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A Geospatial Model of Periurbanization—The Case of Three Intermediate-Sized and Subregional Cities in Chile

Gerardo Francisco Ubilla-Bravo

Departamento de Gestión e Innovación Rural, Facultad de Ciencias Agronómicas, Universidad de Chile, Santa Rosa 11315, La Pintana 8820808, Chile; gerardo.ubilla_bravo@yahoo.fr or gerardoub@uchile.cl

Abstract: Throughout the 20th century and in the first decades of the 21st century, the geospatial dynamic exhibiting the highest rate of change globally corresponds to urban expansion surrounding metropolitan areas and large cities. Around intermediate-sized cities, there have also been rapid changes in their geographical space, but study in these areas has had less academic attention and development. Considering this context, this article intends to analyze the dynamics in the periurbanization of communes with intermediate-sized cities. In this study, three geographical criteria were defined for the definition of the study area and seven geospatial indicators of sociodemographic, socioeconomic and land occupation categories, with the purpose of determining the composition of the periurbanization process. Finally, the discussion presents a perspective on the dynamics of periurbanization, the interpretation of future projections identifying three geospatial phenomena and a proposal for a geospatial choromatic model with the composition of periurbanization, based on three subregional intermediate-sized cities in the Metropolitan Region of Santiago de Chile. This research contributes new reflections to the debate around spatial planning and periurban research in Latin America and the Global South.

Keywords: Chile; geospatial model; intermediate-size cities; periurban area; periurbanization; rururbanization; subregional cities; suburbanization

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1. Introduction

On a global scale, studies examining geospatial dynamics with the highest rate of change highlight urban expansion, especially around metropolitan areas and large cities [1,2]. In this context, the phenomenon of urban expansion has solidified processes that lean towards metropolization and the formation of megalopolises [3]. However, other geospatial configurations have also emerged, receiving less attention and development, such as the phenomenon of periurbanization. This is not equivalent to urban expansion but contributes to it [4] and its internal composition.

Regarding the type of human settlements, medium- or intermediate-sized cities at the subregional level have also experienced less proliferation of knowledge compared to large cities, which also face specific challenges [5]. Therefore, it is relevant for geography as part of the spatial sciences to extend scientific knowledge about all processes and patterns in the geographic space. Consequently, it is necessary to examine the phenomenon of periurbanization in intermediate-sized cities. Additionally, it should be noted that in the scientific literature, the production of geospatial models to represent these particular phenomena is not observed.

To gain a better understanding of the periurbanization process, the specific objectives of this research are proposed as follows: (i) to analyze the variation in different population categories in intermediate-sized cities, and (ii) to characterize the proportion and evolution of land use in periurban areas. These objectives lead to the main goal, which is to determine the composition of the periurbanization process through a geospatial choromatic model using chorems and based on three cities located in the central region of Chile. The logical

sequence for achieving this goal involves, firstly, conducting a literature review on the general geohistorical context in Latin America and Chile and subsequently, defining key concepts of geospatial categories specific to the Chilean case. This culminates in addressing the research problem, formulating relevant research questions, and testing a hypothesis based on a theoretical model. In the methodological framework, criteria are applied for defining the study area as well as the indicators that will be analyzed. The results account for dynamics over a range of three to four decades. Finally, the discussion section emphasizes the significance of the findings regarding periurban dynamics, their projections, and ultimately, the intricate composition of the periurban area, with the support of the chorematic technique.

1.1. State of the Literature and Conceptual Framework: General Context of Urban Expansion in Latin America and Chile

At the end of the 20th century and the beginning of the 21st century, various processes unfolded globally and particularly in Latin America. These included deindustrialization, post-Fordism, internationalization, the development of the global city, and socio-spatial polarization [6]. These processes represent the spatial expressions of globalization [7]. Another factor to consider is the explosive surge in urban expansion or growth worldwide [8]. One of its consequences is the fragmented nature of urban areas on the periphery of major cities, characterized by a mixture of land use [9].

