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Review

Sustainability in Peri-Urban Informal Settlements: A Review

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Abstract: The study of peri-urbanization attracted attention in the final quarter of the 20th century, due to the pace it acquired worldwide and the implication that urbanization and overall settlement patterns have on social sustainability and development. Theoretical and conceptual achievements are remarkable. Multi-country collaboration has produced a growing body of research on sustainability and peri-urban settlements. There is a lack, however, of a review of the practices of peri-urban informal settlements, the predominant mode of urban expansion, mainly in developing and rapidly urbanizing regions of the world. The purpose is, then, to systematize, from recent literature, the knowledge of the context, challenges, and practices, as well as their impacts and potential courses of action, to ensure sustainability in human–natural complex of the territory beyond urban cores, suburbs, or slums. A systematic review approach was adopted, for articles published in reputable journals, with support of previous reviews, books, and reports. A pragmatist combination of content analysis and critical review identified core topics and highlighted contrasting views. An analytical framework is proposed. Four categories—drivers, challenges and practices, impact, and future trends—are proposed as an adequate approach to systematizing the literature. The review finds that the practices focus on service and resource provision, on regulations to approximate informal to formal institutions, and on an economy founded on the resource base and service provision. This review provides insights on future trends and research topics.

Keywords: peri-urban; informal settlement; sustainability; spatial planning

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1. Introduction

Urbanization, with its twin process of peri-urbanization, has been a subject of research particularly since the mid-20th century. It is increasingly acknowledged that this is one of the world's macro-trends impacting local and global sustainability in its main dimensions. While hosting more than 55% of the world's population, consuming over 78% of the produced energy, emitting over 60% of greenhouse gases, and contributing to about 60% of global GDP, cities account for less than 2% of the Earth´s surface [1–3]. Scholarly literature reviews on urban expansion and on the understanding of the peri-urban space and life are focused on building foundational knowledge on their driving forces and constraints, as well as on the impacts and stresses they pose to the social, cultural, economic, institutional, and environmental sustainability of urban centers. Yet, both suburbanization and peri-urbanization are still predominantly occurring in an informal mode in areas that were not subject to land-use planning. Over 1 billion people, mostly in Asia and Sub-Saharan Africa, are living in slums and informal settlements, and, in Africa, adding the peri-urban territory to metropolises dramatically increases its surface area while only modestly increasing the population, by virtue of having a lower density [3,4]. Places are constructed informally, as the driving forces and the local conditions permit.

The subject of this review is sustainability in peri-urban informal settlements of predominantly agrarian regions with rapid urbanization, given the above-mentioned trends. The goal is to review how research has been approaching the practice on the informal side of peri-urban issues, challenges, and processes of transformation. In the last few decades, advances have been achieved in theoretical and conceptual frameworks to study peri-urban settlements and their relationships to sustainability. The focus on the cities has moved into self-governance of peri-urban areas, discussing the trade-offs in ecosystem services and informal settlements. This review follows a pragmatist approach. Informality in peri-urban settlements is here assumed to be "a fact of life [that] should not be ignored" [5] (p. xxxvi). While remaining the centers, cities are embedded in urban systems that include both lower-ranked urbanized centers and interstitial areas. This review intends to contribute to answering the questions, "What are the key issues or topics, challenges, and approaches to problem-solving, and the outcomes and impacts thereof in rapidly changing peri-urban informal settlements, where rules, procedures, and policies are shaped concurrently with the change processes?" and "How are ideas, visions, and action shaping reality there?" Are there any ways in which both occupation and informality may be improved in peri-urban territory? Successes and validity of ideas and actions are measured against the outcomes in relation to the dimensions of sustainability.

Sustainability, including peri-urban sustainability, refers to the state or path of an urban system in search of a balanced interplay between social and ecological subsystems through adaptation and resilience to deal with limited physical resources, which involves changes and uncertainties, unpredictability, inertia, and diversity of the economy and institutions [6–10]. It is affected by the distribution of people in space and relates to the construction of spaces from a material and immaterial perspective. The understanding of peri-urban informal settlements and their links to urban sustainability were reviewed. Peri-urban territories remain difficult to define and have received several names, from urban fringe to territories-in-between [11–13]. This article understands peri-urban territories as spaces of transition and tension between the urban and rural sociocultural, physical, economic, and institutional realities, where land use is mostly informal or unplanned, usually encompassing a diverse set of administrative entities 30 to 150 km beyond the limits of a city [4,14–16]. An unsustainable peri-urbanization exhibits social and functional decomposition, spatial and social segregation, resource stresses, and spatial and institutional fragmentation [17–19]. Informal settlements are those that do not follow formal plans and regulations. Some authors give them a negative connotation of disorder, sanitary problems, and chaos, especially when referring to inner-city slums [20–22], whereas others argue that "chaos" is only apparent—a way to overcome the incapacity of governmental institutions and to reclaim the right to be chaotic and unorderly, and thus "redefine the right to the city" [4,23,24] (p. 34). Peri-urban informal settlements have a higher degree of complexity due to the hybridization and diversification of people, space, landscape, economy, and institutions. Therefore, sometimes customary rules are the guide to socioeconomic and social-environmental relationships. This review follows this tenet of the worldview that life in peri-urban informal settlements in developing regions is neither necessarily disorganized and chaotic, nor unpredictable and impermanent. That informal creation of space is a practice used by both the poor and the better-off [25], which justifies further research.

The following section presents the methodology, with information on the approach and the criteria of selecting and processing the corpus of the analysis. The third section presents the results. The summary and discussion are presented in the concluding section.

2. Methodology

2.1. Approach

A qualitative systematic literature review approach was adopted to frame the state-of-the-art from the most recent literature on the subject. It was a meta-analysis in that it tried to find and count related categories in the literature being reviewed to assess the trends. It was also a meta-synthesis since most studies in the field are of a qualitative interpretive

nature [26]. The preliminary literature review allowed a set of preliminary categories of analysis to be defined.

A combined preliminary analytical framework (Figure 1) focuses on settlements that resulted from informal processes, the practice, and approaches to face challenges to improving the livelihoods, sustainability, and governance frameworks, which, in informal settlements, are different and less government-dependent than in formal settlements. Both include some form of regulation and consider the context of their emergence to mitigate or adapt to the impacts of their implementation. Such practices and challenges are dependent on regional or local factors and have impacts on sustainability that may or may not be further regulated by policies and rules. These are also to be identified.

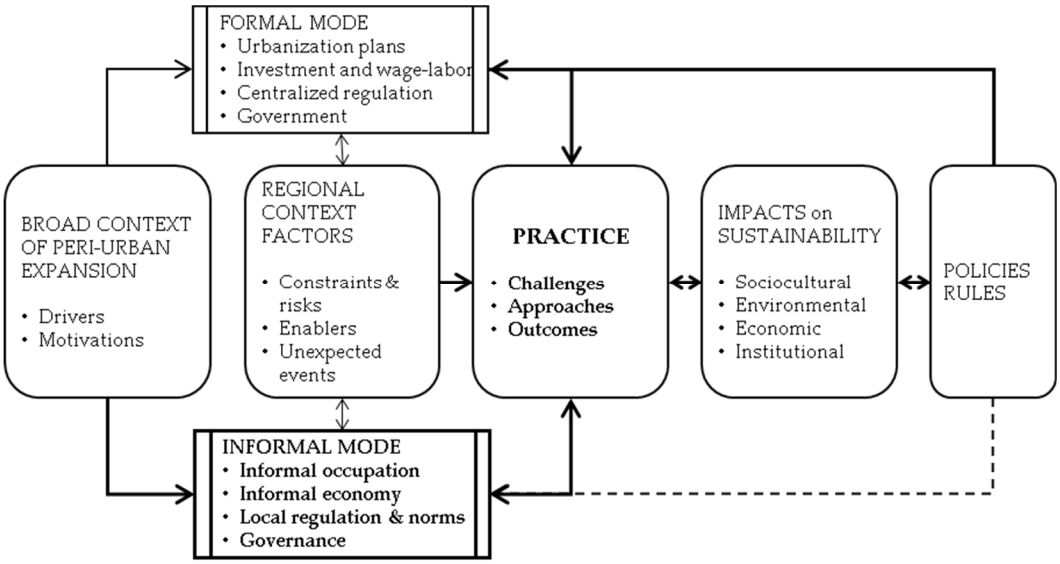

Figure 1. The preliminary analytical framework of the review.

2.2. Corpus Selection

Criteria of inclusion and exclusion were set to obtain articles recently published in peer-reviewed journals.

For the search expression "peri-urban and sustainability," the citation report of the Web of Science (WoS) database (n = 596), referred to in December 2021, showed a slight increase in number of citations per year until 2010, a higher and steady increase starting in 2011, and a sharp increase after 2017. The time interval of interest was selected as the last 10 years (2012–2021), which covers a period of prolific publication on the subject (Figure A1, in Appendix A).

Excluded were topics such as urban gardening, urban agriculture, urban trees, urban conservation parks, health, specific epidemiologic studies, childhood and old age care and services, and inner-city infrastructure of waste management and pollution. Studies on the broad and nationwide implementation of the SDGs and risk management were also generally excluded. However, if a spillover effect was judged to influence the sustainability in the creation and expansion of peri-urban informal settlements, they were included (Figure 2).

The PRISMA checklist and flow diagram [27] were used to select the 126 journal articles to be reviewed. The articles were selected from the relevant categories of publications in the databases of the Web of Science Core Collection—which includes publications from Elsevier, Sage, Taylor & Francis, and MDPI, as well as SciELO and ScienceDirect (Elsevier).

Open-source free software such as Biblioshiny in Bibliometrix for R and others [28,29] were used as an auxiliary means of analysis.

