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Impacts of the COVID-19 Pandemic and the Russia–Ukraine Conflict on Land Use across the World

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Abstract: The impacts of the COVID-19 pandemic and the Russia–Ukraine crisis on the world economy are real. However, these implications do not appear to be symmetric across countries and different economic sectors. Indeed, the consequences of these two shocks are more severe for some countries, regions and economic activities than for others. Considering the importance of the agricultural sector for global food security, it is important to understand the impacts of the pandemic and the conflict on the different dimensions of agriculture, namely land use. Given the scarcity of data for the last few years available from the various statistical databases, this research mainly considers the insights highlighted in the literature on the implications, in agricultural dimensions, of the most recent shocks. The study here presented shows that the Russia–Ukraine crisis has had more impact on land use changes than the pandemic, namely promoting adjustments in the decisions of farmers and policymakers to deal with constraints in agri-food chains. Nonetheless, the impacts of the conflict on land use were not totally explored.

1. Introduction

Land use is interrelated with ecosystem planning [1], sustainability dynamics [2], carbon balance [3] and sink [4], water management [5], habitat dynamics [6] and policy design [7]. Indeed, land use changes, namely those associated with urbanization, have had impacts on the ecological dimensions [8]. Urban land use management requires adjusted approaches to address the complexity of the variables involved [9]. Changes in land use over the last few decades has also had, jointly with other factors, environmental effects with consequences for global warming [10]. Specifically, these changes have impacted soil fertility [11], soil carbon management [12], wildlife populations [13], fish populations [14] and biodiversity [15].

The end of the Soviet Union brought, in the respective geographies, changes in the structure of land use as a consequence of transitions for market economies [16], affecting the agricultural dynamics [17], for example. Cropland abandonment was a reality after the Soviet collapse [18], with implications for rural development. The agricultural sector plays a determinant role for rural populations [19]. In addition to the framework here described, it is worth highlighting the importance of Russia and Ukraine for the grain markets [20], and their vulnerabilities to socioeconomic and environmental factors [21].

The COVID-19 pandemic and Russia–Ukraine conflict have had impacts on several sectors worldwide [22], and the implications on land use are no exception. The ways in which different countries deal with these shocks are different [23], and depend on their internal strategies. The COVID-19 pandemic, for instance, influenced military–political interactions in some contexts [24], as well as the conditions of health assistance [25], medical research [26] and business models [27]. The Russia–Ukraine crisis brought additional challenges to these contexts worldwide [28], specifically in the several dimensions related to human health [29]. The negative effects of this conflict are expected to be serious for healthcare [30], especially among the Ukrainian population [31].

Global warming, COVID-19 and the Russia–Ukraine conflict have become the main concerns of various international stakeholders related to food security [32], due to the impacts on the food supply chains [33] and the uncertainty generated [34]. Some of these contexts, such as those associated with the pandemic, are involved in discussions that are not always unanimous [35].

The scenario described above highlights the relevance of the current contexts associated with climate change, the pandemic and the Russia–Ukraine crisis on the various dimensions of sustainability and across different economic sectors, including land use and agricultural performance. In any case, the most serious challenge seems to be dealing with the constraints on the grain production of leading producers and their respective supply chains. These barriers, reinforced by the conflict among Russia and Ukraine, bring additional concerns for the national and international organizations related to food security. New strategies must be designed to deal with this threat. The land use and the agricultural organization worldwide require reassessments. From this perspective, this research aims to analyze the COVID-19 pandemic and Russia–Ukraine impacts on land use worldwide through a literature survey complemented with statistical assessment and bibliometric analysis.

2. Materials and Methods

To achieve the objectives proposed above, statistical information from Eurostat [36] was considered using monthly, disaggregated data, and a literature survey was carried out based on bibliometric analysis. For the literature review and bibliometric analysis, 316 documents were taken into account; these were obtained from the Scopus database [37], for the topics "COVID-19" and "land use" from a search performed on 1 September 2022. The literature review and bibliometric analysis were focused on the COVID-19 topic, because of the limited number of studies found on the topics Russia–Ukraine conflict/war/crisis and land use.

For the bibliometric analysis, procedures proposed by VOSviewer software [38–40] were followed. The literature review based on bibliometric assessments was conducted in a systematic way, following the research of Moher et al. [41] and Martinho [42–44].

The monthly statistical information was assessed for unknown structural breaks caused by the COVID-19 pandemic and Russia–Ukraine frameworks through the Quandt likelihood ratio (QLR) test; this is a changed version of the Chow test used to find break dates [45]. A structural break in a time series is verified when an abrupt change in a point of the series occurs. These changes may be a consequence of disturbances in the parameters of the framework that originates the data [46]. Testing for structural breaks is a crucial step for studies involving statistical information, particularly for recent time periods after the shocks of the COVID-19 pandemic [47] and the Russia–Ukraine conflict. On the other hand, the findings of these assessments may provide relevant information for several stakeholders, including policy and decision makers, specifically to inform about changes that deserve special attention, and more vulnerable parameters that need specific interventions by national and international organizations. In addition, failure to consider these changes in empirical research may lead to biased results and conclusions [48].