The authors who have studied urban expansion and dispersion in major cities of Latin America have highlighted their significant transformations, such as in Mexico City [10,11], Buenos Aires [12,13], Santiago [14,15], Sao Paulo [16], Bogotá [17], and Quito [18]. These cities experienced a trajectory of constant demographic and spatial growth between the 15th and 20th centuries [19]. All these authors concluded that economic globalization aides the development of information and communication technologies, which improves infrastructure and transportation. These elements contribute to the fragmented form of the periphery [20] in major Latin American cities [19]. This situation leads to a discussion about the nature of urban growth based on two theories of geospatial organization: the compact city and the diffuse city [9,21]. The compact city is associated with the intensive use of urban areas within a limited space compared to metropolitan areas [21–23]. The diffuse city primarily explains the socio-spatial phenomena that occur in the urban–rural interface, where fragmentation and urban dispersion prevail [9]. These areas exhibit a high level of complexity regarding land use transformations [24], prompting an inquiry into the power relationships among actors in the periurban zone [25,26] as well as how to perceive and to coordinate this geographic space [27]. Chapuis [28] has proposed four factors of periurbanization: (i) the increase in the standard of living of the population leads to the purchase of a house and cars; (ii) the value of the land market is cheaper than in the city; (iii) the degradation of the positive image of the city in that it is considered polluted, noisy, and inhumane; and (iv) the valorization of the countryside as a symbol of calm, nature, security, and identity.

In terms of Latin America, Allen [29] addressed the complexity of periurban areas, also referred to as the urban–rural interface, and suggested advancing their analysis. Additionally, he emphasized the need to employ alternative theories (beyond the compact city and diffuse city) to comprehend the various emerging phenomena. The author introduced the term "periurban interface" (PUI) to refer to these areas and established categories to distinguish different approaches or research frameworks: "(i) periurban areas as city peripheries; (ii) periurban areas as socioeconomic peripheries; (iii) PUI as an interaction between rural and urban flows; (iv) PUI as an ecological, socioeconomic, and institutional mosaic" [29] (pp. 2–3).

The phenomenon of urban expansion is not exclusive to large urban areas or metropolises. Sereno, Santamaría, and Santarelli [30] highlighted this process in medium-sized cities in Argentina, referring to these areas as "rururban" areas, and analyze the "impacts of global urban pressures and the sense of belonging on the willingness to change their way

of life and the fate of the lands" [30] (p. 41). Additionally, Ávila [31] suggested using the concept of "periurban" to address the process of cities expanding into their rural areas. He particularly emphasizes the heterogeneity of the actors involved in the periurban space in Latin America.

In Chile, since the 1970s, and particularly in the Metropolitan Region of Santiago, the situation of the urban–rural interface or periurban area corresponds to the same phenomenon of economic globalization, where urban and suburban growth is discontinuous and fragmented [32]. Likewise, two types of growth are observed: one of a precarious nature "linked to a process of de-ruralization [dependent on] the dynamics of the [agricultural] export sector" [33] (p. 13); and another associated with a population with higher incomes and better socio-economic conditions [32]. Armijo [33] noted the advance of accelerated urbanization in the rural areas of the Metropolitan Region of Santiago, especially in the capital city's metropolis [34]. Among the new land uses are installations of industries established in a dispersed manner across the territory and enclosed lots and condominiums for high-income populations [35].

From this context, it can be emphasized that urban expansion in Latin America, and particularly in Chile, has been the subject of several studies [10,12,18]. However, the evolution of the land use mixture beyond large cities needs to be analyzed with a specific focus on the periurban area.

1.2. Key Concepts, Research Problem, and Hypotheses

The periurban areas surrounding the Metropolitan Area of Santiago, as well as those of intermediate-sized cities in the Metropolitan Region of Santiago, are complex areas to define. Due to the absence of an official definition of periurban by the Chilean State, six notions are reviewed here that enable an approach to understanding the periurban. These are: urban area, urban limit, rural area, human settlement, capital city of a commune, suburban area, parcela de agrado, and hamlet.