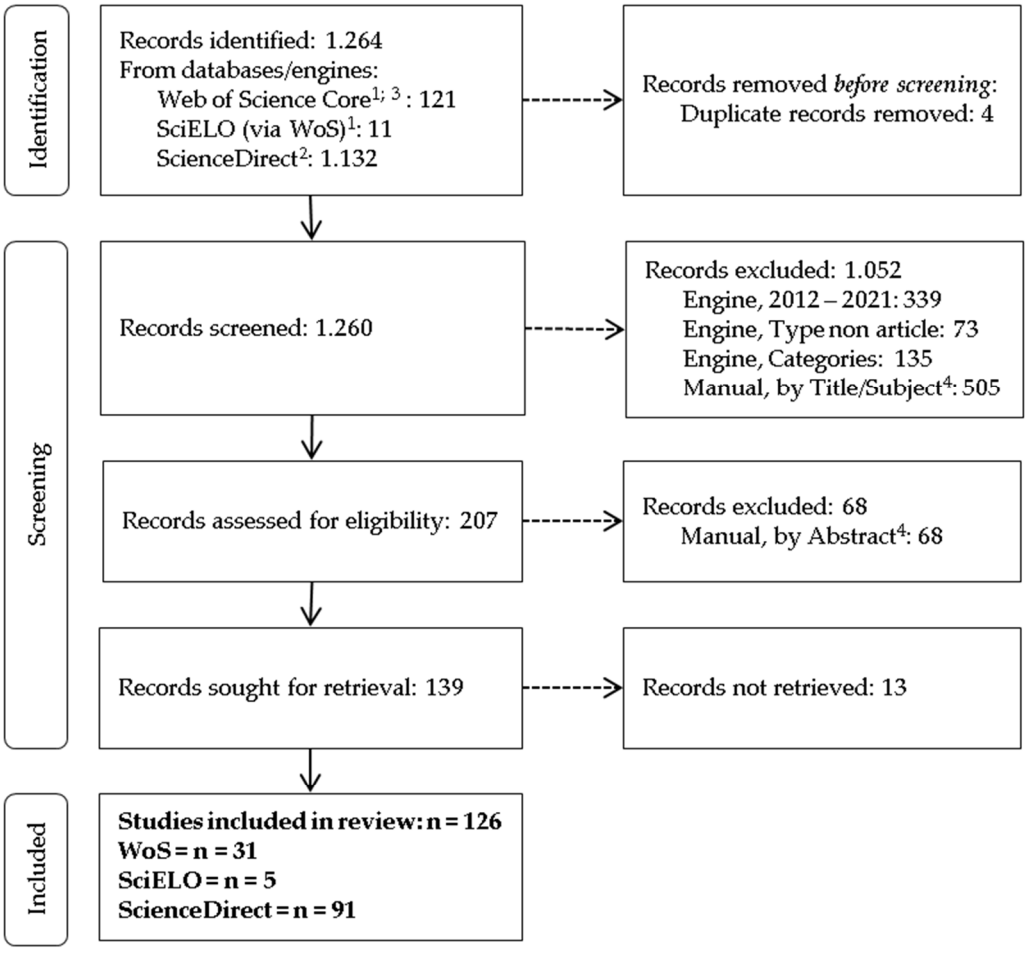

Figure 2. Flow diagram of corpus selection (based on http://prisma-statement.org, accessed on 28 February 2021 [27]).

2.3. Exploring the Corpus, the Concept Map, and the Coding Frame

To evaluate the dynamics and consistency of the research on the subject, two sets of bibliometric data were compared. The first, used as a reference base, was a set of n = 497 of the 505 articles from the Web of Science database on peri-urban sustainability. The second was a set of n = 122 of the 126 articles of the corpus on peri-urban informal settlements. Some bibliometric data could not be retrieved. Co-authorship for authors, organizations, and countries; co-citation of country collaboration networks; and co-occurrence of keywords are presented in Table 1. Collaboration among countries in the selected literature on informal settlements (n = 122) was similar to the reference base (n = 497), but the collaboration among organizations was much less.

The country collaboration world map was explored (Figure 3). The collaboration analysis also shows that, based on the address of the corresponding author, all papers were multi-country in Benin, Hong Kong, Japan, Mexico, Peru, and Thailand; between half and three-fourth in Australia, China, Germany, India, Spain, Sweden, and Switzerland; and between one-fourth and one-third in Canada, Italy, South Africa, the United Kingdom, and the United States of America. This provides for a diversity of contexts in the corpus.

Table 1. Co-authorship, co-citation, and co-occurrence of keywords in reference vs. corpus.

Description	Reference Base 497 of *n* = 505 Articles			Selected Corpus 122 of *n* = 126 Articles		
	Co-Authors	Documents	Citations	Co-Authors	Documents	Citations
Co-authorship						
authors (min. 3 and 2 articles, for base and corpus)	16	54	481	5	12	98
organizations (min 3 and 2 articles, for base and corpus)	14	97	1442	7	17	172
countries (min. 10 and 3 articles for base and corpus)	17	525	7766	17	145	2378
Co-citation of authors (min 20 citations)	21		712	10		277
Co-occurrences (all keywords)	sustainability (130); urbanization (57); agriculture (44); management (44); policy (27); ecosystem services (38); cities (29); peri-urban (42); urban agriculture (30); city (32); governance (29); urban (28); peri-urban agriculture (22); systems (26); growth (25); water (23); health (25)			peri-urban area (35); urbanization (25); informal settlements (16); urban area (14); land tenure (17); governance approach (14); land management (12); China (11); rural area (10); urban development (13); land use planning (12); South Africa (10); climate change (10)		

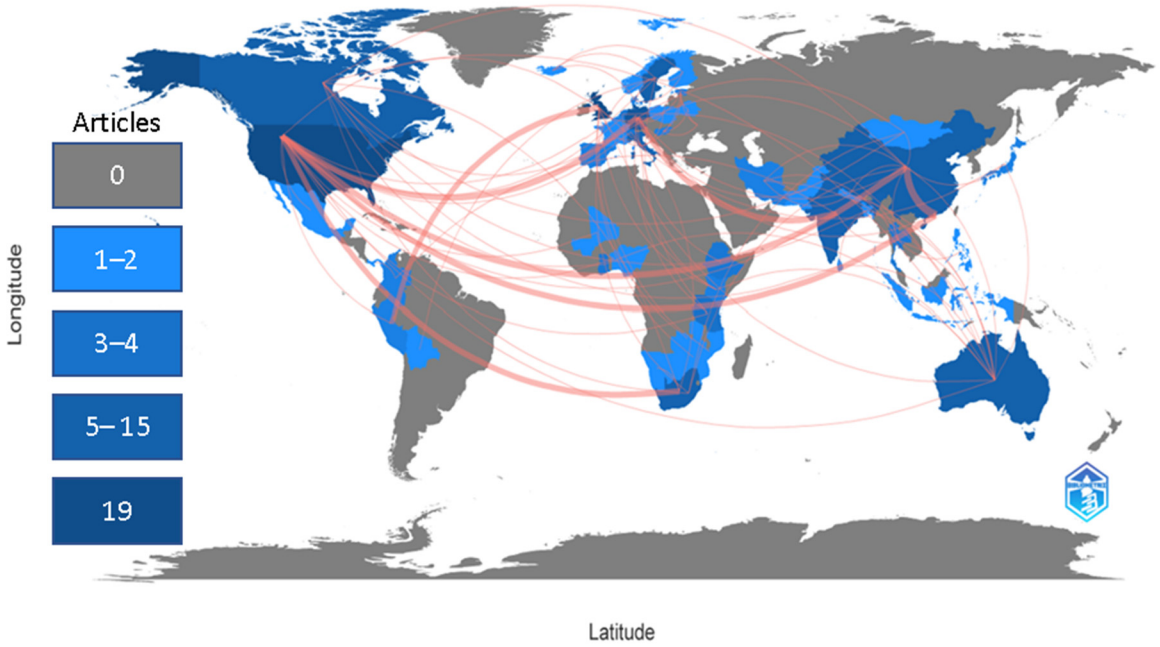

Figure 3. Country collaboration world map for the articles in the corpus.

The most relevant affiliations, with at least six articles, were RMIT of Melbourne University; University of Cape Town; University College London; University for Development Studies of Tamale, Ghana; Addis Ababa University; Purdue University; University of Basel; and The University of the West Indies. Multi-country studies involving universities seemed to be the most customary practice in the field.

The thematic dynamics in the literature on peri-urban sustainability highlighted ecosystem services as well as urban growth, water resources, peri-urban agriculture, and informal settlements (Figure A2, in Appendix A). The thematic evolution in the literature on peri-urban informal settlements also highlighted ecosystem services but concentrated on land planning and land registration (Figure A3 in Appendix A). These are linked to peri-urban agriculture and related to food and water security, while responding to the demand for living space by both the urban dwellers and the rural population.

Codes to assist in analyzing the corpus were iteratively based of the preliminary analytical framework (Figure 1) and the most frequent keywords. The pre-processing and exploration of the body text of the selected corpus yielded the most frequent unigrams, bigrams, and trigrams (Table A1, in Appendix B). Although these missed some basic constructs (e.g., food security, peri-urban agriculture, ecosystem services), they were also used. This serves as a point of reflection on the limitations of non-expert use of text analysis software.

3. Results and Discussion

3.1. Categories Derived

Four categories were derived as adequate for systematizing the literature:

1. Drivers and motivations, both structural and functional, of informal settlements in peri-urban areas, following the categorization developed by Dadashpoor and Ahani [13].
2. The current practices and challenges on (a) basic services of provision of resources, utilities, and services; (b) the regulatory practice; (c) the economic organization; and (d) the overall governance options for informal settlements.
3. The negative impacts on sustainability and related challenges, encompassing (a) the sociocultural impact related to inequalities and social segregation; (b) the environmental impacts, including land use and land cover changes, biodiversity, and the stance facing the risks of natural disaster; (c) the impact on the economy in relation to unequal access to opportunities of social mobility; and (d) the impact on the structure and functioning of the institutions (rules and organizations) in relation to the co-existence of formal and informal paths to sustainability.
4. Future trends. This category includes the normative body covered by the corpus, divided into (a) strategic interventions and (b) systemic issues to be addressed.

Categories on the methodologies and indicators used in the studies were not considered here, since a recent review on the subject [30] was used as a resource. Details on the categories derived from the literature are presented in Table A2 in Appendix C.

Table 2 reflects the contribution of the articles to the analysis of the categories: Articles in rank 1, for categories 1, 2, and 4, had at least 10 counts of codes; in rank 2, at least two counts; and in rank 3, the count was minimal but considered qualitatively relevant. For category 3, the ranking was more subjective since references to impacts were extremely limited.

Table 2. Articles arranged per contribution to the analysis of categories.

Category	Rank 1	Rank 2	Rank 3
1. Drivers and motivations	[25,31–76]	[19,77–110]	[111–123]
2. Practices and challenges	[25,32,33,37,44,45,48,54,56,68,76,77,80,85,102,107,110,124–129]	[31,36,41,43,49,51,55,57,58,61,64,70,73,82–84,87,92,93,95,100,109,130–141]	[97,99,101,105,111–114,117–122,142–144]
3. Negative impacts	[25,33,41,45,48,52,55,56,58,61,63,70,77,98,100,131,140,145–147]	[37,46,60,62,66,72,78,79,84–86,89,96,103,106,126,132,137,148–150]	[151]
4. Future trends	[25,36,56,72,76,94,110,128,140,152,153]	[33,49,55,81,83,102,124,126,127,145,147,148,154]	[19,35,113,119,141,143]

These categories and codes did not co-occur equally along the period of study. However, it is possible to distinguish between three clusters: The first service provisions to community-based inclusive governance were associated with environmental changes. In the second, implementation practices and tenure systems co-occurred with the resource-based economy, and in the third, there was co-occurrence of power relations and institutional capacity to address changes, population, and planning practices. The most frequent references were made to land tenure, production and consumption patterns, history or geography, implementation, and community-based governance (Figures A4 and A5, in Appendix D).

The following subsections refer to the categories of drivers and motivation, practices and challenges, negative impacts, and future trends. At the end of each subsection in Sections 3.2 and 3.3, tables of reading notes are presented.

3.2. Drivers and Motivations

The structural drivers are (a) the historic and geographical context, (b) the tenure systems and property rights framework, and (c) the political and economic models of organization and administration of the society. The functional drivers are related to flows and processes in (a) population structure, growth, and movement; (b) natural and built environment changes; and (c) social institutional capacity to address change. As these drivers reflect centripetal and centrifugal forces, they included constraints and enablers in moving from and to peri-urban informal settlements [13].

This subsection presents how these six drivers manifest in peri-urban informal settlements.