The structural breaks, assessed in the present study, are promoted by specific factors within the framework of the worldwide impacts of the pandemic and conflict. These specific determinants are interesting topics for future research. In this research, the aim was to identify the months since the beginning of the pandemic associated with structural breaks. The variables considered to test structural breaks were selected based on their relationships with land use, taking into account the multidimensional interlinkages of land management. Other variables could be considered, however, finding information on the recent time period is not an easy task.

3. Testing for Structural Breaks

We carried out the QLR test [49] to search for structural breaks (considering a critical value of 3.66 at 5%) in variables related to land use with monthly disaggregated data, following Torres-Reyna [45] and Stata software [46,50,51] procedures. The selection of the variables was dependent on the availability of statistical information for the most recent months worldwide. The intention was to capture the effects of the COVID-19 pandemic and the Russia–Ukraine crisis. In this way, a period from January 2020 (2020m1) until June 2022 (2022m6) was considered. The variables analyzed were the following for the current 27 European Union countries [36]: harmonized indices of consumer prices (HICP, monthly rate of change for all items); actual rentals for housing (ARH, index, 2015 = 100); construction confidence indicator (CCI, seasonally adjusted data, not calendar-adjusted data); and harmonized unemployment rates (HUR, percentage of the population in the labor force, seasonally adjusted data, not calendar-adjusted data, and total unemployment according to the International Labour Organization definition).