The General Ordinance of the Urbanism and Construction Law [36] provides the definitions for the first three terms in Chile. An urban area is defined as the "territorial surface located within the urban limit, destined for the harmonious development of populated centers and their existing and projected activities according to the [urban regulation] instrument". An urban limit is the "imaginary line that delimits the urban areas and urban expansion indicated in the [urban regulation] instruments". A rural area is the "territory located outside the urban limit".

The latter has sparked criticism [4] because it proposes a meaning associated with the exclusion of the urban. A human settlement is a constructed geographical space where individuals can carry out their vital activities, such as living and producing (either permanently or temporarily). This settlement can have any number of inhabitants and can be concentrated or dispersed [37]. In Chile, a city is a category of human settlement with more than 5000 inhabitants, which also constitutes an urban area (National Institute of Statistics of Chile—INE Chile [38–40]). A city capital of a commune corresponds to the urban area where the commune is located within its jurisdictional territory. Generally, it corresponds to the city that concentrates the majority of the population of the communal territory.

Continuing with the definitions, the suburban area corresponds to a human settlement with low population density. The Metropolitan Regulatory Plan of Santiago [41] determines the typologies that allow for the development of suburban areas. There are two types: areas to be urbanized up to 16 in/ha (equivalent to the parcela de agrado) and the Mixed Agricultural Interest Area (transition areas of populated cores) [41]. Based on the previous definition, a parcela de agrado is considered a human settlement with low population density comprising a set of properties, each with an area of 5000 m^2. It is worth noting that agricultural activities are not carried out on these properties. Finally, a hamlet is a "rural entity with its own name that has 3 or more dwellings, close to each other, with fewer than 301 inhabitants, and is not part of another entity" [40] (p. 4).

As reviewed throughout this section, context has been provided on urban growth or expansion in Latin America with a focus on large cities. This was followed by a conceptual examination of the periurban and other notions within six geospatial categories applied to Chile. However, within this context, a more systematic treatment of the periurban, such as the identification of its internal composition, is not clear from an academic standpoint. Considering these ideas, the questions driving this research are as follows: how have sociodemographic, socioeconomic, and land use dynamics developed in the periurban areas of communes with intermediate cities? Do these dynamics allow for the identification of periurbanization components around subregional intermediate-sized cities? In this regard, it is posited that the process of periurbanization does indeed occur around subregional intermediate-sized cities in Chile. However, there is a lack of a geospatial model with its internal composition. Additionally, the following question is posed: Is the composition of this periurban area continuous or discontinuous in nature? Thus, the hypothesis proposed is that the geospatial expression of periurban areas around subregional intermediate-sized cities in Chile is of a discontinuous type. It is argued, then, that the built areas are dispersed with various uses, as proposed in Pouyanne's theoretical model [42]. In order to address the questions and validate the hypothesis, a methodological strategy is employed that incorporates criteria for defining these cities in the case of the Metropolitan Region of Santiago.

2. Materials and Methods

2.1. Selection and Justification of the Study Area

As outlined in the problem statement, the study area encompasses periurban areas surrounding subregional intermediate-sized cities, particularly those situated within the urban system of the Metropolitan Region of Santiago. The city of Santiago, also known as the Metropolitan Area of Santiago, was excluded due to its status as the primary urban settlement in the region and being of large size. To identify intermediate-sized cities, three criteria were taken into account: (i) recognition as a subregional center, (ii) competition for land use, and (iii) the functional centrality of cities at the regional level.