3.2.1. History and Geography

Most research recognizes either history or geography as drivers of the occupation of urban peripheries (reading notes in Table 3). This is reflected in four theories that explain the formation of peri-urban informal settlements in developing countries: flaws in land management, perpetual imbalance between supply and demand of resources, services and infrastructure, and colonial legacy and inadequate economy based on socioeconomic factors [77]. By knowing the historical and geographical context, the appropriate theory or theories to understand the formation of informal settlements can be identified and evaluated to frame site-specific studies. History and geography are structural drivers that manifest at different time and spatial scales, and influence the organization of society and space, providing foundations for other drivers. In society, they are related to intercultural exchange, laws and traditions, trade relationships, and conflictual domination relationships. Influence on the legal system and territorial organization can be centuries old [38,85,119] or rooted closer, to the colonial past [49,72,108], in the globalized ideology of market-oriented liberalism [45,49] and more recent struggles and localized strife [150,153]. Historical and geographical factors play a role in long-distance trade and cultural interaction [33,50,65]. These factors have impact on the idea of what "modern" and "development" mean [95,120,132], on the complexity of tenure systems and spatial organization [50,69,76], on the organization of the provision of utilities [46,96,119], on local food systems [108], and on the processes of rights regularization. Some informal settlements were a result of the traditional socioeconomic organization or of politics of frontiers and borders for intentional segregation, for instance, with the creation of "homelands,"; along ethnicity or nationality lines [49,53,72]; or by gating communities and villages [129].

In terms of space, these drivers operate at various scales: from the global to the regional scale [34,36,83], or at national or subnational macro-regions [54,127], cities, and places. Settlement location and patterns are driven by the possibility of accessing resources. Informal settlements occur in diverse settings and purposes: along open coastal areas, river flood areas, or hill slopes [55], or to avoid or face natural hazards and risks [83,92]. They are also driven by opportunities and the possibility of improving the satisfaction of basic services, and thus can develop along roads, railways directed to the hinterland [4], and other infrastructure for water and power access (ex. [98,134], including through illegal means [47,80,146]). The resulting proximity impacts the provision of utilities and technology transfer [47,61]. The expansion of peri-urban informal occupation is associated with processes of landscape change that result in diverse degrees of density and patterns of occupation, successively converting agricultural land of low-intensity use into open space and built-up space [91]. It can happen in a somewhat unorderly way, or in "inter-fingering" patterns, alternating agriculture and settlement [38] (p. 137), or they may result in ordered and organized settlements that are still informal, or in gated communities [129]. In fact, in both developed and developing countries, informal settlements are not necessarily irregular, and may enable future housing upgrading [99].

Table 3. Reading notes for "History and Geography".

Code	Dimensions	Topics
History	Time scale • Ancient society • Colonial past • Recent history	• Meanings: modernity; development; sustainability • Sociocultural organization: intercultural exchange; self-help • Power relations: inequality; segregation • Legal and administrative systems and traditions • Economic system
Geography	Spatial scale • Global • Regional/national • Subnational/local	• International interests • Integration • Investment, relocation • Borders and frontiers
	Location (proximity)	• Availability of resources • Access to utilities and services • Access to markets • Risk of disasters
	Patterns and changes	• Land use • Regularities • Opportunities

3.2.2. Tenure Systems

Tenure systems and property rights function as either centrifugal or centripetal forces for the informal occupation of the territory. Tenure security is a major concern in peri-urban informal settlements (reading notes on the subject in Table 4).

Table 4. Reading notes for "Tenure Systems".

Code	Dimensions	Topics
Tenure systems	Tenure/property regime • Public • Communal • Private	• Presence of hybrid regime • Recordation and regularization; registration • Limits to use and transfer • Ecosystem services • Attractiveness for investment in housing, utilities, other
	Security of tenure • Actual • Perceived • Risk of eviction	• Trust • Recognition • Common use • Limits to use and transfer by different actors
	Governance	• Conflict resolution • Compensations • Transparency of allocation • Disaster risks management

Tenure systems are sets of norms, either formal or informal, that establish the relationship of access, possession, and use, bringing together rights and duties of individuals or communities in relation to the surrounding environment. Tenure systems can be statutory, customary, or informal, and may take the form of private tenure, free access, or public tenure, and in peri-urban settlements they are predominantly informal [32,57]. Property rights establish the legal—usually economic—relationship between people and things or resources. These two constructs of tenure systems and property rights are usually associated with tenure security—either legal or perceived [70].

The perception of tenure security may function as a driver of investment in informal settlements, and informal tenure security may be perceived as more secure than legal tenure depending on the use and time spent in the place and allow for flexible responses to vulnerability. Any improvement in the security of tenure, especially of land, is desired and

has the potential to reduce conflicts, if properly undertaken and under proper governance to include all forms of tenure (see Section 3.3.1).

3.2.3. Power System, Administration, and Economic Development

Power system, administration, and economic development options drive informal peri-urbanization by providing a foundation for implicit choices and decision-making.

Power relations are influenced by historical and geographical factors at all scales. However, the research on peri-urban informal settlements highlights the importance of the context at local and other subnational levels, including at a micro-scale [31,66,153]. Power relations influence and are influenced by informality [49,75,153] and impacts on visions, policy, and institutions in the context of a market logic, eventually requiring the reaffirming of authority in the face of change [31,73,108]. Control of resources is a source of power. This may happen in community-level institutions, such as associations [133,141], when moving from a mostly customary or informal to a statutory tenure system. They are at the heart of conflicts and of their resolution [49,141,153], and can generate inequality, vulnerability, and missed opportunities [45,112,134]. Power relations help explain the flow and access to contested natural resources, such as land and marshlands; water, including for irrigation, fisheries, and coastal resources; and utilities such as transport, technology, and electricity. They also help explain the operation of the market, including the food systems [122,133]. Power relations are reflected in property rights and are embedded in where, how, and when infrastructure is established and how institutions implement their procedures—for instance, in what is referred to as land regularization programs. Power relations influence the locus and legitimacy to adjudicating and to revoking rights by several informal means both physically, through borders, and institutionally. Although considered in general a good practice, in some instances decentralization may increase inequality [73]. Understanding in situ power relations and how informal and formal actors interact improves the understanding of how informal settlements are driven and function in the broader context of their sustainability (reading notes on this subject in Table 5).

Table 5. Reading notes for "Power system, Administration, and Economic Development".

Code	Dimensions	Topics
Power system	Sources of power • Vested by the state • Informal powers Legitimacy • Inclusiveness • Representativity • Independence	• Control over resources • Control over services • Control over the economy • Enforcement systems • Transition from informal to statutory • Networks beyond the peri-urban areas
Administration	• Government system • Decentralization • Clientelism • Independence	• Provision for public participation • Public investment capacity • Law enforcement • Conflict resolution • Trust
Economic development	Business environment • Economic freedom • Labor laws • Property rights Government/public participation	• Availability of resources • Access to utilities and services • Inequality • Competition • Barriers to private investment (statutory or social) • Conditions for public participation (cases, limits)

3.2.4. Population Growth, Structure, and Movement

Population growth, structure, and movement are major drivers of informal peri-urbanization, and flexibly adapt to respond to specific local, physical and environmental, historical, infrastructural, economic, and institutional contexts. Informal peri-urbanization results in larger land occupation, land-use conversion, and prospects of growth than inner informal areas of the cities (see Table 6 for reading notes).

Table 6. Reading notes for "Population Growth, Structure, and Movement".

Code	Dimensions	Topics
Population	Natural growth Migration • Internal • Cross-border	• Pressure in services and resource demand • Census data • Voluntary displacement • Forced displacement and social disintegration • Gentrification • Proximity to services
Structure	Age and gender groups • Youth • Employment • Housing	• Non-agricultural employment • Work conditions • Skills • Integration and social capital

Both natural growth and movement of population through internal, cross-border, and circular migration; gentrification; and forced or voluntary displacement have an impact on the process of urban expansion and informal peri-urbanization [40,87,139,142]. This may generate social fragmentation along ethnic or social status groups but is also an opportunity to develop new safety nets and social capital [53,108,110]. The search for affordable space is for preferably one's own housing and is driven by the proximity to employment or social services, environmental services, and amenities, as well as administrative measures and plans [37,67,75,100]. The condition that drives the youth age group in peri-urban settlements is a recurrent issue [44,73,100]. Their primary motivation is to find employment and other economic and social mobility opportunities. The absence of skills to compete in the urban market is also a driver for some to settle in peri-urban regions [77]. The rates of change and the artificial formal definition of spaces and borders or frontiers add to the challenge of keeping updated statistics and mapping the population in these regions.

3.2.5. Environmental Changes

Changes in the physical environment at the local level may occur for natural reasons and through human intervention. These site changes bring changes in the situation and functioning of the settlements (see Table 7 for reading notes on the subject).

Table 7. Reading notes for "Environmental Changes".

Code	Dimensions	Topics
(Physical) Environmental changes	Natural causes Human intervention • Feeds back as a driver • Depletion or improvement of ecosystem services	• Changes in the landscape • Availability and suitability changes • Ecosystem changes • Ecosystem service availability • Green infrastructure • Disaster management preparedness

Physical environmental changes are reflected in land cover, land use, and landscape changes, and occur relatively fast in peri-urban areas because of fast occupation, social change, and exposure to climatic and meteorologic phenomena, for instance in island and coastal cities, as well as because of institutional changes, economic interventions, or conflicts over resources [64,93,149]. Environmental change provides feedback and functions as a driver, attracting or constraining the move to and occupation of the urban periphery. That impacts the availability of natural resources such as land, water, fisheries, wood and biomass, and clean air. Thus, rapid growth of occupation implies a faster-than-expected change in the context, putting pressure on both formal and informal institutions and opening new topics of study. For instance, the concern with and awareness of green infrastructure or the use of open spaces are increasingly present in current research on peri-urban informal settlements.

3.2.6. Social Institutional Capacity to Address Change

Constructed social capital and the institutional capacity of the society to address change enable informal peri-urbanization but can also raise barriers to the marginalized (see Table 8, for reading notes).

Table 8. Reading notes for "Social Institutional Capacity to Address Change".

Code	Dimensions	Topics
Social capital and institutions	Organization • Rules and social norms	• Number of informal organizations or NGOs • Local networking and beyond • Community organization and sense of belonging • Self-help and solidarity • Safety nets
	Inclusiveness • Feedback as a driver • As a tool and resource	• Levels of participation • Barriers to inclusion • Social enforcement • Negotiation tool • Protection/safety and protest • Information and knowledge exchange • Risk of violence

Informal settlements in peri-urban areas are not homogeneous, and the sociocultural context is considered, especially in the case of social interventions [36,64,96]. Social capital and traditions of solidarity and social networks drive peri-urbanization, which is in turn a product of the process [66,90,94]. Social capital is a resource for the creation, operation, and maintenance of infrastructures, transport and communication systems, water, food security, and access to employment and other forms of capital [59,124,134], as well as for the exchange of information and knowledge related to production [54,67,146], for facing disasters and vulnerabilities, for moving from resilience to adaptation, and for improving the management of socio-ecological systems in the peri-urban [102,138,154]. It also serves as a tool to negotiate or protest, sometimes violently [65,150,153]. Social capital may, however, act against openness and equality in the access to resources and services and enable exclusion based on identity [35,129]. In addition, participation may not necessarily result from the number of civil organizations [80] but more as a way to interact with formal and governmental institutions.