The beginning of the conflict between Russia and Ukraine seems to have had more effects, in terms of structural breaks, on the harmonized indices of consumer prices, construction confidence indicator and harmonized unemployment rates (Figures 1–3, respectively), than the pandemic. The structural breaks regarding rentals in the housing market occurred earlier with COVID-19, towards the end of 2020 (Figure 4). These findings may provide support for future studies that intend to consider monthly statistical information, since the beginning of the COVID-19 pandemic, in the European Union context. Overall, the impacts of the pandemic were not, in some circumstances, as severe for some indicators as the Russia–Ukraine crisis.
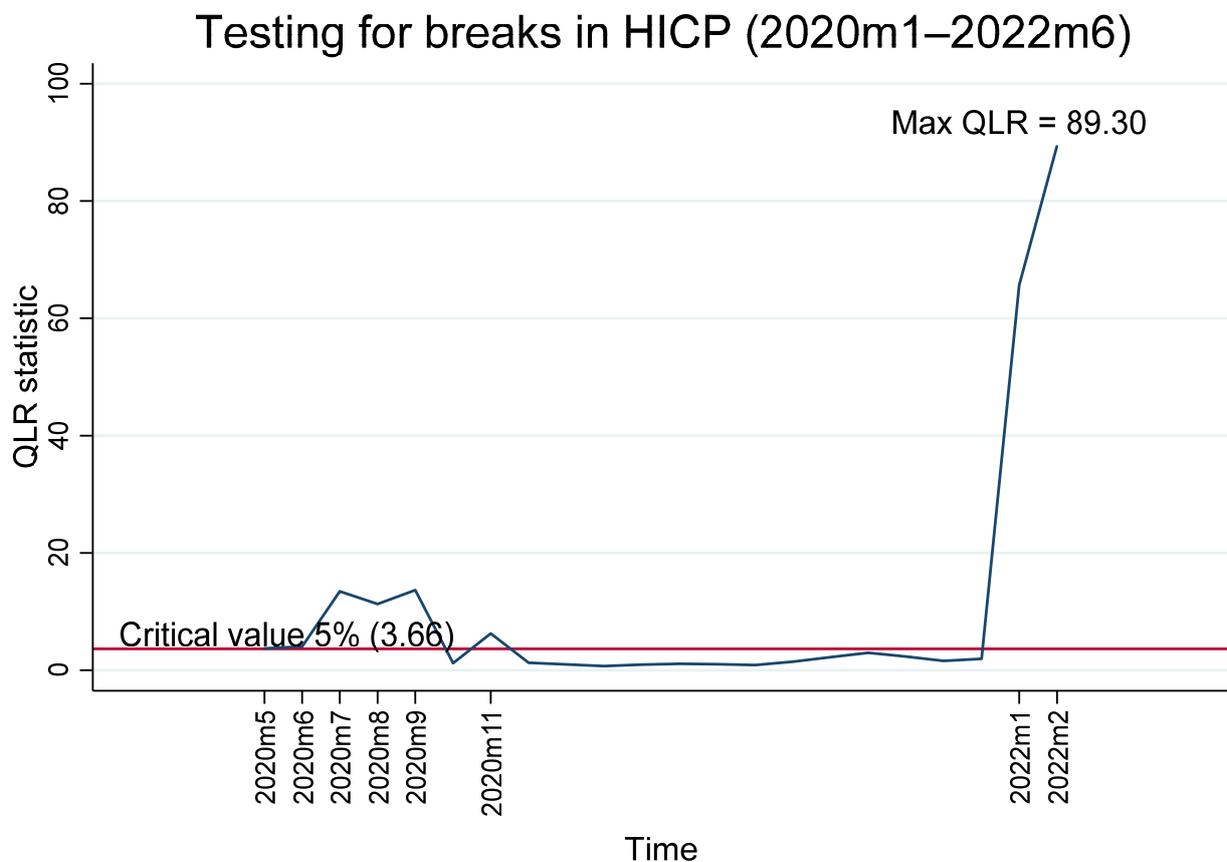
Figure 1. QLR test for the harmonized indices of consumer prices (HICP) over the period 2020m1–2022m6.
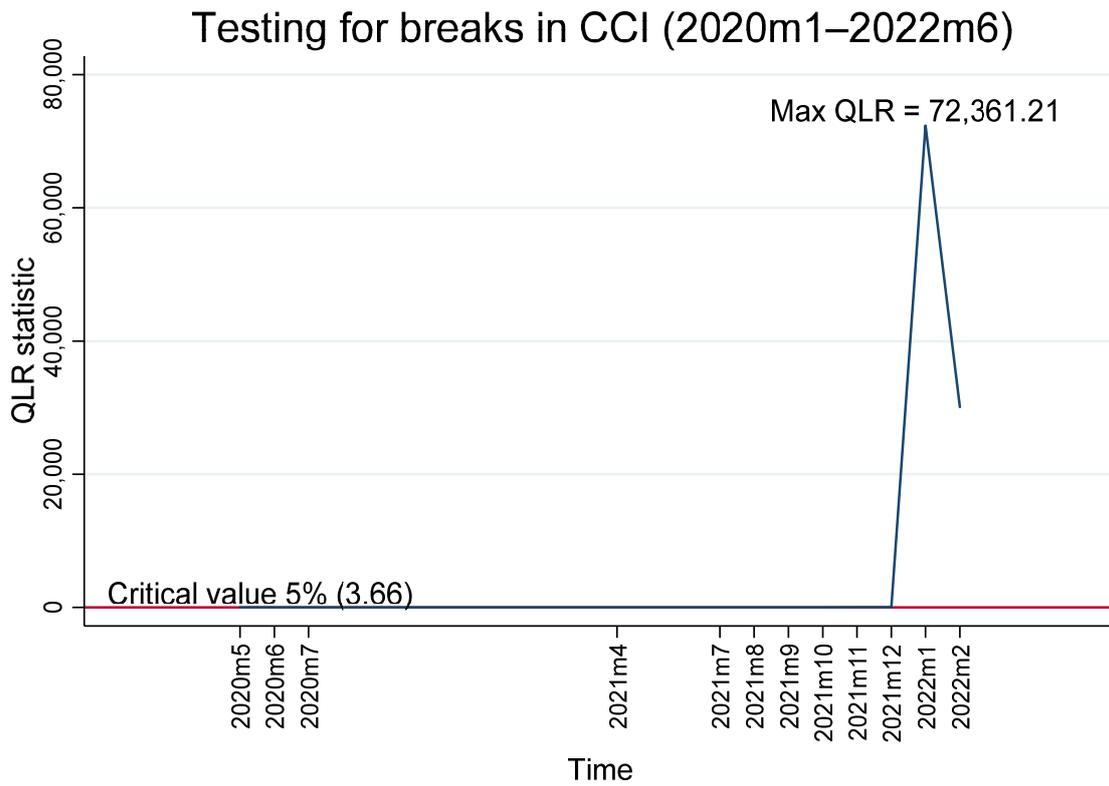
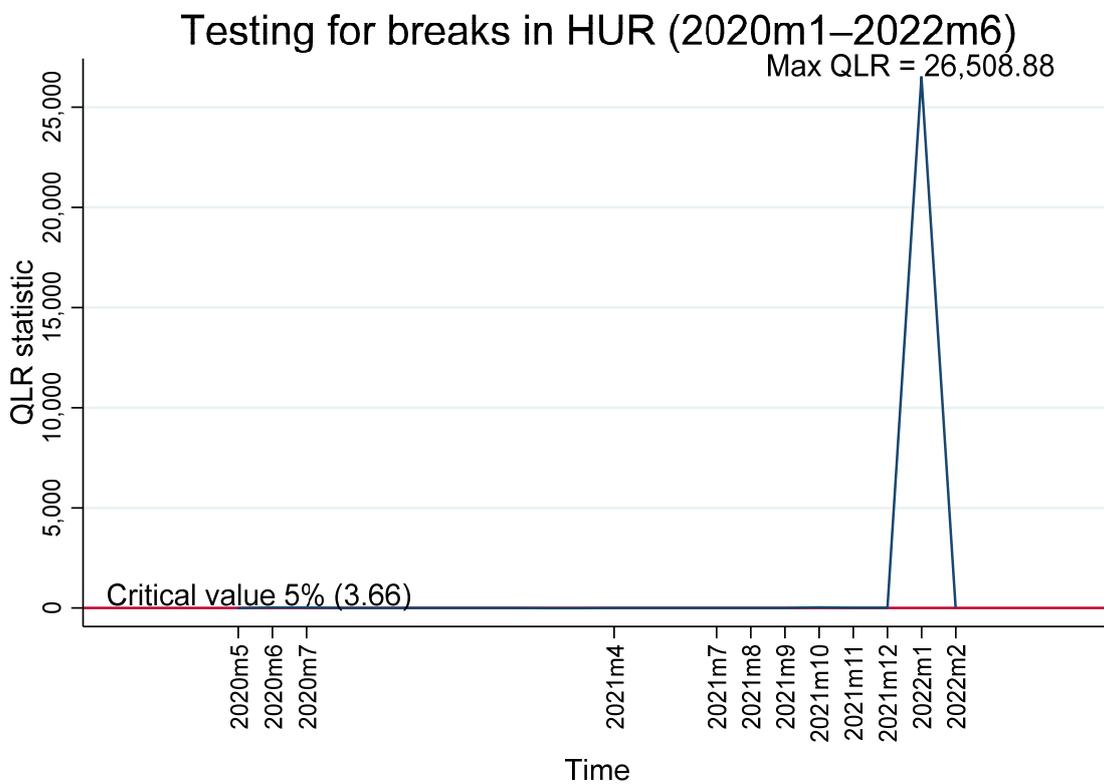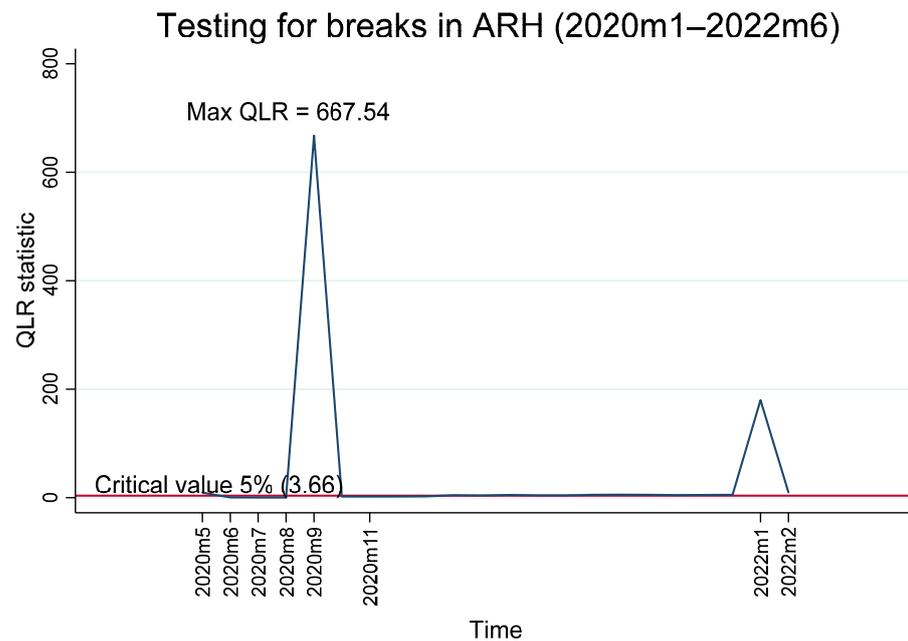**Figure 2.** QLR test for the construction confidence indicator (CCI) over the period 2020m1–2022m6.

