accountability, respectively.

The temporal impacts of the year were significant for all land suitability of the natural resources and environmental tolerance (mean impact: 4.49, significant at 0.90), the demand for highway construction (mean impact: 1.66, significant at 0.99), and the building construction and development restrictions (mean impact: 2.73, significant at 0.99). Therefore, if the original article used initial data in the recent decade, food logistic providers would cause about 4%, 2%, and 3% increases in the natural resources and environmental tolerance, the demand for highway construction, and building construction and development restrictions, respectively. For the spatial patterns, different regions have a significant effect on land suitability impacts due to food logistic providers. Therefore, studies conducted on food logistic providers in Asia and Europe show impacts in terms of natural resources and environmental tolerance (mean impact: 1.83, significant at 0.99 and mean impact: 8.14, non-significant), the demand for highway construction (mean impact: 6.46, significant at 0.99 and mean impact: 8.62, significant at 0.99), and building construction and development restrictions (mean impact: −2.59, non-significant and mean impact: 5.95, significant at 0.99). As a result, both the demand for highway development and the tolerance capacity of resources would have increased by around 6% and 2%, respectively, if the original study had been conducted in Asia. In Europe, food logistic providers enhance the demand for highway construction by 9%, and limits on building and development by 6%, respectively.

4 | DISCUSSION

4.1 | Land suitability effects

Land suitability, in terms of natural resources and environmental tolerance, the demand for highway construction, and building construction and development restrictions, has significant effects on logistics providers' impacts. Natural resources and environmental tolerance can increase the average of distribution and transportation, inventory control, and accountability, while the demand for highway construction increases warehousing, and distribution and transportation. However, building construction and development restrictions dropped the average of warehousing and inventory control. Therefore, natural resources and environmental tolerance can promote the service and responsibility of providers.

As a result, the environment and the resource tolerance capacity can have a big impact on logistics service providers. The outcomes of the previous research, i.e., Bao et al. (2020), Davis et al. (2021), and Luo et al. (2020), are similar to the results of the current study. Bao et al. (2020) studied an analytical framework for assessing resource levels, environmental pressures, and tolerance capacity over the large-

scale Yangtze Basin. This paired analysis of resources and environmental pressure, capacity, and governance specified the geographical potential and direction of use by applying spatial analysis and limiting factor analysis methods. Their results showed that the resource environment tolerance capacities have spatial differences. The environmental pressures of the upstream resources were lower than those of the downstream ones, which does not correspond to the natural resources and environmental tolerance but corresponds to the resource environment governance levels. The proportion of unused land is the main factor limiting the tolerance capacity of the regional resource environment. Davis et al. (2021) studied environmental variability along the food supply chain to reduce risks associated with periodic food shortages, price increases, and food quality declines by systematic reviewing existing literature. Their results showed that researchers on food supply shocks have primarily focused on corn, rice, and wheat. Thus, food logistics providers need to complete food basket, diverse environmental resources, and link between food production and consumption and nutrition. Their findings offered food replacement for individuals, change of resources for production center, and strategic reserves to deal with environmental shocks for governments. In addition, Luo et al. (2020) examined the evolution of the urban land tolerance capacity in China during the period of rapid urbanization from the perspective of the carrier load by using the equal interval method and quartile method. Their results showed that the performance of land capacity in urbanization is evolving towards a better situation. Some cities may have better evolutionary performance, though they have a moderate amount of poor land tolerance capacity. In addition to helping policymakers better understand the state of the land-tolerance capacity and take appropriate steps to increase capacity performance, their findings helped to advance the field of land research.

According to the results, the demand for highway construction can improve all logistics service providers. This means that following land use selection with a stronger influence on the earlier evaluation of land suitability will have a greater impact in the new round. The outcomes of the previous research, i.e., Dwitasari et al. (2020) and Hodgson (2018), are in line with the findings of the current study. In this regard, Dwitasari et al. (2020) focused on assessing the effect of the Trans-Sumatran Highway construction on logistics costs based on a qualitative approach in Indonesia. Their results showed that there are several advantages taken from the toll road development. Manufacturers can achieve greater inventory turnover through faster shipping processes. In terms of transportation, reduced travel times and flat toll roads can save car maintenance and fuel expenditures. Moreover, tolls can remove the extra costs that used to often arise in travel. Finally, it was argued that highways can increase transportation and logistics activities. In addition, Hodgson (2018) studied the effect of infrastructure development on the geographical distribution of cities using location data based on instrumental variable regressions in the American West. This study estimated the probability of survival and life expectancy for economic activity as a function of the infrastructure provision. The likelihood of the economic activity surviving with infrastructure development was 20%–50% greater than in places with infrastructure concerns. Given the close historical correlation between the places of economic activity and the location of cities, their results provided evidence that infrastructure development cast a shadow over the agglomeration—cities with almost adequate infrastructure were likely to decline, compared with cities that remained isolated.