3.3. Practices and Challenges

The previous subsection provided tools to better understand drivers such as history and geography, the systems of tenure, and a difficult-to-transform context of power relations. It also identified the resilient and flexible demographic flows and changes in the natural and social organization and institutions. Peri-urban informal settlements are thus characterized by hybrid and complex social, environmental, economic, and institutional contexts. The challenge is to respond to societal demand for stable and secure rights to access resources, goods, and services to improve the livelihoods and prospects of development, either through formal or informal means. Four domains of practice were identified: first, the sociocultural practices to access resources of land, water, and security and affordability of food, energy, transport, and environmental services; second, the regulatory practice, which aims to sustain the balance between the provision of services to the society and environmental systems; third, the opportunities and constraints to produce and consume, employ, and advance economic activity by combining both the informal local supply of local demands and the relationship with economic investments and activities generated regionally or globally; and fourth, the above practices are pulled together into the domain of institutions and governance modes involving a range of actors and rules that keep the functioning of the peri-urban informal settlements and its relation to the elements of the urban system where they belong.

3.3.1. Sociocultural Practices and Challenges

Sociocultural practices and challenges focus on integration by providing resources, utilities, and services to satisfy basic needs, maintaining the balance between long-held local traditions and the influence of closer urban centers, sometimes overlooking the perception of risks (see Table 9 for the reading notes on this subject).

The demand for land and other resources, goods, and services, as well as the exposure to risks, increase with the population growth rate and changing preferences while generating conflicts and innovation in service provision and livelihood conditions.

"Land" was the single most-used word in the selected corpus of research on peri-urban informal settlements and practices. Land for affordable housing, agriculture and food security, ecosystem services, infrastructure development, waste management, and industrial development in urban peri-urban areas is demanded by local and external actors and performs functions for the associated urban system [49,76,133]. Although a major driver of informal occupation of the urban peripheries, land allocation is not always transparent [76,131,137]. Access procedures depend on social organization, customary tenure and inheritance rules, market motivation, and, more generally, power relations [153]. Social and economic status influence the way land is obtained by negotiations, acquisition, or expropriation, with or without due compensation. The low value attributed to compensations and the market set-prices of peri-urban land facilitate gentrification and suburbanization movement, not only for said housing and agriculture purposes, but also for industry reallocation. It can also be obtained through illegal encroachment [25].

Table 9. Reading notes for "Sociocultural Practices".

Code	Dimensions	Topics
Sociocultural practices	Land-related services	Garden agriculture and housing; self-help; spatial segregation; subdivision; gating; neighborhood organization; urbanization services; safety nets; public and open spaces; protected and sacred spaces; inheritance; gender equality; formalization of rights pros and cons; social safeguards; ecosystem services; landfills
	Water and sanitation (some also related to energy services)	Equality of access; infrastructure coverage; groundwater; self-help; maintenance arrangements; hygiene education; pollution and waste management; infrastructure financing; allocation; transparency; security of tenure; rights transfers; negotiations Affordability; compensations; formalization pros and cons;
	Resource governance	Participative land-use planning; bargaining power; protected areas; fragmentation and consolidation; risk maps
	Conflict resolution	Legality; legal pluralism; custom formalization; types of land-related conflicts; non-judiciary methods; claims and appeals; enforcement; police; safety
	Education and health care	Equality of access; proximity; information and knowledge sharing; life skills; personhood; technology transfer
	Utility: water access	Availability; quality; water rights; irrigation; access and distribution; network; flow and flood management; drought management; technology; power generation; distribution; isolated systems; prices and tariffs as mechanism of segregation
	Utility: energy	Wind, solar, hydro, tidal; biomass sources; maintenance; access and tariffs as inclusion
	Utility: transport and communication	Local and long-distance transport; traveling; proximity; network density access and tariffs as inclusion

Security of land tenure is sought in any system, either customary, informal, or formal, and regardless of the access procedures. In some cases, this is achieved or facilitated through regularization and registration initiatives and officially sponsored programs, using a conventional survey by public or private entities, as well as the so-called fit-for-purpose and the social tenure domain model (STDM) approach [34,36,53]. There is not a single practice in this respect, however, as there is no consensus on the advantages of having

regularization and formalization, and its impact on the security of tenure is not guaranteed, prompting a review of the issue [36,41]. Although some may not be interested in formalization due to mistrusting the government to improve security of tenure [56], other holders, if intending to invest for commercial purposes, will try to improve security through formal means [76] and obtain protection against the risk of eviction. These differences are reflected in the scholarly debate. Some authors defend that regularization or registration have improved tenure security and provided good environment for the long-term investment and improvement of informal settlements, facilitated the operation of a market-oriented land tenure system, and facilitated conflict resolution, while recognizing pitfalls and adopting approaches to bring about success, such as involving private surveyors and community engagement, and by recognizing secondary and communal rights [56,128,141]. International agencies are seen on this side [73,128]. Others expound the weaknesses and threats of losing part of the continuum of rights, and that such initiatives increase the risk of exclusion through gentrification, promoted clientelism, and reduced sharecropping opportunities, leading to the fragmentation of family farms, segregated against the poor, women, and children, while favoring strangers, without bringing added tenure security. For this camp, the initiatives favored some market-oriented crops, such as palm-oil, against traditional farming systems. In this camp, land regularization is considered a means to increase the states' grip on land reform, land use, and land sales and taxes, which generates conflicts and facilitates expropriation or other means of dispossession. These practices facilitate or materialize land grabbing and an aggressive market intervention of the better-off and best educated, putting protected areas in jeopardy. These authors, although suggesting a different sort of formalization or recognition, also suggest that at least some conditions need to be set for the process to be sustainable [41,67,72].

Land-based conflicts linked to regularization are described as site-specific and might result from scarcity, urban sprawl, the lack of ambiguity or variation in land administration, subdivision, competing uses, and power relations, and lead to unrest, violence, and added scarcity for agriculture and ecosystem services [41,70,153]. Land-based conflicts were categorized into "conflicts of interest," "conflicts of power," and "normative conflicts" by Dadashpoor and Ahani [32] (p. 221). Lombard and Rakodi [49] (p. 2685) cited Van Leeuwen and Van der Haar (2016) in categorizing studies on urban conflicts into those of "environmental scarcity," "political ecology," and "legal anthropological." Encroachment, the gradual, stealthy, and illegal occupation of other´s property or rights, is also a source of conflicts and practiced by both the poor and the better-off in the middle class [25,110].

Water, sanitation, and electricity and transportation infrastructure are the subject of varied but increasingly sophisticated practices of service provision in informal settlements in peri-urban territory, and inequality is noticed in availability, accessibility, affordability, quality, and management. Practices related to water go beyond the immediate human metabolism, providing space for ecosystem services and biodiversity conservation, and for resistance, resilience, and adaptation to risks.

The availability of water, sanitation services, and infrastructure is a driver for occupation, and may accelerate gentrification, pushing out the poor [40,66,146]. Access to water, sanitation, and hygiene services [97] in peri-urban settlements, as with access to other utilities, is provided either by the government or municipal authorities, eventually in partnership with the private sector and co-production, through networks and through non-network self-help or other strategies that are sometimes illegal [47,80,112]. Inequality of access is a typical outcome of current practices in this respect [124,134,146]. Access to and safety of water is linked to access to land rights and production systems, such as those involving irrigation, and as with land, they depend on social relationships [68,71,101]. The affordability of service provision, including water and energy, transportation, and financial services, depends on the prices set by the provider as well as on the capacity to invest in infrastructure. Unaffordability and tariffs that may include payment for other services are additional drivers of inequality [98,134,146]. Technology adoption is related to remoteness,

affordability, and productive use. The most mentioned technologies are those related to power generation and distribution, transport, food marketing, and sanitation [35,58,135].

The research reflects on the water–energy–food nexus [86,93,146] and identifies and describes practices connecting it to the land nexus and to waste and wastewater management of the urban system of reference [105,135,146].

Current water management practices cover ecosystem services from wetlands, lakes, the sea, forests, and protected areas, and are also linked to biomass renovation, biodiversity and landscape conservation, and green infrastructure [74,79,104,113]. Research was done on the integration of local and scientific knowledge, traditional weather forecasting, climate-smart agriculture, and multidisciplinary strategic cooperation to face risks of floods, flashfloods, and stormwater management needs [52,83,145].

3.3.2. Environmental Regulatory Practices

The regulatory practices of today provide a foundation from which to develop a road map for future sustainable practices. The regulatory practices in peri-urban informal settlements face the challenge of bridging formal and informal actors, rules, and procedures.

Four domains were identified (see Table 10): objectives, approaches, objects of regulation, and agents. Regulations aim to promote sustainability [77], incentivize environment-aware behavior engaging experts and landowners [152], ensure provision of land-related conflict resolution [32], and promote social capital [54]. However, regulations are not always beneficial. Informal settlements in the urban periphery exist, in part, to avoid non-inclusive regulation by municipal authorities, because of the additional administrative burden, weak capacity, or unwillingness to regulate [49], and rules that do not receive local recognition or respect local culture. Moreover, at times, rules constrain partnership initiatives [76,77,99]. The question, then, is why to regulate informal settlements driven exactly by the avoidance of regulations.

Table 10. Reading notes for "Environmental Regulatory Practice".

Code	Dimensions	Topics
Environmental regulatory practice	Objective • Sustainability • Facilitate integration • Prevent/combat • Bad practices	• Pros and cons of regulation • Winners and losers • Establish standards to solve normative inconsistencies • Opportunity and acceptability of the regulation • Legitimacy • Enforcement capacity to generate credibility
	Approach • Recognition and affirmative • Repression and prohibition	• Co-creation • Regulation by imitation • Conflict prevention • Evasion and protesting • Capacity to enforce
	Objects • Resource use • Standards • Relocation • Market • Quality	• Limits of use and protection • Occupation patterns, urbanization, housing, agriculture • Sizes of plots • Relocation of investment • Labor, food, prices and tariffs, compensations • Food, water, building, pollution
	Agents • Government • Governance bodies • Chiefs • Informal	• Laws: national, sectoral • Local edicts and by-laws • Sizes of plots • Relocation of investment • Labor, food, prices and tariffs, compensations

There are two main approaches: "recognition and affirmative regulation [and] prohibition and repression" [147] (p. 253). Contradictions that may exist between rules or norms allow for the use of practices that are neither regular nor completely illegal [132]. Although practice may legitimize regulations [25], a more aggressive approach may be adopted by representative authorities, since regulations should not be left entirely to the market and trade-offs [85,93]. Another way to put it is that current regulatory practice may be the result of social norms and cultural values [67,85,137] or the initiative of local authorities and networks to discipline the use or delivery of public interest [37,141].

The objects of regulation are those related to land access and occupation, resource use, climate adaptation and mitigation, plot size, road and street networks, housing, agriculture (e.g., [129,130,153]), and those regulating tariffs, prices, and rents and promoting the reduction of transactions costs [77,134,152]. There is also a practice of regulating activities related to production and consumption, such as food-related issues [66,108] and quality of industries, since the lack of such regulations also drives industry reallocation to peri-urban settlements [66] and urban mobility [120,147]. Sanitation is weakly regulated either by formal or informal institutions [111]. Some of these regulations may be done locally, whereas others require municipal or state intervention and some (e.g., the cases of food quality, industry, and labor) may require negotiations with a range of formal and informal institutions and constituencies.