Figure 3. QLR test for the harmonized unemployment rates (HUR) over the period 2020m1–2022m6.

Testing for breaks in ARH (2020m1–2022m6)

Max QLR = 667.54

Critical value 5% (3.66)

Figure 4. QLR test for the actual rentals for housing (ARH) over the period 2020m1–2022m6.

4. Bibliometric Assessment

Figure 5 and Table 1 show the metrics obtained with text data, considering terms as items. This information was found through binary counting, which means that the number of occurrences represents the number of documents in which the term appears. The information in Figure 6 and Table 2 was also obtained through text data and considers terms as items, but with full counting (the occurrences symbolize the total number of occurrences of a term in all documents). The dimension of the circles and respective labels in Figures 5 and 6 are proportional to the number of occurrences. In these figures, each color is associated with a cluster, and the proximity between the terms is related to the relatedness [39].

Table 1. Top 20 terms with the highest occurrences found in text data for the topics "COVID-19" and "land use", applying binary counting with 1 as the minimum number of occurrence of a term.

Terms	Occurrences	Average Publication Year	Average Citations	Average Normalized Citations
matter	11	2021	3	2
feature	10	2021	9	1
century	9	2022	1	0
sensing	8	2021	2	0
vehicle	8	2021	3	0
wave	7	2021	8	1
pollutant	6	2021	2	2
cluster	5	2021	4	1
disease risk	5	2021	10	1
insecurity	5	2021	4	1
island	5	2021	3	0
mix	5	2022	5	1
satellite	5	2021	4	1
temperature	5	2021	4	1
test	5	2021	14	2
accuracy	4	2022	4	1
actor	4	2022	2	0
agency	4	2021	16	1
body	4	2021	9	1
conference	4	2022	0	0

Figure 5. Network visualization map constructed from text data, considering terms as items, for the topics "COVID-19" and "land use", applying binary counting with 1 as the minimum number of occurrence of a term.

Figure 6. Network visualization map constructed from text data, considering terms as items, for the topics "COVID-19" and "land use", applying full counting with 1 as the minimum number of occurrence of a term.

Table 2. Top 20 terms with the highest occurrences found through text data for the topics "COVID-19" and "land use", applying full counting with 1 as the minimum number of occurrence of a term.

Terms	Occurrences	Average Publication Year	Average Citations	Average Normalized Citations
interest	26	2022	1	0
author	23	2022	1	0
declaration	19	2022	2	0
zone	17	2021	1	1
bioaerosol	15	2021	8	1
gtc yr	15	2020	611	15
proceeding	14	2021	0	0
adoption	13	2021	3	1
financial interest	12	2022	0	0
matter	12	2021	3	2
Nepal	12	2021	3	0
start up	12	2022	0	0
vehicle	12	2021	4	0
Africa	11	2021	3	1
awareness	11	2021	5	1
content	11	2020	9	0
personal relationship	11	2022	0	0
S. baicalensis	11	2020	10	0
soc	11	2022	0	0
temple	11	2022	0	0

In Tables 1 and 2, the average publication year is the average publication year of the documents where the terms appear, the average citations are the average number of citations obtained by the documents where the terms appear, and the average normalized citations were used to correct for the fact that older documents may have more citations than more recent papers [39].

The metrics in Figure 5 and Table 1 demonstrate that terms such as sensing, vehicle, wave, pollutant, disease risk, insecurity, island, temperature and test are among the items with the highest number of occurrences for binary counting (number of documents where the term appears at least once). Some of these terms also appear when considering the top 20 items for full counting (Figure 6 and Table 2), jointly with other terms; for example, Africa and personal relationship. These top 20 terms identified for binary and full counting reveal the concerns of the scientific community in some specific contexts, such as Africa, and with the several dimensions associated with the pandemic, namely those related with impacts on human life.

Table 3 presents the bibliographic data and bibliographic coupling links used in this study. To identify the top 20 documents, the metric total link strength (total strength of the links associated with each document) was considered. These documents will be considered in the next section for a systematic literature review. The consideration of using bibliometric analysis to support a systematic literature survey has been previously considered, for example, by Martinho [42–44].

Table 3. Top 20 documents with the greatest total link strength found using bibliographic data and bibliographic coupling links for the topics "COVID-19" and "land use", applying full counting with 0 as the minimum number of citations of a document.

Documents	URL	Total Link Strength	Citations	Normalized Citations	Publication Year
ferreira m.n. (2021) [52]	https://doi.org/10.2305/iucn.ch.2021.parks-27-simnf.en	110	6	1	2021
lawler o.k. (2021) [53]	https://doi.org/10.1016/s2542-5196(21)00258-8	104	9	1	2021
wu t. (2021) [54]	https://doi.org/10.1007/s13280-020-01497-4	94	27	4	2021
shaer a. (2021d) [55]	https://doi.org/10.1080/17549175.2021.1995028	87	1	0	2021
talukder b. (2022) [56]	https://doi.org/10.1016/j.onehlt.2022.100416	86	0	0	2022

Table 3. *Cont.*

Documents	URL	Total Link Strength	Citations	Normalized Citations	Publication Year
rivera-ferre m.g. (2021) [57]	https://doi.org/10.1016/j.agsy.2021.103134	79	16	2	2021
roberts m. (2021) [58]	https://doi.org/10.1016/j.epidem.2021.100523	74	1	0	2021
shaer a. (2021a) [59]	https://doi.org/10.1016/j.jth.2021.101244	74	4	1	2021
shaer a. (2021c) [60]	https://doi.org/10.1016/j.cities.2021.103255	74	12	2	2021
plowright r.k. (2021) [61]	https://doi.org/10.1016/s2542-5196(21)00031-0	73	49	7	2021
white r.j. (2020) [62]	https://doi.org/10.1111/mam.12201	69	54	1	2020
albers h.j. (2020) [63]	https://doi.org/10.1007/s10640-020-00449-6	65	6	0	2020
mouratidis k. (2021) [64]	https://doi.org/10.1016/j.landusepol.2021.105772	60	11	2	2021
wang j. (2021) [65]	https://doi.org/10.3390/ijerph18147561	60	6	1	2021
reaser j.k. (2021) [66]	https://doi.org/10.1111/rec.13357	56	13	2	2021
shaer a. (2021b) [67]	https://doi.org/10.1016/j.tranpol.2021.08.016	54	2	0	2021
reaser j.k. (2022) [68]	https://doi.org/10.1111/conl.12869	53	2	3	2022
barbier e.b. (2021) [69]	https://doi.org/10.1016/j.jeem.2021.102451	53	4	1	2021
budiman i. (2021) [70]	https://doi.org/10.33396/1728-0869-2021-4-15-24	53	2	0	2021
wali b. (2021) [71]	https://doi.org/10.1016/j.healthplace.2021.102659	49	9	1	2021