The results indicated that building construction and development restrictions can drop logistics service providers. Thus, the building construction and development restrictions can have an inhibitory effect on logistic service providers. The outcomes of previous research, i.e., Kumar et al. (2022) and Yuan (2019), are in line with the results of the current study. Kumar et al. (2022) identified barriers to implementing smart technology in sustainable warehousing by using the Delphi approach in India. Their results showed that the most important limitations in the implementation of smart and sustainable supply chain methods of warehousing included lack of government support, lack of vision and task, and lack of skilled labour. Their study contributed to decreasing the effect of various barriers that increase the chances of technology selection in warehousing. Yuan (2019) examined how changes in planning practices affect different warehousing development paths by applying a quantitative method. Based on his results, warehousing was influenced by the main elements of planning including land-use policies, financial incentives, and environmental regulations. The development of green storage facilities in suburban cities caused more environmental concerns, compared to brownfield redevelopment in nearby municipalities.

4.2 | Food logistic providers' effects

Land suitability is significantly affected by logistics providers in terms of warehousing, and distribution and transportation. Thus, land logistics providers including warehousing, and distribution and transportation have a significant effect on land suitability in terms of the demand for highway construction. The findings of the previous research, i.e., Noorzai (2020), are similar to the results of this study. Noorzai (2020) determined the decision-making criteria for choosing the delivery system of highway projects in Iran. His results showed that construction design is often an optimal way that can help project owners make the right decisions about the best project delivery system.

4.3 | Spatiotemporal patterns

The temporal patterns are significant in increasing warehousing, distribution and transportation, inventory control, and accountability over time. In addition, the time impacts are significant in increasing the natural resources and environmental tolerance, the demand for highway construction, and building construction and development restrictions over time. In the field of continental impacts, European countries indicate the most impacts on the logistics providers' impacts (i.e., accountability). In addition, European countries show the most

spatial patterns on the land suitability impacts (i.e., the demand for highway construction).

The limitation that the current study faced is that the original articles did not quantitatively estimate the effect of all aspects of land suitability (i.e., natural resources and environmental tolerance, demand for highway construction, and building construction and development restrictions) on logistics land use decisions. Furthermore, there are no original articles that investigated the mutual impacts of land suitability and land logistics, simultaneously.

5 | CONCLUSION

Land suitability analysis is a process to specify the suitability of a particular area according to its inherent characteristics. Analyzing land suitability can have various impacts on food logistic providers in terms of warehousing, distribution and transportation, inventory control, and accountability. To answer the first question of the research, it is necessary to mention that natural resources and environmental tolerance significantly affect distribution and transportation, inventory control, and accountability. In addition, the demand for highway construction significantly affects warehousing, and distribution and transportation. Thus, the structure by which products are classified, transported, and distributed at the destination, which also improves the procedure of storing the physical stock of products for sale or distribution, was promoted by the demand for highway construction, compared to not demanding it. It is essential to note that building construction and development restrictions have significantly negative impacts on warehousing and inventory control. As a result, the process of holding physical inventory of items for sale or distribution, and the process of registering a company's inventory level with construction and development constraints are decreased compared to no constraints. The second research question is addressed such that food logistic providers, in terms of warehousing, and distribution and transportation, significantly affect the demand for highway construction. The third question of the research has been answered by the spatio-temporal impacts of analyzing land suitability and food logistic providers. The temporal effect of land suitability has the highest positive influence on distribution and transportation, and the temporal effect of logistics land development has the highest positive influence on natural resources and environmental tolerance. In addition, the spatial effect of land suitability has the highest positive impact on logistics providers in terms of inventory control in European countries, and the spatial effect of logistics providers has the highest positive impact on land suitability in terms of the demand for highway construction in European countries.