3.3.3. Economic Practices and Challenges

Economic practices and challenges relate to natural resources, services and informality, opportunities, and employment generating investment, and are addressed in parallel with the social, environmental, and institutional dimensions of sustainability. Reading notes on Table 11 outline the dimensions and topics on this subject.

There is an association between the peri-urban economic landscape and the functional and economic drivers of peri-urbanization. Peri-urban economy is recognized as connected to urban and rural economies and the global market [32,73,84]. The economy in peri-urban areas is organized around land and services to respond to demands from the urban, peri-urban, rural, and global markets.

First, there are land-based economic activities. In land-based activities, land prices, compensation and expropriation mechanisms, availability and wages of skilled labor, and institutional arrangements influence investment decisions in access to land and the rate of land-use change [90,103,148]. The practice also shows that land ownership is not always the best form of tenure, as the rental land market may provide a better environment for non-agricultural economic growth [64,69,119]. To find the right balance, the hybrid tenure system is taken advantage of to gradually promote formalization, associating the land economy and governance [72]. The increased demand for land, as cities expand, drives the change from a more rural to a more urban—still mostly informal—land-use pattern, according to its location, aptitude, or suitability. In this context, land is either fragmented or consolidated to accommodate private housing, and for the development of the rental and "tile" market ([124] (p. 61) and [129] (p. 97)) and infrastructure. Food production concentrates in fertile land or wetlands for high-value products such as vegetables and fruits [108,118,133], supported by irrigation and other technological levers. The proximity of a seaport or to regional markets may determine land acquisition for investments in industry and agroindustry, offering employment opportunities. Incentives to domestic and foreign investment fall under the nationwide macroeconomic policies and economic development models [47,61,139]. Some households benefit from the expansion, whereas others' livelihoods are lost [94].

In coastal areas, sea-based investments may occur, such as in shipyards, in fisheries, and in aquaculture industries [92,119]. Mining may also promote—or force—peri-urbanization, according to the resource base [48,61].

Second, there is the service economy to serve local and proximate urban population demands. The demographic dynamic prompts economic activities based more on utilities

and services. These include networked distribution of energy and water from distant and diverse sources, including wind farms [47,51,61], or the development of communications networks. They also include more small-scale, self-help, locally produced surface and groundwater systems, either for farming or hygiene, sanitation and waste disposal, and management services, as well as domestic or small systems of solar power. These are the initiative of individuals, the state, and private investors [47,96,146] (see Section 3.3.1). Trade and transport, also mostly informal, flourish in peri-urban areas, depending on opportunity costs. In peri-urban settlements, where large shopping malls or large commercial surfaces are rare, clustering of commercial and cottage activity is common [108,120,147], and the proximity to urban centers facilitates the movement of qualified labor. Natural conditions may also favor the provision of ecosystem-based and tourism services, and some reserves, sanctuaries, and other protected areas may be located within peri-urban areas. Ecosystem service economy may be at conflict with the land-use changes associated with urban expansion [149].

The research reflects the challenges in the connection between economy, governance institutions, and social sustainability. It also raises the topic of interdependency among several areas of the service economy. Peri-urban economic activities in informal settlements generate conflicts and trade-offs, some aggravate vulnerabilities and inequalities, and other present opportunities to improve livelihoods. Likewise, access to technology and finance is not neutral. Overall, although presenting opportunities, informality in peri-urban settlements also presents a challenge to adequate consumer regulation and tax collection, driven by and with implications for the institutional capacity.

Table 11. Reading notes for "Economic Practices".

Code	Dimensions	Topics
Economic practices	Based on • Resources • Services • Informality—pros and cons	• Land for agriculture, housing, and industry (incl. mining, fisheries) • (Lower) prices and availability (of larger consolidated plots) • Rental services of warehousing, commerce • Utility services: water, power, transport, and infrastructure • Entertainment and ecosystem services
	Linked to • Urban • Rural • Regional and global	• Acceptable proximity of infrastructure • Rental or leasing housing • Growing consumer market • High-value vegetables, fruits • Favorable logistical geolocation
	Challenges • Connection with institutions • Informality	• Underdeveloped market • Underdeveloped institutions • Labor- and employment-related issues; unskilled workforce • Quality • Unskilled workforce
	Agents • Farmers; private sector • Public; communities • Partnerships	• Private sector—international • Private sector—local; absentee landowners • Government • Informal

3.3.4. Modes of Governance and Institutional Practices and Challenges

Modes of governance and institutional practices and challenges occur in a hybrid context, dynamically approximating formal and informal institutions.

Governance modes are arrangements of actors and rules, i.e., institutions, according to their dominance and regular practices to govern the society, spaces, and resources in a territory [84,85,108]. The modes of governance may be state-based, which can be improved with private–public partnerships; market-based, where the rules and principles of supply

and demand, competition, and individual or firm benefit maximization prevails; and the community-based mode of governance, where community structures and rules, usually informal, prevail. There can also be networked and decentralized modes of governance with practices of inclusion and participation [43,93,110]. It is a characteristic of informal peri-urban settlements that several of these modes of governance co-exist and overlap or become hybrid, enhancing their complexity [46,49,53]. Managing the distance between the informal and formal procedures is a key challenge and practice [53,108] to achieve without jeopardizing expectations, since formalization is not always the best answer to improve security of tenure, reduce conflicts [41], and achieve equitable outcomes [140], or the best way to improve trust in institutions [56].

Major challenges generating conflicts are those related to ambiguity and legal pluralism, e.g., [31,108,141], which can be exploited both by regular and powerful users [31,114] to fit their interests, which do not necessarily coincide with the interests of the institutions they are part of [57]. The co-evolution of a wide variety of actors and rules also presents a challenge in governance: Actors' behavior and choices are influenced and influence the institutions in a co-evolution relationship [57,67,108].

The practice of territorial governance goes in the direction of managing the hybrid institutional context to ensure food production and service provision at reduced costs; manage ambiguities, negative externalities, and structural inequalities; and develop innovative and adequate ways to care for limited resources and fragile ecosystems, as well as risk management and adaptation, through a flexible approach of co-creation and co-management that institutionalize inclusiveness, participation, conflict management mechanisms, and subsidiarity [53,79,145]. Governance in peri-urban areas tries to gradually approximate formal and informal institutions, sometimes through a dynamic process of adaptation of norms to changes (also known as "institutional bricolage" [67] (p. 2)), matching legality and legitimacy, overcoming marginalization and institutional fragmentation, and reaching institutional fitness [66,67,103]. In the absence of such management, violent modes of governance and "cacique"-led governance may emerge [49,126,150].

Modes of governance are discussed in connection with economic activities and natural and human-caused change, which, as seen above, are linked to history and geography, tenure, power systems, population, and service provision (Table 12 offers reading notes on this issue).

Table 12. Reading notes for "Modes of Governance".

Code	Dimensions	Topics
Modes of governance	Modes • State-based • Market-based • Community-based • Distributed • Hybrid	Aims—are they common? • Sustainability: • Food production • Affordable service provision • Inclusiveness • Integration • Institutional fitness • Actors' co-evolution: impacts?
	Challenges: • Ambiguity • Fragmentation • Social • Spatial/environmental • Institutional • Negative externalities	• Structural inequalities • Exploitation of gaps • Marginalization • Segregation • Fragmented habitats • Fragile ecosystems • Threat to limited resources • Non-transparent decision-making processes • Responsiveness • Managing forms of fragmentation
	Practices • Adaptation • Inclusiveness • Cross-fertilization	• Institutionalizing participation • Co-creation • Co-management • Co-evolution of actors: accountability? • Approximating hybrid procedures • Managing externalities (some may be good)

3.4. Negative Impacts

By involving a sizable population and territory, informal occupation of the periphery of urban centers generates negative impacts and externalities in major dimensions of sustainability: sociocultural, environmental, economic, and institutional.

The impacts in one dimension may not occur in isolation. For instance, institutional impacts on governance arrangements may amplify social impacts, reflected in social stability and security in the water, energy, and food nexus [67,86]. On the other hand, weak government can be associated with negative environmental impacts. The following provides issues related to the interconnection of the negative impacts of informal peri-urbanization with the stated dimensions of sustainability.

3.4.1. Sociocultural Impacts

Social and spatial segregation, meaning the occupation of different spaces by different social groups with different values and characteristics, are recorded impacts of the process of informal occupation of the peri-urban territory, and they are in turn related to the deepening of inequalities, polarization, and conflicts [19,59,82], with the result of "disintegrated development" [37] (p. 22). Social segregation is also associated with marginalization and exclusion in accessing services related to land [141], water, sanitation and energy [47,58,97], transport [59], the labor market [70], and security [32]. Social segregation does not happen the same way everywhere [37]. When at a small scale, its effect is not significant, and in urban villages, as opposed to urban gated communities, it may be "very positive for society" [129] (p. 11).

The research tries to link informal peri-urbanization with poverty and poverty reduction. For some, peri-urbanization, with its conversion of land-use, induces poverty for farmers [48,94], and poverty is a characteristic of informal peri-urban settlements associated with social segregation [130]. Intentional action is needed to reduce poverty in those areas [61,73,87]. However, Bartels [25] contended the thesis that peri-urbanization is always driven by poverty—"suburbanization of poverty" [99] (p. 1037)—since peri-urbanization is also driven by not-so-poor populations.

3.4.2. Environmental Impacts

Informal occupation of peri-urban territories may be accompanied by deforestation, loss of biodiversity, and soil erosion [93,123]; increased risk of fires [52,138,145]; floods and rise in sea level [43,83,86]; and higher exposure to pollution in the water–food–energy nexus and landfill economy [117,148].

Through its associated process of land cover and land-use changes, which does not always follow suitability or carrying capacity, informal settlements result in a loss of soil fertility and land and habitat fragmentation [82,149], with a consequent decrease in farm density; it also affects fragile and exposed ecosystems, such as wetlands, parks, and coastal areas [31,89,104].

Infrastructure development may generate impact on the resource base because it attracts investment and hence informal settlements that put further pressure on resources of land, water, and energy, and may increase exposure to pollutants [85,88,89].

3.4.3. Economic Impacts

Rapid informal peri-urbanization unbalances the supply facing the demand for land and results in loss of livelihoods of populations who live on the land through displacement and land grabs. Farms are fragmented for housing or commercial use [66,82,119]. Inequality widens because on one side, land is acquired at low prices, with inadequate compensation in case of expropriation or off-registered transactions [55,72,77], and on the other side, value is captured and rapid wealth is accumulated in the hands of a few landowners and land developers through capitalization [86,90]. Compounding the forces driving inequality, property may be lost to settle debts [57] and land is grabbed, sometimes through

formalization for domestic and foreign investment, where disproportionate advantages go to local elites and powerful people as well as to landowner villagers [73,121,148].

Economic inefficiencies are both drivers and results of the informal and unplanned occupation in peri-urban areas [41,77]. The "tyranny of distance" falls on those who get an employment opportunity but must bear higher transportation costs [38] (p. 133). Insecurity of rights in a dubious tenure environment and the risk of expropriation in the context of informal settlements in peri-urban area impacts economic investment decision-making [84].