5. Literature Review Based on Bibliometric Analysis

The relationships between the land use dynamics and the COVID-19 pandemic are multidimensional, as is highlighted in Table 4. In fact, the land use changes promoted by the need for urban expansion, climate change and farming intensification to deal with the increased demand for food have impacts on the host habitats of pathogens of infectious diseases. The consequence of this is the transmission of these diseases to the human population and their spread worldwide through transportation systems. On the other hand, these consequences have impacts on land use through feedback loops that are self-reinforced.

Table 4. Contributions from the top 20 documents with the highest total link strength.

Documents	Objectives	Insights about COVID-19 and Land Use
ferreira m.n. (2021) [52]	Overview of zoonotic diseases	Land use change influence the emergence of new zoonotic diseases
lawler o.k. (2021) [53]	Explore the feedback loops between the zoonotic diseases causes and consequences	Climate change and land use change are among the drivers of zoonotic diseases
wu t. (2021) [54]	Review how ecosystem change, meat consumption, urban expansion and connectivity among regions and countries are interrelated with the emerging infectious diseases	Meat consumption and land use change promote the pathogen transmissions from animals to humans
shaer a. (2021) [55]	Assess the impacts of the COVID-19 pandemic on active mobility of men and women in Iran	Active mobility during the pandemic was affected by the built environment
talukder b. (2022) [56]	Understand the factors that influenced the origin of COVID-19	Land use and land cover changes are among the planetary health drivers of the COVID-19 pandemic
rivera-ferre m.g. (2021) [57]	Analyze the feedback loops among the pandemics and the food systems	Food systems have impacts on land use changes and consequently on the pandemic
roberts m. (2021) [58]	Review the dimensions of wildlife–human interfaces and the appearance of infectious diseases	The emerging zoonotic diseases are promoted by anthropogenic factors, including the land use changes
shaer a. (2021) [59]	Analyze the changes in the factors that influence the active mobility of older adults in Iran during the pandemic	Land use characteristics are among the main factors that influence the active mobility during the crises
shaer a. (2021) [60]	Evaluate the implications of the pandemic on the active mobility in Iran	The conditions of the built environment are the main drivers of active travel

Table 4. *Cont.*

Documents	Objectives	Insights about COVID-19 and Land Use
plowright r.k. (2021) [61]	Investigate the relationships between land use changes and emerging zoonotic diseases from a landscape perspective	Multidisciplinary cooperation is needed to protect the landscape conditions that mitigate the risks of infectious transmissions from animals to humans
white r.j. (2020) [62]	Review land use changes and pathogen spillover	Forest degradation, urban expansion and farming intensification impacts the zoonotic diseases emergence and spread
albers h.j. (2020) [63]	Highlight potentialities to consider diseases spread dimensions in human behavior assessments	Multidisciplinary approaches are needed to address the human-environment relationships
mouratidis k. (2021) [64]	Evaluate the impacts of the pandemic on the quality of life	Land use was changed during the COVID-19 pandemic
wang j. (2021) [65]	Review built environment and COVID-19 risks	Built environment is interrelated with the transmission risks
reaser j.k. (2021) [66]	Assess ecological strategies to mitigate zoonotic diseases	Ecological restoration strategies may reduce the risks of pathogen spillover
shaer a. (2021) [67]	Analyze the mobility of older adults during the COVID-19 pandemic	The transportation framework impacted the mobility under pandemic conditions
reaser j.k. (2022) [68]	Investigate the landscape immunity framework	The environment is modified by changes in the land use and this impacts the relations among the pathogens and their hosts
barbier e.b. (2021) [69]	Assess the risks of diseases transmissions	Wildlife Habitat conservation is crucial to reduce the risks of infectious pathogen spread
budiman i. (2021) [70]	Review human–nature relationships	COVID-19 pandemic impacted the land use, namely the forest management
wali b. (2021) [71]	Investigate the relationships between pandemic consequences and built environment	Built environment has implications on the COVID-19 pandemic severity