The first criterion should enable the selection of cities recognized as subregional centers in the Metropolitan Region of Santiago. Thus, the final proposal of the Environmentally Sustainable Territorial Planning Project was considered relevant input since it defines these centers [43]. Similarly, the urban population data collected by INE Chile [40] is another pertinent input. In both cases, the authors defined subregional centers based on demographic size, using a threshold of 40,000 inhabitants. The second criterion is competition for land use, which is divided into two factors: geohistorical and geoclimatic in nature. Regarding the geohistorical factor, consideration was given to the guidelines outlined in the instrument known as the Metropolitan Regulatory Plan of Santiago, which defines land uses. Additionally, a study providing results on the land use dynamics of the entire Metropolitan Region of Santiago was taken into account [44]. Thanks to these inputs, it was confirmed that the greatest competition for land is located to the south and southwest of the Metropolitan Region of Santiago. The other discriminant location factor (geoclimatic) is desertification present in the province of Chacabuco [45]. This has been a less attractive factor for recent spontaneous urbanization to the north of Santiago due to progressive water scarcity. Thus, the intermediate-sized cities in the southern and southwestern areas of the Metropolitan Region of Santiago where the proliferation of urban dispersion and fragmentation is observable have been chosen. The third criterion pertains to the use of the Davies index, which measures the functional centrality of cities based on the quantity and variety of services each city offers [46]. This condition allows for the determination of urban centers with greater functionality based on an index value of 1000. The study by Rossetti et al. [47] applied this index to all cities within the human settlement system of the Metropolitan Region of Santiago. Consequently, from the intersection of these three criteria, the communes where the subregional intermediate-sized cities of Buin, Melipilla, and Talagante (see Figures 1 and A1)[1] are located are analyzed, as summarized in Table 1.

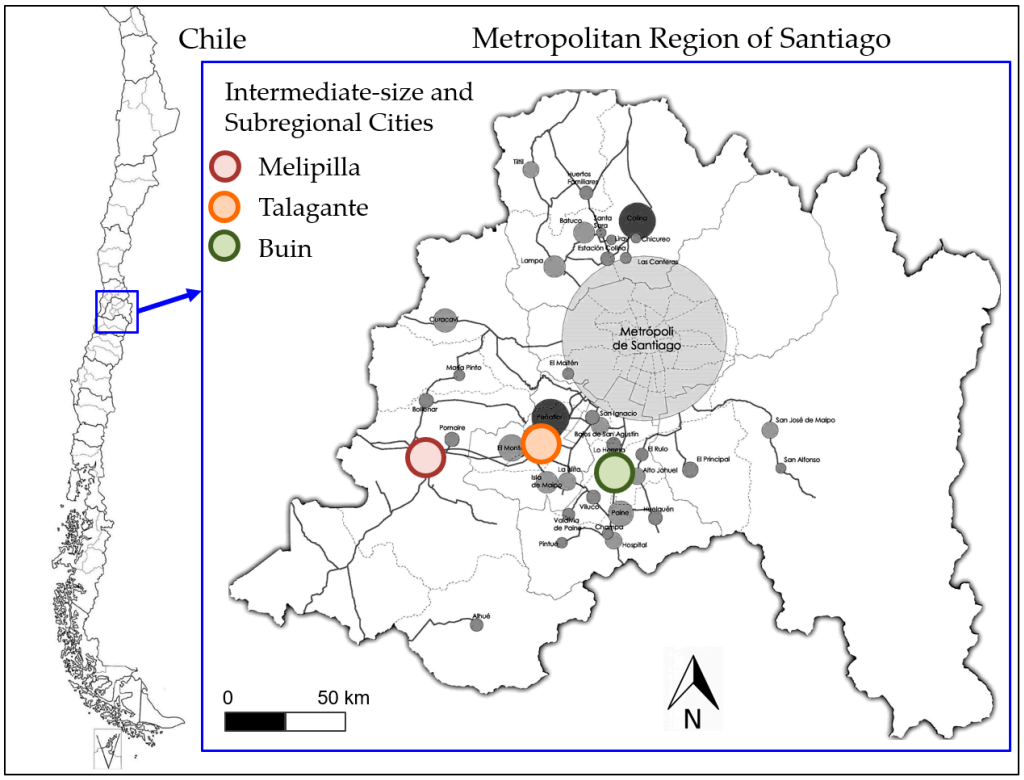

Figure 1. Study area: Intermediate-sized and subregional cities of Melipilla, Talagante, and Buin in the Metropolitan Region of Santiago, Chile. Source: Author's own elaboration based on [47,48].

Table 1. List of subregional intermediate-sized cities in the Metropolitan Region of Santiago and their selection criteria.