Higher transaction costs are of importance to consider investment and decision-making in land development projects from the beginning to get deeds [99] to enforce rights [41]. It should be noted that top-down villager funding of redevelopment initiatives—for instance, to provide housing—has higher transaction costs than top-down government-funded initiatives. However, both have higher costs than bottom-up initiatives funded by villagers, especially if managed by fairly elected representative bodies [144]. This means that a negative economic impact is expected if top-down solutions are imposed upon communities. This relates economic impacts to governance modes in informal peri-urban spaces.

3.4.4. Institutional Impacts

The accelerated arrival of actors and the practice of different rules in the informal peri-urban space pose challenges that may not be met at the same pace by the institutions, with further negative impacts on their organization, work, and performance.

Usually spanning several administrative units, peri-urban areas are informally occupied, straining the capacity of weak local government institutions [39]. Enforcement capacity is diminished if non-inclusive modes of governance are adopted. Formal institutions tend to be overloaded to formalize land rights in informal settlements, using traditional systematic and centralized processes with little coverage [36,41]. By abandoning its obligations, a weak local government facilitates an increase in transaction costs [128].

Weak governance is associated with corruption. Corruption is reported in relation to electricity provision [61]; land governance and registration [72,84,108], including of communal lands [42,64]; climate risk-reduction initiatives [151]; environmental standards [122]; and waste management [125], and it can come from various actors such as politicians, government entities and officers, land-use planners [132], landowners, and even gangs.

Illegality is a sign of weak government and corruption, and it spans several issues subject to laws and by-laws, such as illegal sale of plots and squatting [49,132], illegal connections to the electricity grid [146], illegal landfill and waste disposal, and illegal practice of forbidden urban agriculture [108]. Illegalities can also happen a posteriori by banning certain activities through zoning [148].

Not all informal forms of occupation are illegal or bad, however. Although some qualified this as chaos to be ordered, other authors viewed this as an opportunity to incorporate local dwellers into the governance and development of their newly created spaces and promote decentralization [23].

3.5. Future Trends of Practice and Research Topics

Two broad approaches can be considered in relation to the future of spatial planning in peri-urban informal settlements: The first approach is to function as or after it happens unregulated, on demand, or when the situation requires. Plans are adjusted to the created human–nature complex, to provide infrastructure [25], or for the redevelopment of urban villages [144], knowing that post-settlement network extensions are costly and imply processes of land acquisition [124]. They are adjusted to existing land-use changes, a process that is at the root of initiatives of regularization and formalization of rights, referred to in more than 10% of the reviewed articles. The second approach is to preventively have some strategic, broad spatial planning in place, as some opposed master plans [39], integrating major dimensions of sustainability and resilience, and structuring parts of the informal nature of the occupation. Out of the 126 articles, 36 or 28.6% referred to planning and requalification. The two approaches need not be contradictory.

Some practices may work as a research field to identify additional strategic actions that may be necessary in the future. For this reason, implementation perspectives are considered. A normative approach is adopted with respect to the future.

3.5.1. Land Management and Governance

The trend in land management and governance in peri-urban informal settlements is focusing on combining and gradually moving from the informal to the formal through legal visibility.

The trend identified is to move from a dualistic and fragmented legal system to a cooperation between the two modes of land governance: formal and informal [41,49,107]. Land is at the core of peri-urban informal settlements, and hybrid land governance is inescapable [53]. It is known that actors participate in both formal and informal processes [57] and, although individual titling and formal registration is not always the best solution either for agriculture or housing [56,69,84], formal tenure provides more security of tenure than informal land administration [34,57]. The recognition of customary tenure norms allows for better integration of informal and formal processes [36,67]. Although advocating for an ambiguous legal framework may be convenient for some because informality opens up other ways to access land rights, the solution to land governance is important as a background to improve other services, such as water and waste management [112,148]. The process should be conducted in partnership arrangements with landowners and tenant participation, ensuring voices for vulnerable groups, and simplifying and de-bureaucratizing surveying procedures and standards [94,110,128]. Legal visibility, allowing for inspections, should be provided [72,153]. Conflicts should be effectively managed at distinct levels [56,141]. The process should rely on data and imagery to help reduce costs and promote quality.

The hostility facing informal settlements must be overcome [137], and the risks of violence, corruption, mismanagement, land grab, bias for incoherence with rural development policies, opportunism allowed by customary access to land, and regularization that provides incentive to illegal occupation must be managed [42,132,140]. There is also the potential exclusion of those who cannot afford the costs unless pro-poor methods of land recordation are used [36,41]. There is a need to integrate the registration process in a broader context of land policy reform, which needs to have a clear shared vision [44]. Practices to avoid are political interference [128], allowing the spillover of land-related conflicts into the wider society [49], coupling registration with credit and farming and subsidization of fragmented urban agriculture projects [67,133], obstacles to land rights transfers and leasing and manipulating prices and compensation values that provide incentives to off-register transactions, and in general letting transaction costs rise [72,84,144]. Titling or some form of recordation is not to be promoted before land-use planning [64] and with no regard for the pros and cons of customary arrangements and norms, including checks and balances on the exercise of customary norms [31,42,64].

3.5.2. Spatial Planning

The trend in spatial planning is to move to strategic flexible planning.

A clear vision of the process of peri-urbanization is required when considering spatial planning and trade-offs are to be expected [85,127]. The trend in spatial planning is to move from master plans to participatory, multi-layered, holistic, integrated, comprehensive, and flexible strategic plans that are based on quantification of resource expansion and degradation and account for changes in context and opportunities [37,39,154]. The plans resort to adequate data and imagery for different layers [60,91,145] and are co-produced with local knowledge [52,145]. Such strategic plans are expected to promote resilience and natural hazard risk management and realistically balanced socioecological services [91,93]. They provide for zoning and integration of space to produce renewable energy, peri-urban forest, and green spaces [51,113,123], and cover water, transport, and green infrastructure [59,89,96].

The move to strategic planning does not dispense with layout and urbanism plans, although master plans are said to have been rigid, easily outdated, and may stay unused for decades, like in Abuja from the late 1960s to the first decade of the 2000s [39,59]. This mostly strategic planning challenges the tradition of spatial planning as a centralized activity where the government is the only responsible party [41]. Planning deregulation may also result in inequalities present in metropolis to spill over to peri-urban landscape and farming systems [82], and it may be difficult to reach an adequate coordination between central and sectoral resource regimes and local regulatory arrangements [152]. Clear compensation standards need to be set and considered while the plan is being developed and reflect heterogeneous interests of displaced and compensated landowners [48,90,101]. Appropriate land reclassification needs to be carried out [65,75,148]. Besides, there are doubts about protecting agricultural areas in the face of the rapid peri-urbanization, since other approaches may be chosen provided that livelihoods are not lost [94], and the scale for planning to account for intercity relationships needs to be studied, as well as the relationship between urban, peri-urban, and rural spaces [65,107,115].

Some practices are recommended to be avoided in spatial planning. By recognizing that institutions, like spatial plans, are social constructs and that what is written does not always conform totally with the constantly changing surrounding context, that is, the socio-ecological environment, the way of life, the scale and breath, and the modes of providing justice, they need to be flexible to adapt. Rigidity is, then, to be avoided [103]. Even knowing that sustainability is not neutral politically and ideologically, the spatial plan should not be politicized in the sense of favoring places solely for power purposes [51]. Spatial plans deal with socio-institutional and territorial fragmentation, and unequal benefits of the plan are to be avoided to prevent segregation and conflicts and unequal access to the green spaces of the cities and surrounding areas [19,113]. A spatial plan should avoid generating loss of livelihoods [48,94,103]. In peri-urban informal settlements, most of the space is not statutory, with registration, and local and or customary norms are in use. Although pointing to a future of gradual formalization, spatial plans should avoid disregard for the pros and cons of those norms and customs [31,42]. Spatial plans may imply displacements and resettlements, where compensation is necessary. Forced displacement, and perverse and homogenous compensation standards that do not consider the social heterogeneity and that may lead to loss of livelihood of migrants and displaced people, are also to be avoided [90,101].

3.5.3. Suggested Research Topics

The authors on peri-urban informal settlements suggested research topics in the fields of land governance and management; land, land-use change, and peri-urban expansion patterns; food systems; and water and waste governance. Climate resilience and vulnerability, socio-ecosystems services, and transportation were also suggested research fields. Research was also suggested on broader issues such as informality and greater urbanization models [63,78,127]. Researchers also suggested some conditions and methodologies to be used to improve the understanding of how those settlements function, such as data acquisition systems for both planning and governance requirements [82,107,145].

Suggested topics to research land governance and management include how to deal with hybrid land governance [53,108]; land registration, recordation, pro-poor cadaster tools, and decentralization or devolution of land administration roles and responsibilities [36,84,110]; economics of size and scale [82,84]; the management of micro- and macroscale food systems and its relation to the social structure and the role of women and farmer-led markets [67,108,133]; and expanding on typologies and causes and resolution of conflicts [32,49,153].

In terms of urbanism and housing, urban expansion, and development, suggested topics included users and barriers to accessibility to green spaces [113], neighborhood governance and reclassification—what is public interest or public purpose [75,148], the role of real estate property rights, and housing and building standards and models [76,99,145].

Topics on water management were suggested to include the impact of overextraction of groundwater on wetlands [79], the lack of demand for civil society organizations to participate in water governance arrangements [96], and forms of participation in waste management and willingness to pay [125].

Research topics on climate resilience included vulnerability and governance regimes [146], vulnerability of rural areas vi-s-vis the size and distance to urban centers [115], co-production of resilience solutions [145], governance vis-s-vis interdependent infrastructure, equity and justice in access to support following extreme events [86], trade-offs in the governance of socio-ecologic systems (SES) [89,91,93], and cooperation in problem solving in the governance of SES in a context of change [37].

In terms of transport, topics for further research included informal transport systems, impact on socially vulnerable communities, road safety, and drivers' associations [59,87,120,147].

Other topics included the application of the urban governance index to capture local dynamics and service provision [80], and the specificities of spatial planning approaches to small developing island states [33].

4. Conclusions

The study of peri-urban informal settlements, well beyond metropolitan limits where agriculture predominance starts to dissolve, deals both with urban expansion and rural transformation. Methodologies and tools require adjustments to understand rekindled social organizations where ethnic and customary practices are transformed due to new relationships based on the proximity to urban and immediate material interests, to observe the changes in environmental territorial fragmentation and consolidation reflecting the land-use and land cover changes, and to measure the informal-to-formal economic transformation.

The proposed analytical framework (Figure 1) was found to be generally appropriate. It can be improved by identifying the key practices as being (a) on services, utilities, and resource provision and allocation; (b) on the regulatory framework; and (c) on the economic transition practices.

The proposed categories of analysis allowed us to find the key issues concerning sustainability in peri-urban informal settlements and generally answer the research questions about the drivers, practices and challenges, and impacts and trends.

In terms of drivers, history and geography are structural drivers of peri-urbanization and informal settlements manifested at different time and spatial scales, providing foundations for other drivers. Tenure security is a major concern in peri-urban informal settlements. The power systems implicitly drive informal peri-urbanization and need to be accounted for. Population growth, structure, and movement flexibly adapt to site-specific contexts. Constructed social capital and physical environment enable informal peri-urbanization but can also raise barriers to the marginalized. Change in natural and modified environments may be a driver of peri-urban informal settlement, resulting in changing the context.