These frameworks require adjusted policies designed and implemented by national institutions and international organizations, primarily to preserve and restore ecological conditions and landscape immunity. Land use management in cities and the respective built environment also impacts the conditions experienced by populations during the pandemic outbreak, specifically in terms of mobility; this deserves special attention from urban policy and decision makers.
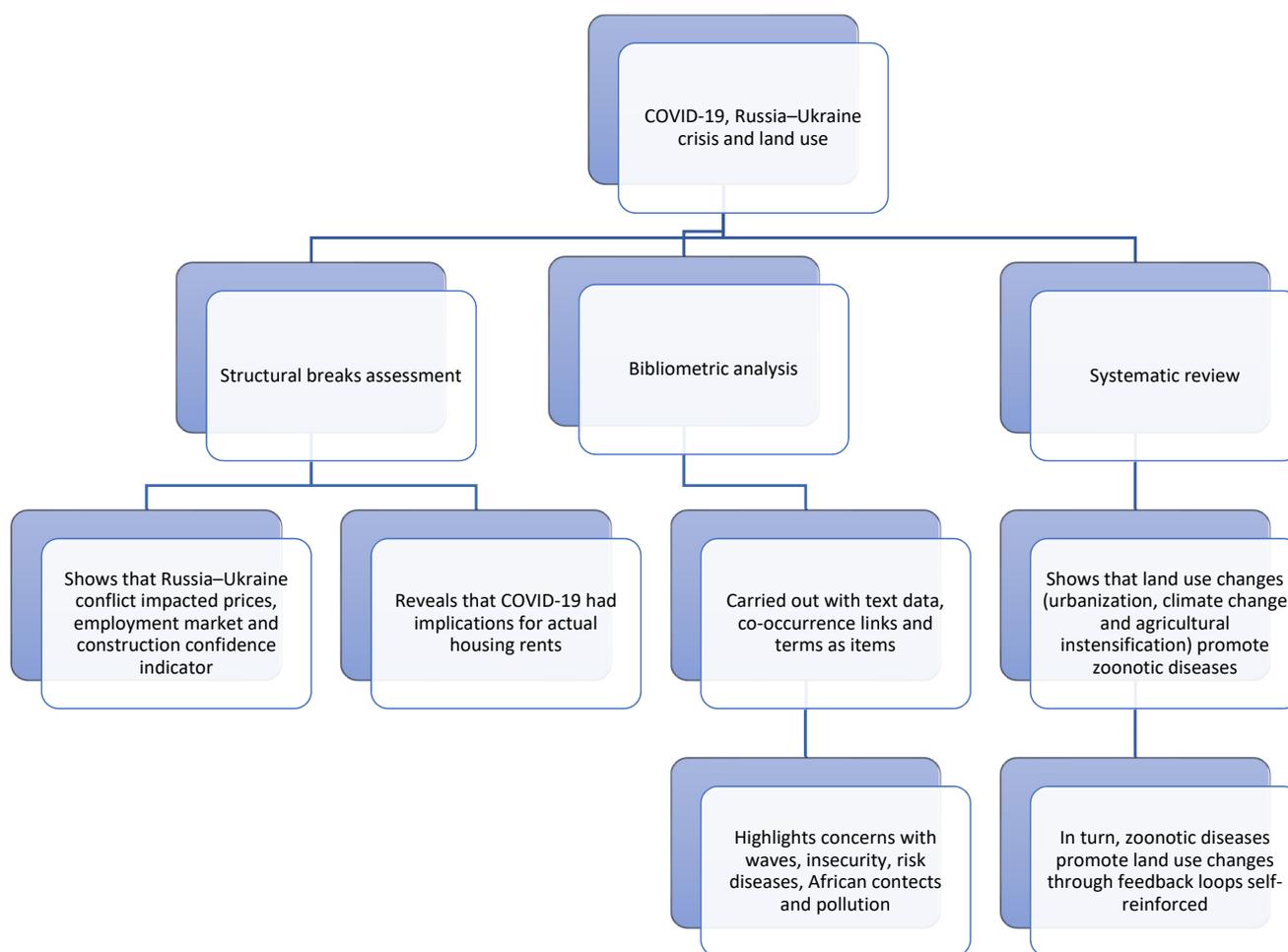
6. The Main Results

The main objective of this research was to analyze the relationships between land use, the COVID-19 pandemic and the Russia–Ukraine crisis. To achieve this aim, a systematic review based on bibliometric analysis was carried out. For the bibliometric analysis, 316 documents were considered from the Scopus database in a search performed on 1 September 2022 for the topics "land use" and "COVID-19". This study focused on these topics, because for the topics "land use" and Russia–Ukraine crisis/conflict/war the number of documents found was negligible. In addition, with statistical information from Eurostat, the structural breaks of some variables were tested. The variables selected to assess the structural breaks were those with available data for the recent months and that were in some way related to land use.