Ultimately, the results of the current study showed that land suitability can effectively improve global logistics providers' impacts. Policymakers should consider the global issue of land suitability according to its advantages. First, more accountability for officials and decision makers is one of the biggest advantages of land suitability. Second, land suitability provides the basis for distribution and transportation, and inventory control and effectively controls storage costs. Thirdly, warehousing due to land suitability ensures a regular supply of goods in the market. Accordingly, various recommendations can be made to policymakers. Land suitability analysis can be recommended for the planning sphere of officials and decision makers. Land suitability is recommended in the form of adjusting the natural resources and environmental tolerance, the demand for highway construction, and the removal of the building construction and development restrictions for regions currently facing distribution and transportation and inventory control issues. It is recommended that policymakers use land suitability in the form of the demand for highway construction to provide adequate infrastructure to store and regularly supply products. The theoretical and policy implications regarding the best ways for managing transportation inventory, and warehousing costs include coordination of inventory and warehousing based on product demand forecast, implementation of inventory and warehouse management systems, adoption of lean and agile principles, application of technology intelligent and automation, and performance evaluation and optimization. Ultimately, this study suggests that researchers focus on the infrastructure needed to build highways and examine the reduction in building construction and development restrictions. Furthermore, various methods, such as monitoring and controlling land suitability studies, should be considered in order to lessen the burden on the resource environment.

This review of the land suitability assessment literature has important implications not only for Europe but for other world regions as well. Land suitability remains an undervalued factor in land use and land cover change globally. Results suggest that proper land suitability provides enhanced accountability to policymakers, effective storage cost control, and a consistent supply of goods to market. Future research could fruitfully build on these results to examine similarities and differences in land suitability outcomes across world regions.

CONFLICTS OF INTEREST

There is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CONSENT TO PARTICIPATE

All authors contributed equally to the preparation of this manuscript.

CONSENT TO PUBLISH

All authors have read the manuscript and agreed to its publication.

ORCID

Hossein Azadi https://orcid.org/0000-0003-4363-9405

REFERENCES

Akbari, Z., Hesar, A. Y., Siamian, N., Fürst, C., Värnik, R., & Azadi, H. (2024). Feasibility of using vertical farming in northern Iran: A multiple necessity. *Journal of Environmental Management*, *354*, 120232.

Amato, F., Guignard, F., Robert, S., & Kanevski, M. (2020). A novel framework for spatio-temporal prediction of environmental data using deep learning. *Scientific Reports*, *10*(1), 22243.

Ayhan, Ç. K., Taşlı, T. C., Özkök, F., & Tatlı, H. (2020). Land use suitability analysis of rural tourism activities: Yenice, Turkey. *Tourism Management*, *76*, 103949.

Azadi, H., Robinson, G., Barati, A. A., Goli, I., Moghaddam, S. M., Siamian, N., Värnik, R., Tan, R., & Janečková, K. (2023). Smart land governance: Towards a conceptual framework. *Land*, *12*(3), 600.

Bao, H., Wang, C., Han, L., Wu, S., Lou, L., Xu, B., & Liu, Y. (2020). Resources and environmental pressure, carrying capacity, and governance: A case study of Yangtze River Economic Belt. *Sustainability*, *12*(4), 1576.

Casino, F., Kanakaris, V., Dasaklis, T. K., Moschuris, S., Stachtiaris, S., Pagoni, M., & Rachaniotis, N. P. (2021). Blockchain-based food supply chain traceability: A case study in the dairy sector. *International Journal of Production Research*, *59*(19), 5758–5770.

Chen, Z.-S., Zhang, X., Govindan, K., Wang, X.-J., & Chin, K.-S. (2020). Third-party reverse logistics provider selection: A computational semantic analysis-based multi-perspective multi-attribute decision-making approach. *Expert Systems with Applications*, *166*, 114051.

Cichosz, M., Wallenburg, C. M., & Knemeyer, A. M. (2020). Digital transformation at logistics service providers: Barriers, success factors and leading practices. *The International Journal of Logistics Management*, *31*(2), 209–238.

Dang, T. T., Nguyen, N. A. T., Nguyen, V. T. T., & Dang, L. T. H. (2022). A two-stage multi-criteria supplier selection model for sustainable automotive supply chain under uncertainty. *Axioms*, *11*(5), 228.

Davis, K. F., Downs, S., & Gephart, J. A. (2021). Towards food supply chain resilience to environmental shocks. *Nature Food*, *2*, 54–65.

Dong, S., Esmalian, A., Farahmand, H., & Mostafavi, A. (2020). An integrated physical-social analysis of disrupted access to critical facilities and community service-loss tolerance in urban flooding. *Computers, Environment and Urban Systems*, *80*, 101443.