Where practices and challenges are concerned, a three-pronged thematic deserved attention from researchers and practitioners: First, socio-cultural practices and challenges were found to focus on integration by providing resources, utilities, and services to satisfy basic needs, maintaining the balance between long-held local traditions and the influence of closer urban centers, sometimes overlooking the perception of risks. Second, the regulatory practices in peri-urban informal settlements face the challenge of bridging formal and informal actors, rules, and procedures. Third, the economy is built around natural resources and services and is characterized by informality. The modes of governance and institutional practices and challenges occur in a hybrid context, dynamically approximating formal and informal institutions.

Impacts found were social segregation, disintegration, and inequality; environmental loss of the resource base and increased risks; economic loss of livelihoods and insecure decision-making environment and inefficiency; and institutional fragmentation, with a weakened government, corruption, and illegality.

The research is currently focusing on land management and governance, to combine and gradually move from the informal to the formal by acquiring legal visibility. Spatial planning practice is moving to strategic flexible planning. Suggested research fields highlight land governance and management; the water–energy–food, land, and waste nexuses; climate resilience and vulnerability; and socio-ecosystem services. Informality and greater urbanization models are broader topics that are also suggested.

The results show that informal occupation of peri-urban territories is an inescapable process, and there seems to always be some form and extent of informality in those areas. They encompass both poor and rich residents and are not necessarily chaotic or disordered. The reviewed literature attests to the growing scientific research on the practices emerging in the peri-urbanization process. Although knowledge is being consolidated and systematized in some fields, new research issues are being identified and pursued, contributing to promoting new avenues towards the gradual formalization and sustainability of peri-urban informal settlements.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Distribution, Over Years, of Papers and Citations on "Peri-Urban AND Sustainability" in the Web of Science Database

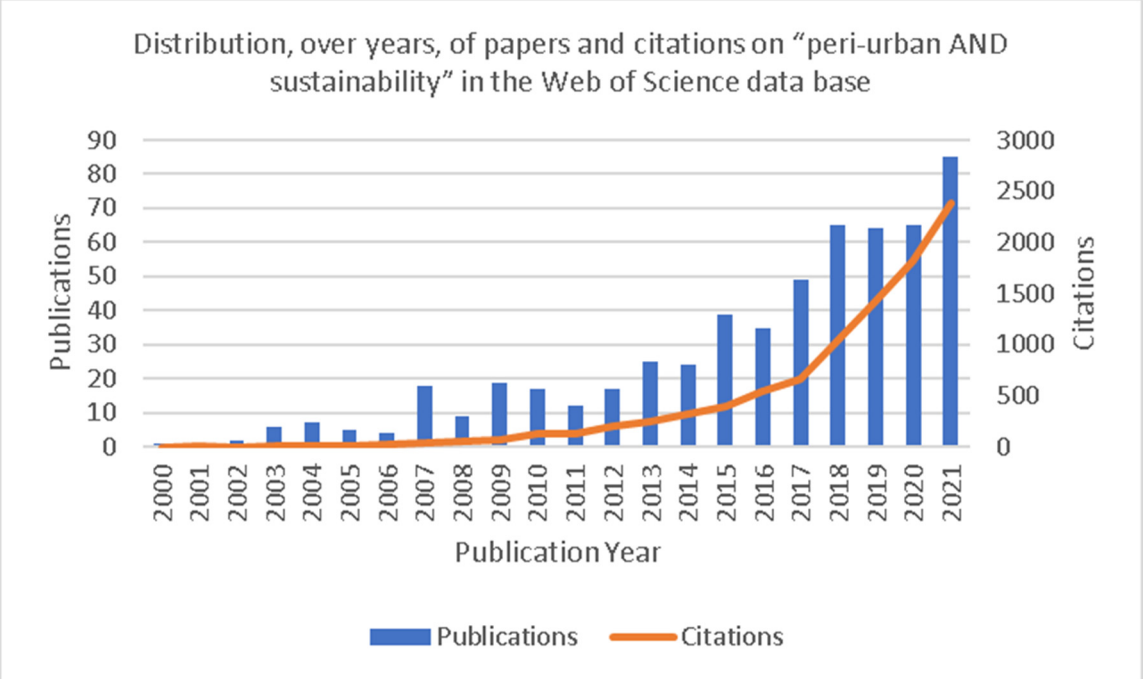

Figure A1. Distribution of papers and citations on "peri-urban and sustainability" in the Web of Science database. Source: Data from Web of Science, provided by Clarivate. Web of Science and Clarivate are trademarks of their respective owners and used herein with permission.

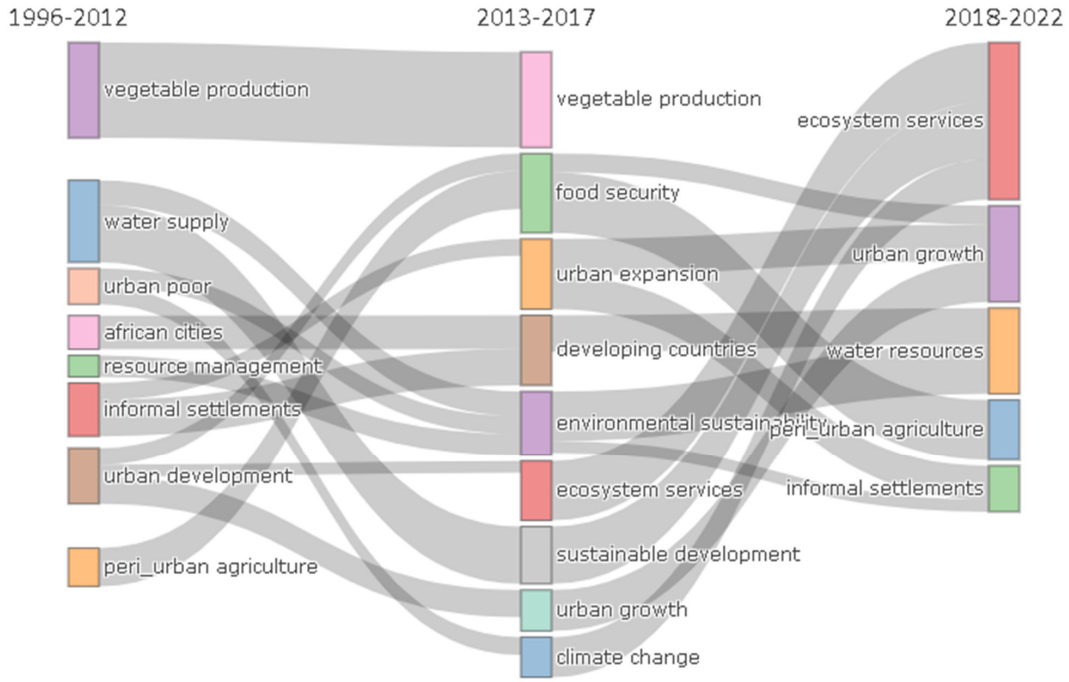

Figure A2. Thematic evolution on sustainability in the peri-urban territory (produced with Biblioshiny of Bibliometrix for R [155] (version 3.2.1; March 2022. Naples, Italy), [156] (version 4.1.3; March 2022. Vienna, Austria).

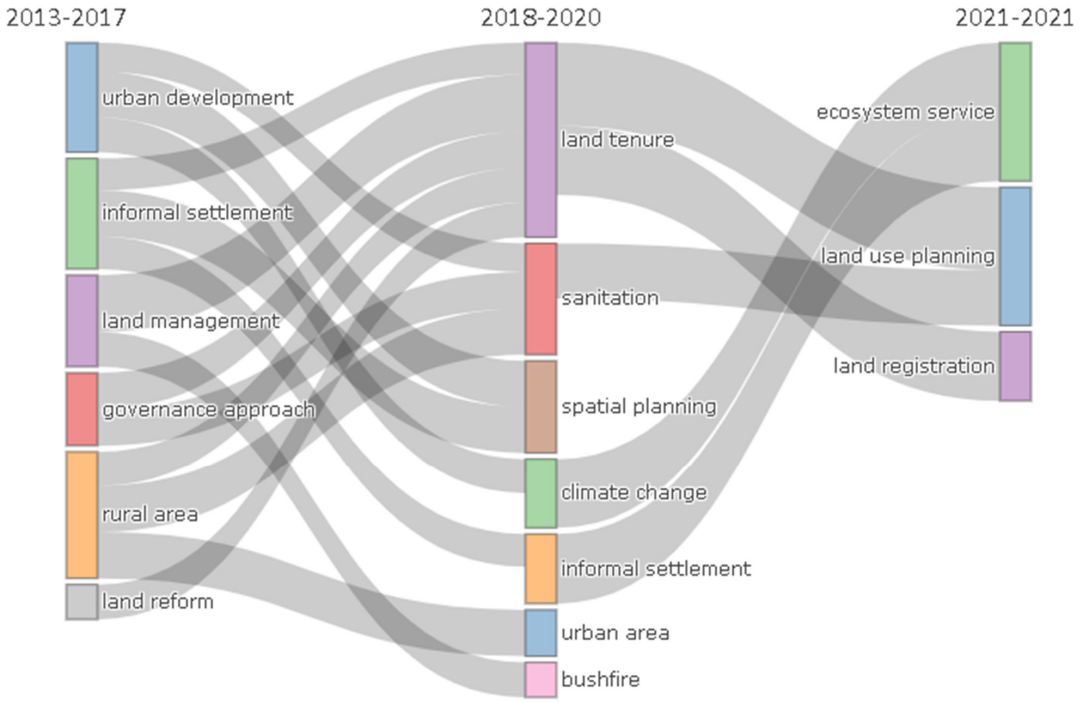

Figure A3. Thematic evolution in the reviewed literature on peri-urban informal settlements (produced with Biblioshiny of Bibliometrix for R [155] (version 3.2.1; March, 2022. Naples, Italy), [156] (version 4.1.3; March 2022. Vienna, Austria).

Appendix B. The Most Frequent Words, Bigrams, and Trigrams

Table A1. The 20 most frequent words, bigrams, and trigrams in the body text of the corpus.

Unigram	Count	Bigram	Count	Trigram	Count
land	3340	peri urban	656	peri urban area	212
urban	2538	informal settlement	573	peri urban land	136
informal	1193	urban land	288	land use planning	73
settlement	1113	land tenure	184	urban land use	50
city	882	urban village	181	land access system	41
water	762	land management	164	peri urban space	40
service	717	climate change	142	peri urban settlement	37
housing	640	private firm	122	land management framework	37
community	618	land conflict	121	pour flush toilet	34
local	609	urban expansion	114	urban land management	33
sanitation	593	middle class	112	land use policy	32
system	592	land administration	109	land use management	31
household	516	rural urban	103	urban land conflict	28
process	510	land planning	96	urban rural land	27
food	493	land access	87	land tenure right	26
access	476	tenure security	83	trigger veto barrier	26
change	453	socio economic	73	land use conflict	26
resident	451	service provision	71	planning surveying service	26
rural	442	informal land	70	land use change	25
planning	431	population growth	66	Sub-Saharan Africa	24

Appendix C. Codebook, Articles (Cases) with Code, and Code Frequency

Table A2. Codebook: number and percentage of cases with code.