Criteria	Source	Subregional Intermediate-Sized Cities in the Human Settlement System
(i) Potential to be a subregional center based on population size	[43]	(i) Tiltil, (ii) Colina, (iii) Curacaví, Melipilla, (iv) San José de Maipo, (v) Buin, (vi) Talagante and (vii) Alhué.
	[40]	(i) Peñaflor, (ii) Colina, (iii) Melipilla, (iv) Talagante, (v) Buin and (vi) Padre Hurtado.
(ii) Competition for land use	[44,45]	(i) Buin, (ii) Isla de Maipo, (iii) Talagante, (iv) El Monte and (v) Melipilla.
(iii) Functional centrality of cities	[47]	(i) Melipilla, (ii) Talagante and (iii) Buin.

Source: Author's own elaboration.

2.2. Compilation, Analysis, and Representation of Geospatial Data

After defining the study area, an analysis table was developed, detailing the categories of dynamics, geospatial indicators, analysis period, and primary sources (see details in Table 2) to characterize the urban, rural, and periurban areas of the specified communes. The analysis aims to measure variations in key indicators such as the urban population, rural population, economically active rural population structure, and urban area, as Sahana et al. [49] proposes, while also providing a general overview of urban, rururban, and suburban areas. For all these indicators, the geographical scale within which the work is framed is intracommunal, with the main source is the National Institute of Statistics of Chile (INE Chile). Additionally, for the analysis of the latter indicators, georeferenced vector layers and geographical data from the Metropolitan Government of Santiago (GORE RMS) and INE Chile itself are used as inputs.

Table 2. Categories and indicators for the analysis of geospatial processes in subregional intermediate-sized cities and their peri-urban areas.

Dynamics Category	Geospatial Indicator	Year or Period	Data Source Institution
Sociodemographic	Variation in Urban Population	1982–2017	INE Chile
	Variation in Rural Population	1982–2017	INE Chile
	Variation in Population in Communal Capital Cities	1982–2017	INE Chile
Socioeconomic	Variation in Rural Economically Active Population Structure	1992–2002	INE Chile
Urban Expansion and Distribution of Associated Land Uses	Variation in Urban Area	1976–2012	GORE RMS
	Proportion of Urban, Rururban, and Suburban Areas	2016	INE Chile
Land Use in the Peri-urban Area	Evolution of Land Use and Cover	2016	INE Chile y SEREMI VyU RMS

Source: Author's own elaboration.

For the population variation analysis, urban, rural, and communal head city areas are considered. Table 3 provides details on the urban entities included in the urban areas of the three communes for each census since 1982. In the case of the Buin commune, the centers of Maipo and Linderos were included in the city of Buin between 1982 and 1992. City data is calculated for the period from 1982 to 2017. Talagante city is the only exception, as it is the sole urban center in its commune. To depict the evolution of land use and cover, a modeling of the geographical space is proposed using chorems. These are the elementary structures of geographical space [50,51]. The technique is useful for providing a current diagnosis and for representing the future through a scenario, projection, or forecast. The proposed geospatial model of periurbanization in this work is based on the chorematic technique. Specifically, three basic principles of geospatial organization of chorems have been used: hierarchy (for human settlements and activities), contact (for edges), and tropism (for flow and movement).

Table 3. Human settlements considered as urban areas, by commune and year, associated with the population and housing census.

Commune	Urban Human Settlement Name	Census Year
Buin	Buin (communal capital)	1982, 1992, 2002, 2017
	Maipo	1982, conurbation with "Buin" since 1992
	Linderos	1982, conurbation with "Buin" since 1992
	Alto Jahuel	1982, 1992, 2002 and 2017
	Valdivia de Paine	1982, 1992, 2002 and 2017
	El Rulo	2002 and 2017
	Viluco	2002 and 2017
Melipilla	Melipilla (communal capital)	1982, 1992, 2002 and 2017
	Pomaire	1982, 1992, 2002 and 2017
	Bollenar	1982, 1992, 2002 and 2017
Talagante	Talagante (communal capital)	1982, 1992, 2002 and 2017

Source: Author's own elaboration.

3. Results: Geospatial Dynamics

The results are organized according to three categories of analysis—sociodemographic dynamics, socioeconomic dynamics, and urban expansion dynamics—as well as the evolution of land use and land cover models in periurban areas.