Dwitasari, R., Perdana, Y. R., Gusleni, Y., & Meyrawati, Z. (2020). The impact of the trans-Sumatran highway development on logistic cost efficiency. *IPTEK Journal of Proceedings Series*, *5*, 13–15.

Gaudenzi, B., Zsidisin, G. A., & Pellegrino, R. (2020). Measuring the financial effects of mitigating commodity price volatility in supply chains. *Supply Chain Management*, *26*(1), 17–31.

Guida, M., Moretto, A. M., & Caniato, F. F. A. (2021). How to select a supply chain finance solution? *Journal of Purchasing and Supply Management*, *27*(4), 100701.

Gul, Z., Tang, Z. H., Arif, M., & Ye, Z. (2022). An insight into abiotic stress and influx tolerance mechanisms in plants to cope in saline environments. *Biology*, *11*(4), 597.

Hodgson, C. (2018). The effect of transport infrastructure on the location of economic activity: Railroads and post offices in the American west. *Journal of Urban Economics*, *104*, 59–76.

Jagtap, S., Bader, F., Garcia-Garcia, G., Trollman, H., Fadiji, T., & Salonitis, K. (2021). Food logistics 4.0: Opportunities and challenges. *Logistics*, *5*, 2.

Kumar, A., Mangla, S. K., Kumar, P., & Karamperidis, S. (2020). Challenges in perishable food supply chains for sustainability management: A developing economy perspective. *Business Strategy and the Environment*, *29*(5), 1809–1831.

Kumar, S., Raut, R. D., Narwane, V. S., Narkhede, B. E., & Muduli, K. (2022). Implementation barriers of smart technology in Indian sustainable warehouse by using a Delphi-ISM-ANP approach. *International Journal of Productivity and Performance Management*, *71*(3), 696–721.

Lagorio, A., Zenezini, G., Mangano, G., & Pinto, R. (2020). A systematic literature review of innovative technologies adopted in logistics management. *International Journal of Logistics Research and Applications*, *25*, 1043–1066.

Luo, W., Ren, Y., Shen, L., Zhu, M., Jiang, Y., Meng, C., & Zhang, P. (2020). An evolution perspective on the urban land carrying capacity in the urbanization era of China. *Science of the Total Environment*, *744*, 140827.

Mahdikhani, M., & Yazdani, B. (2020). Transformational leadership and service quality in e-commerce businesses. *International Journal of Law and Management*, *62*(1), 23–46.

Mahoney, C. W., Tkach, B. K., & Rethmeyer, C. J. (2024). Leveraging national security: Private equity and bankruptcy in the United States defense industry. *Business and Politics*, 1–20.

Mengist, W., Soromessa, T., & Legese, G. (2020). Method for conducting systematic literature review and meta-analysis for environmental science research. *Methods X*, *7*, 100777.

Miani, A. M., Dehkordi, M. K., Siamian, N., Lassois, L., Tan, R., & Azadi, H. (2023). Toward sustainable rural livelihoods approach: Application of grounded theory in Ghazni province, Afghanistan. *Applied Geography*, *154*, 102915.

Min, B., Lee, G., & Kim, S. (2021). Effects of land-use characteristics on transport mode choices by purpose of travel in Seoul, South Korea, based on spatial regression analysis. *Sustainability*, *13*(4), 1767.

Minozzi, S., Dwan, K., Borrelli, F., & Filippini, G. (2022). Reliability of the revised Cochrane risk-of-bias tool for randomised trials (RoB2) improved with the use of implementation instruction. *Journal of Clinical Epidemiology*, *141*, 99–105. https://doi.org/10.1016/j.jclinepi.2021.09.021

Mohammed, S., Alsafadi, K., Ali, H., Mousavi, S. M. N., Kiwan, S., Hennawi, S., & Thai, V. N. (2020). Assessment of land suitability potentials for winter wheat cultivation by using a multi criteria decision support- geographic information system (MCDS-GIS) approach in Al-Yarmouk Basin (S Syria). *Geocarto International*, *37*, 1645–1663.

Mondejar, M. E., Avtar, R., Diaz, H. L. B., Dubey, R. K., Esteban, J., Gómez-Morales, A., & Garcia-Segura, S. (2021). Digitalization to achieve sustainable development goals: Steps towards a smart green planet. *Science of the Total Environment*, *794*, 148539.

Nagarajan, S. M., Deverajan, G. G., Chatterjee, P., Alnumay, W., & Muthukumaran, V. (2022). Integration of IoT based routing process for food supply chain management in sustainable smart cities. *Sustainable Cities and Society*, *76*, 103448.