Category (Subcategory)	Code	Description	Cases or Articles (*n*)	Cases (%)
1. Drivers and Motivations			-	-
1.1. Structural Context	History and geography	Deals with the past and present cultural connections, and the typical additional keywords and expressions are colonization; legal system; geography; frontiers. Deals also with settlement patterns, i.e., the distribution of people in the territory and relates to urbanization, actual land use, location, resources, density, global position. Typical additional keywords and concepts are urban expansion, urban sprawl, suburbanization, villages, natural resources, expansion, drivers.	54	43%
	History OR geography		103	82%
	Tenure systems	Keywords: tenure AND (*system* OR *secure* OR *custom* OR *law* OR *legal* OR *right*). Deals also with property rights, transfer, rent, sales, taxation, subsidies; compensation; expropriation.	68	54%

Table A2. *Cont.*

Category (Subcategory)	Code	Description	Cases or Articles (*n*)	Cases (%)
	Power system and administration and development model	Refers to democracy, autocracy; centralized; decentralized; segregation; local administration. Typical additional keywords and expressions are administration, borders, administrative division, political system, economic system, power relations, legal pluralism. Refers to conditions and enabling environment for investment and cost-reduction.	70	56%
1.2. Flows and processes of change	Population	Deals with population composition, growth rate, demographic dividend. Typical keywords and expressions: youth, female, minorities, growth rate, housing, food security, leisure. Deals also with migrations, ethnic mix, resettlement and displacement, and family, and these are the typical keywords and expressions. Includes social organization, social space, patri- or matrilinearity, measures of success.	47	37%
	Environmental change	It is related to land use and cover change, conversion, risks, resilience, prevention. Additional typical keywords and expressions include water, wetlands, arid lands, river, biodiversity, air. Refers also to man-made environmental changes that drives urban expansion (or contraction).	73	58%
	Social institutional capacity to address change	This code relates to the capacity to formulate spatial plans, as well as its monitoring, enforcement, and conflict resolution. Typical keywords include public administration, inspection, law, courts, tribunals, mediation, customary law.	76	60%
2. Practices and Challenges			-	-
2.1. Sociocultural	Service provision	What and how services are provided, resource allocation for building and maintain infrastructure, segmentation, safety nets, and redistribution. Additional keywords and expressions are water, energy, schools, clinics, health, police, responsiveness. Creation and expansion of water, education, health, sanitation, production, and waste infrastructure is combined.	56	44%
2.2. Environmental	Regulatory practices	The presence of regulations to respect the natural aptitude and carrying capacity, consolidation, diversity, and risk reduction. Additional keywords and expressions are land use planning, land consolidation, diversity, adaptation, waste management, carrying capacity.	19	15%

Table A2. *Cont.*

Category (Subcategory)	Code	Description	Cases or Articles (*n*)	Cases (%)
2.3. Economic	Production and consumption patterns	Refers to economic activity: how allocation of land for various purposes is/was made. Includes procedures to provide tenure security, market of resources, and relates to production and consumption, dietary patterns, recycling, circular economy, marketing, relocation, translocation.	106	84%
2.4. Governance mode	Institutions—actors and rules	Formal and informal actors, rules, law; legality; conflict resolution; consensus building.	53	42%
	State-based and PPP	When the state and government are the main actor in providing services and building and maintaining infrastructure, and mostly influences life by also being the mains customer. Typical keywords and expressions include budgeting, allocation, coverage, quality of services.	14	11%
	Market-based	With the support of the government, through fiscal policy, investment facilitation, and CRS, services and goods are provided by the private sector, and the typical additional keywords are incentives, business index, connection, business organizations.	28	22%
	Community-based inclusive governance	This mode of governance ensures participation, education, and civil society involvement in promoting practices and delivering outcomes.	74	59%
	Participation	Public participation, information and knowledge sharing, collaboration, local knowledge, participatory SIG, action research.	17	14%
3. Impacts and Future Challenges			-	-
	Sociocultural impact	Refers to inequality, segregation, unrest, vulnerability. Typical additional keywords and expressions are heterogeneity, riot, poor, poverty, Gini, affluent, wealth distribution, injustice, gated communities.	30	24%
	Environmental impact	Impacts and challenges on the environment refer to promotion of unbound use of limited natural resources, fragmentation, diversity loss, increased risks to disasters, and additional typical keywords and expressions include clearance, fire, floods, fragmentation, deforestation, drought, GHG emissions, pollution, exposure.	21	17%

Table A2. *Cont.*

Category (Subcategory)	Code	Description	Cases or Articles (*n*)	Cases (%)
	Economic impact	Refers to inefficiency, non-competitiveness, economic exclusion, and additional keywords and expressions are debt, demand, lack of resources, informality, middle class, bankruptcy.	35	28%
	Institutional impact	Institutional impacts encompass unpredictability resulting from procedural or legal stability, conflicts, and inertias. Additional keywords and expressions are inaccessible, corruption, impunity, fees, weak government.	7	6%
4. Future Practices			-	-
4.1. Strategic	Planning and requalification	Recommendations on spatial planning, requalification, land development. Includes words and expressions such as participatory planning, allotment, reserves, open space, protected zones, zoning.	36	29%
	Implementation	Refers to recommendations on how to implement plans, and the typical keywords and expressions are reclassification, demarcation, civil involvement, recognition of rights, training, communication, public evaluation. Example: land AND (*implement* OR *spatial plan* OR *reclassify* OR *regularize* OR *title* OR *recogni* OR *formalize* OR *demarcate* OR *register* OR *adjudicate* OR *conflict resolution* OR *mediate*).	66	52%
4.2. Systemic	Transformation	Recommendations on practices aiming at transforming the current state: policy, advocacy, mobilization. Includes sustainable development in general.	40	32%

* a wildcard to include words with the same root.

Appendix D. Heatmap of Code Occurrences by % of Number of Articles (n = 126), Clustered per Codes, per Year

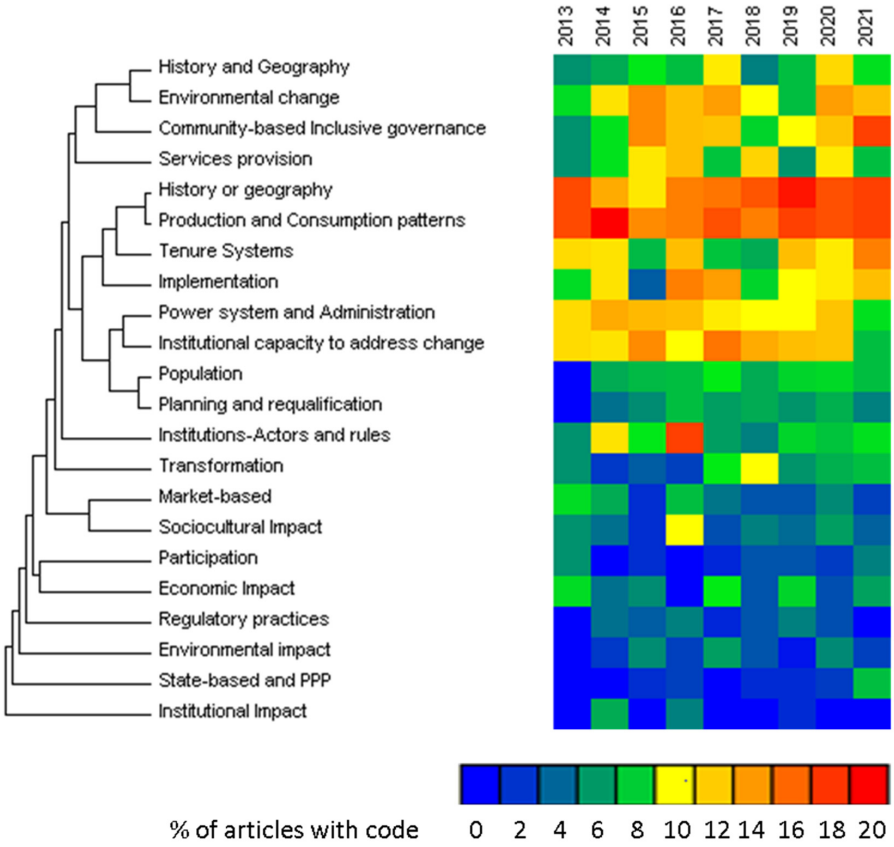

Figure A4. Heatmap of code co-occurrences by % of number of articles (*n* = 126), clustered per codes, per year.

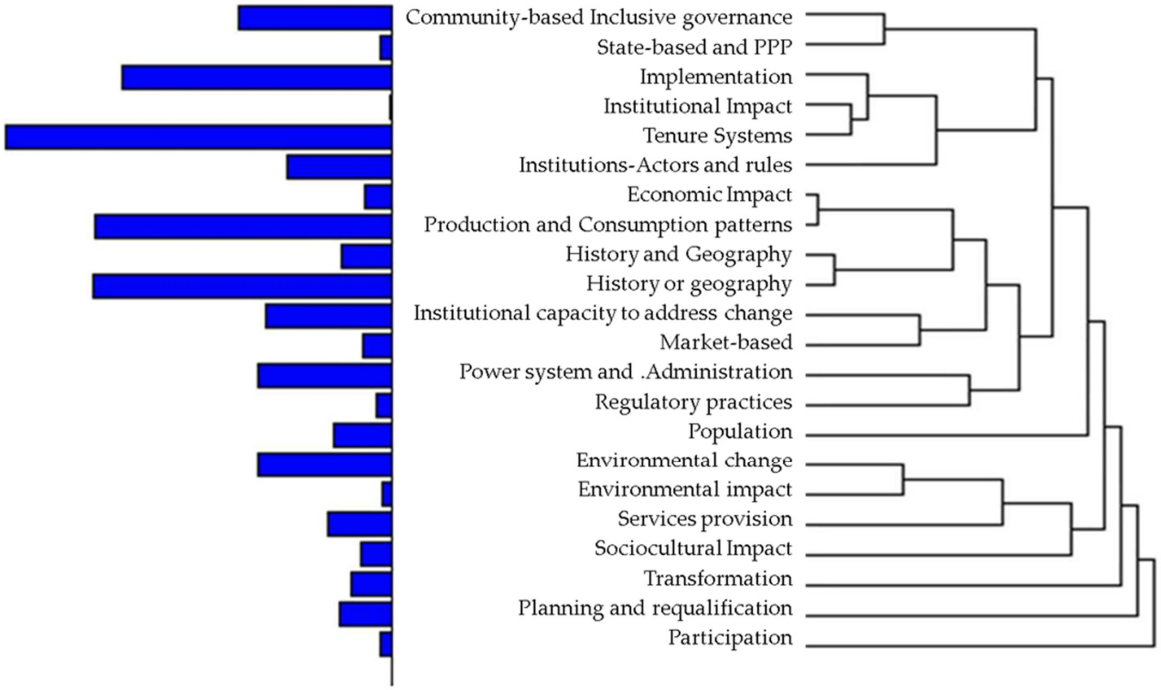

Figure A5. Dendrogram, with agglomeration by inclusion order and frequency of codes.

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