3.1. Sociodemographic and Socioeconomic Dynamics

The analysis of sociodemographic dynamics focuses on the population variable in three geographical areas: urban areas, rural areas, and capital cities of communes.

The evolution of the population in the urban areas of the three communes is characterized by consistent growth, as shown in Table 4, considering the three intercensal periods plus the total period (1982–2017). In general, the range of variation values is approximately between just under 20% at the minimum and a little over 50% at the maximum, with an average of 33.8%. One point of note is that while growth is present in all three cases and their respective periods, the temporal patterns vary in each case. Buin exhibits a steady acceleration in all three periods, ranging from 33.21% (1982–1992) to 54.96% (2002–2017). Melipilla, on the other hand, experiences a slowdown in growth during the second intercensal period (1992–2002), followed by a return to high dynamics of urban population variation (2002–2017). In the case of the commune of Talagante, the growth of urban population steadily decelerates over the three periods for which data is available, decreasing from 46.7% (1982–1992) to 18.52% (2002–2017). Considering the entire 35-year period (1982–2017) and all three cases together (see Table 4), the three communes averaged a 139% growth in urban population. In specific cases, Buin nearly tripled its urban population going from nearly 30,000 in 1982 to nearly 83,000 inhabitants in 2017, Melipilla nearly doubled its population from around 42,000 in 1982 to 85,000 inhabitants in 2017, while Talagante more than doubled its initial urban population from 25,000 in 1982 to almost 60,000 inhabitants in 2017.

Table 4. Variations in urban population in the communes of Buin, Melipilla, and Talagante. Periods from 1982 to 2017.

Variation Period / Commune	1982–1992	1992–2002	2002–2017	1982–2017
Buin	33.21%	35.29%	54.96%	179.27%
Melipilla	23.31%	18.70%	39.12%	103.63%
Talagante	46.77%	34.30%	18.52%	133.62%

Source: Author's own elaboration based on [52–54].

The variations in resident populations in the rural areas show consistent growth, with one exception, when considering the three intercensal periods along with the total period from 1982 to 2017 (see Table 5). The range of variation values is approximately between −25% as a minimum and just over 50% as a maximum, with an average of 19.5%. Similar to the previous indicator, growth is present in almost all three cases and their three periods, but the temporal patterns change in each. Thus, Buin initially experienced a demographic growth of nearly 10% (1982–1992) and then witnessed a decline or demographic decrease between 1992 and 2002 with a variation of −25.2%, which is the only exception. Subsequently, it saw its rural population grow again between 2002 and 2017 with a variation of 38.2%. In the case of Melipilla, the growth of the rural population slows down steadily over the three periods for which there is data, going from 27.75% (1982–1992) to 15.64% (2002–2017). Conversely, the commune of Talagante exhibits a constant acceleration in all three periods, from 12.57% (1982–1992) to a high dynamic variation in rural population of 52.60% (2002–2017). Considering the entire period, as shown in Table 5, spanning 35 years (1982–2017) and all three cases conjointly, the three communes averaged a 68% growth in rural population. In terms of each case, Buin saw a slight increase in its rural population from nearly 12,102 (1982) to around 13,703 (2017) inhabitants. Melipilla came close to doubling its rural population, going from about 22,600 in 1982 to 39,000 inhabitants in 2017. Meanwhile, in Talagante, the rural population grew from just over 6800 (1982) to just over 15,000 (2017) inhabitants, more than doubling.

Table 5. Variations in rural populations in the communes of Buin, Melipilla, and Talagante. Periods covered from 1982 to 2017.

Commune \ Variation Period	1982–1992	1992–2002	2002–2017	1982–2017
Buin	9.44%	−25.15%	38.23%	13.23%
Melipilla	27.75%	16.21%	15.64%	71.67%
Talagante	12.57%	27.73%	52.60%	119.42%

Source: Author's own elaboration based on [52–54].