Noorzai, E. (2020). Performance analysis of alternative contracting methods for highway construction projects: Case study for Iran. *Journal of Infrastructure Systems*, *26*(2), 04020003. https://doi.org/10.1061/(asce)is.1943-555x.0000528

O'Leary, B. C., Kvist, K., Bayliss, H. R., Derroire, G., Healey, J. R., Hughes, K., & Pullin, A. S. (2016). The reliability of evidence review methodology in environmental science and conservation. *Environmental Science & Policy*, *64*, 75–82.

Paciarotti, C., & Torregiani, F. (2021). The logistics of the short food supply chain: A literature review. *Sustainable Production and Consumption*, *26*, 428–442.

Parums, D. V. (2021). Editorial: Review articles, systematic reviews, meta-analysis, and the updated preferred Re-porting items for systematic reviews and meta-analyses (PRISMA) 2020 guidelines. *Medical Science Monitor.*, *27*, e934475.

Petersen-Rockney, M., Baur, P., Guzman, A., Bender, S. F., Calo, A., Castillo, F., De Master, K., Dumont, A., Esquivel, K., Kremen, C., LaChance, J., Mooshammer, M., Ory, J., Price, M. J., Socolar, Y., Stanley, P., Iles, A., & Bowles, T. (2021). Narrow and brittle or broad and nimble? Comparing adaptive capacity in simplifying and diversifying farming systems. *Frontiers in Sustainable Food Systems*, *5*, 564900.

Raad, N. G., & Rajendran, S. (2024). A hybrid robust SBM-DEA, multiple regression, and MCDM-GIS model for airport site selection: Case study of Sistan and Baluchestan Province, Iran. *Transportation Engineering*, *16*, 100235.

Rahardjo, B., Wang, F. K., Lo, S. C., & Chou, J. H. (2023). A hybrid multi-criteria decision-making model combining DANP with VIKOR for

sustainable supplier selection in electronics industry. *Sustainability*, *15*(5), 4588.

Restuputri, D. P., Masudin, I., & Sari, C. P. (2020). Customers perception on logistics service quality using Kansei engineering: Empirical evidence from indonesian logistics providers. *Cogent Business & Management*, *7*(1), 1751021.

Ronchi, S., Arcidiacono, A., & Pogliani, L. (2020). Integrating green infrastructure into spatial planning regulations to improve the performance of urban ecosystems. Insights from an Italian case study. *Sustainable Cities and Society*, *53*, 101907.

Shcherbakov, V., & Silkina, G. (2021). Supply chain management open innovation: Virtual integration in the network logistics system. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 54. https://doi.org/10.3390/joitmc7010054

Son, T. H., Weedon, Z., Yigitcanlar, T., Sanchez, T., Corchado, J. M., & Mehmood, R. (2023). Algorithmic urban planning for smart and sustainable development: Systematic review of the literature. *Sustainable Cities and Society*, *94*, 104562.

Song, H., Li, M., & Yu, K. (2021). Big data analytics in digital platforms: How do financial service providers customise supply chain finance? *International Journal of Operations & Production Management*, *41*(4), 410–435.

Tsang, Y. P., Wu, C. H., Lam, H. Y., Choy, K. L., & Ho, G. T. (2021). Integrating internet of things and multi-temperature delivery planning for perishable food E-commerce logistics: A model and application. *International Journal of Production Research*, *59*(5), 1534–1556.

Ustaoglu, E., & Aydınoglu, A. C. (2020). Suitability evaluation of urban construction land in Pendik district of Istanbul, Turkey. *Land Use Policy*, *99*, 104783.

Xin, P., Wilson, A., Shen, C., Ge, Z., Moffett, K. B., Santos, I. R., & Barry, D. A. (2022). Surface water and groundwater interactions in salt marshes and their impact on plant ecology and coastal biogeochemistry. *Reviews of Geophysics*, *60*(1), e2021RG000740.

Yuan, Q. (2019). Planning matters. *Journal of the American Planning Association.*, *85*, 1–19.

Zeng, X., Yu, Y., Yang, S., Lv, Y., & Sarker, M. N. I. (2022). Urban resilience for urban sustainability: Concepts, dimensions, and perspectives. *Sustainability*, *14*, 2481.

How to cite this article: Pour, M., Dogot, T., Lebailly, P., Lopez-Carr, D., & Azadi, H. (2024). Land suitability analysis for food logistic providers: A meta-analysis. *Land Degradation & Development*, 1–12. https://doi.org/10.1002/ldr.5198