The structural breaks assessment shows that the Russia–Ukraine conflict had more impact on the prices, employment market and construction confidence indicator than the COVID-19 pandemic. The consequences of the pandemic were greater on the actual rentals for housing, however, not at the beginning. The bibliometric analysis carried out with text data (considering terms as items) and bibliographic data (bibliographic coupling as links and documents as links) highlights the relevance of the following terms for the scientific community: matter, feature, century, sensing, vehicle, wave, pollutant, disease risk, insecurity, temperature, test, zone, bioaerosol, Africa and awareness. The African

context is, in fact, a concern for researchers and policymakers in the context of pandemic spread mitigation.

The literature review based on bibliometric analysis reveals the importance of land use changes for the emergence of the zoonotic diseases and spread. Indeed, deforestation, urban expansion and pressures on the food systems are among the main drivers of habitat loss for pathogens of infectious diseases, and their consequent transmission to the human population. This is particularly worrying as these frameworks may become self-reinforced processes through feedback loops, where the land use changes promote zoonotic disease emergence and the respective outbreaks may alter the land management.

The main findings are summarized in Figure 7.

Figure 7. Main results of this research obtained via structural breaks analysis, bibliometric assessment and systematic literature review.

7. Discussion of the Main Findings

The impacts of the unexpected shocks on variables associated with several dimensions of human life and their interrelationships are, in general, worrying, and require specific and adjusted assessments [72]. This means that it is important to be aware of the possibilities of structural breaks in the statistical information considered for empirical studies, and to adequately deal with this possibility [73]. The COVID-19 pandemic had effects on the evolution of several indicators [74], as did the Russia–Ukraine conflict. Nonetheless, the existence of structural breaks during the COVID-19 pandemic was not verified in all variables [75,76], showing that there are sectors, activities and regions that are more vulnerable to these unexpected events. In any case, the presence of structural breaks requires adequate approaches that improve the robustness of the findings obtained [77].

Testing for structural breaks is important for several socioeconomic and environmental domains, including sustainability assessments [78], use of natural resources [79], social indicators [80], industry dynamics [81] and characteristics of agricultural markets [82]. The results obtained in this study are in agreement with those found in the scientific literature and highlighted above in this section. In fact, COVID-19 and the Russia–Ukraine conflict have had impacts on several variables, and this must be taken into account in assessments with statistical information from periods since the beginning of the pandemic.

The application of bibliometric analysis to carry out a systematic literature review has already been explored in the literature [42–44], but has not been fully explored in the topics covered here ("land use" and "COVID-19"), highlighting the novelty of this research. Indeed, bibliometric analysis allows one to find the most relevant items, namely documents, and this is particularly relevant when one intends to perform a literature review on topics where the availability of scientific literature on scientific platforms is numerous. Furthermore, bibliometric assessment also allows one to identify trends and gaps to be explored. The findings obtained with the bibliometric evaluation in this study highlight the concerns about the impacts of the pandemic on the different waves, the respective feelings of insecurity and the implications in other dimensions related, for example, to pollution and environmental changes. In turn, these findings reveal that there are topics that deserve further exploration, such as those associated with the Russia–Ukraine crisis and land use.

8. Conclusions, Practical Implications and Policy Recommendations

The COVID-19 pandemic and the Russia–Ukraine conflict have been external shocks for countries worldwide, with impacts on socioeconomic and environmental indicators. In these contexts, if the pandemic seemed to have serious implications for human life in its several dimensions, the Russia–Ukraine crisis brought unexpected socioeconomic consequences, namely those related to inflation and supply chains. This conflict seems to have different dynamics, with distinct effects from those associated with the pandemic. In fact, for the pandemic, there was a common enemy for all countries, but in the Russia–Ukraine conflict, the world is divided with different "enemies".

In addition, these shocks overshadow older challenges and, in some cases, exacerbate them. Concerns about climate change and land use, for example, were passed for a second plan during the pandemic, and this increased the problems associated with global warming. In practice, land use changes have increased the risks of zoonotic diseases and, on the other hand, pandemics promote changes in land use. International conflicts have negative effects on these processes. Particularly for the Ukraine context, the conflict has had severe impacts on land use management, for example, in the agricultural production. This deserves special attention, as Ukraine produced (Gross Production Value (constant 2014–2016 thousand I$)), in the period 2018–2020, about 2% of the total world's cereals and about 3–4% of the world's wheat [83].

In terms of practical implications, the present research highlights the urgent need to create a culture of ecological and landscape preservation and restoration, specifically to maintain habitats and biodiversity. On the other hand, statistical assessments conducted since the beginning of the pandemic should consider the structural breaks identified here. For policy recommendations, we suggest designing policies to break the self-reinforced processes by the national and international organizations, because the natural dynamics seem unable to mitigate the current trends of degradation. For future research, it is important to find alternative information to show the specific impacts of the Russia–Ukraine crisis and pandemic on land use worldwide.

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Informed Consent Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

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