In the case of the communal capital cities, the population variation exhibits a consistent growth pattern, as evident in Table 6, encompassing three intercensal periods along with the total period from 1982 to 2017. Overall, the range of variation values lies between approximately less than 14% as the minimum and just over 83% as the maximum, with an average of 39.3%. It is observed that growth is present in all three cases across the three periods, but the temporal patterns are similar in two out of three cases. Thus, both Buin and Melipilla experience a deceleration in their growth during the second intercensal period (1992–2002), followed by a return to a high variation dynamic in population during their third period (2002–2017). In contrast to the aforementioned, in Talagante, the growth of its population steadily decelerates across all three periods on record, shifting from 49.49% (1982–1992) to 13.85% (2002–2017). Considering the entire 35-year period (1982–2017) and all three cases together (refer to Table 6), the three cities averaged a 169% growth in their population. Regarding each case, Buin surpassed its population by more than threefold, increasing from 18,071 (1982) to over 65,000 inhabitants (2017), Melipilla nearly doubled its population, rising from around 34,000 in 1982 to just over 72,000 inhabitants in 2017, while Talagante also more than doubled its population, growing from slightly over 25,000 (1982) to nearly 57,000 inhabitants (2017).

Table 6. Population variations in the communal capital cities of Buin, Melipilla, and Talagante. Periods spanning from 1982 to 2017.

Commune \ Variation Period	1982–1992	1992–2002	2002–2017	1982–2017
Buin	82.94%	21.27%	63.65%	263.05%
Melipilla	35.74%	17.06%	34.92%	114.38%
Talagante	49.49%	34.30%	13.85%	128.57%

Source: Author's own elaboration based on [38–40].

In the past, nearly the entire population residing in rural areas was engaged in primary sector activities, primarily in agriculture, cattle, and forestry. In Chile, this situation changed during the second half of the 20th century with the introduction of new technologies in agriculture [55,56]. In this regard, the structure of the economically active rural population serves as a good indicator for measuring the economic occupation of inhabitants in relation to their source of employment. In the three studied communes, the data reveals a shift in the composition of the rural workforce structure between 1992 and 2002.[2] The percentage distribution of economic sectors has changed in all three cases. By 1992, both in Melipilla and Buin, over 60% of the rural workforce was employed in primary sector activities, while in Talagante, the proportion exceeded 50% (see Figure 2a). The situation underwent a complete turnaround in 2002 in these three communes, as tertiary sector activities accounted for the majority of the active rural population: nearly 55% for Talagante and between 40% and 45% for Buin. Melipilla still has a high proportion of inhabitants employed in primary activities, accounting for 50% of the total. The process of tertiarization of employment for inhabitants in rural areas can be observed during the intercensal period of 1992–2002 (see Figure 2b).

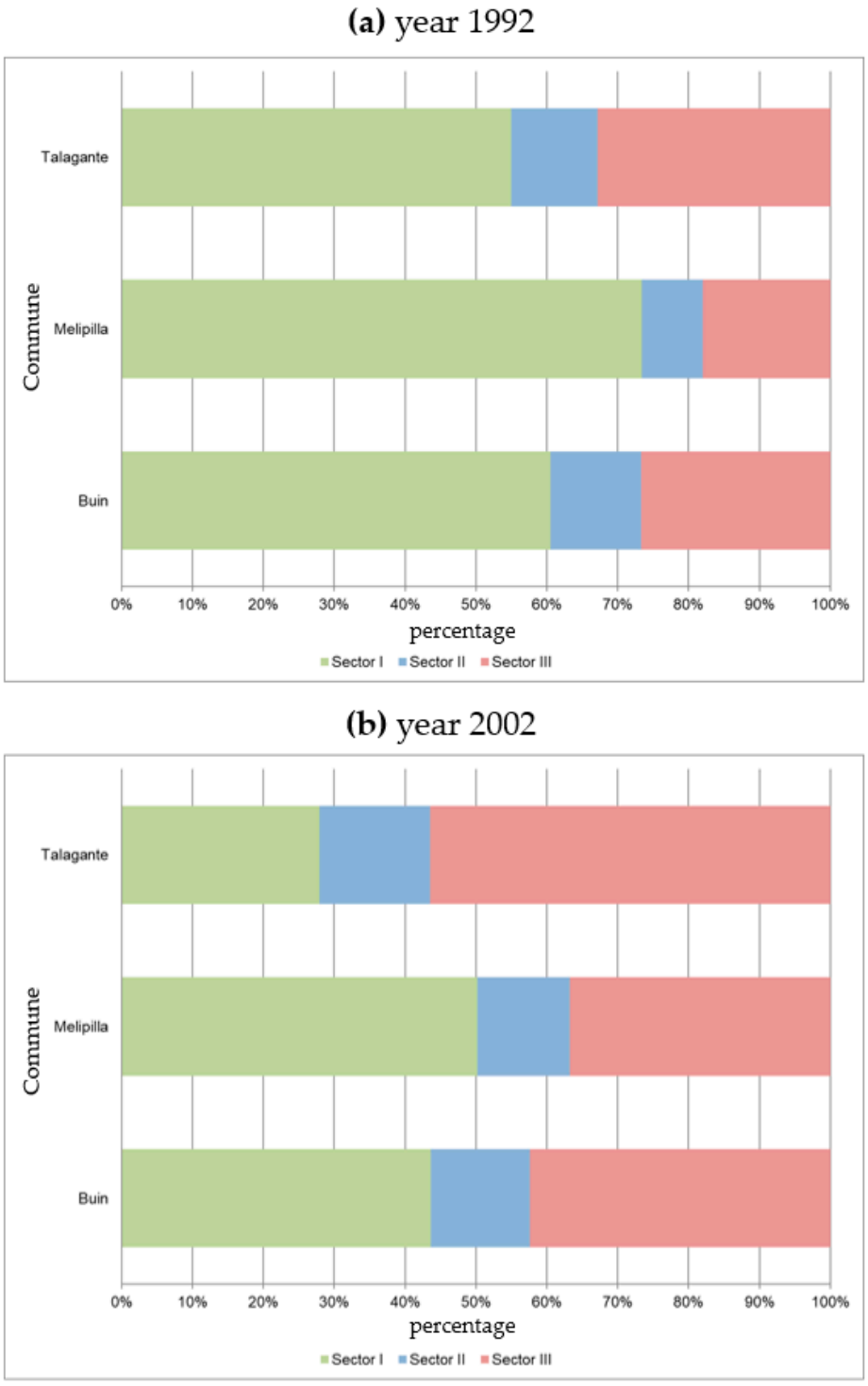

Figure 2. Structure of the economically active rural population in the communes of Buin, Melipilla, and Talagante in the years 1992 (**a**) and 2002 (**b**). Source: Author's own elaboration based on [52,53].

3.2. Dynamics of Urban Expansion and Distribution of Other Associated Land Uses

Regarding the urbanization process in the cities of Buin-Maipo, Melipilla, and Talagante, there is an observable geospatial growth in urban area (hectares per period) over two specific periods along with the overall period from 1976 to 2012. Figure 3 illustrates the net value of the urban area for each city in the respective year. Noticeable differences emerge among the three cities in terms of geospatial extension patterns and temporal pace. Buin-Maipo experienced an urban growth with an average of 8.12 net hectares per

year during the period from 1976 to 2012. The urban area expanded from 398 hectares in 1976 to 690 hectares in 2012, resulting in a variation of 73.51%. In the case of Melipilla, it exhibited a geospatial urban growth rate of 9.82 net hectares per year between 1976 and 2012, increasing from 474 hectares to 827 hectares, corresponding to a variation of 74.63%. It is noteworthy that Melipilla had the largest urban area among the three cities in the observed years (see Figure 3). Finally, Talagante showed a growth of 8.24 net hectares per year, escalating from 268 hectares in 1976 to 565 hectares in 2012. This represented the highest variation among the three in the studied period, with an increase of 110.73%, meaning it more than doubled in size over those 36 years. Considering the entire period (1976–2012) and all three cases together, it is evident that the three communes averaged an 86.29% variation in urban area, equivalent to an average of 8.73 net hectares per year.

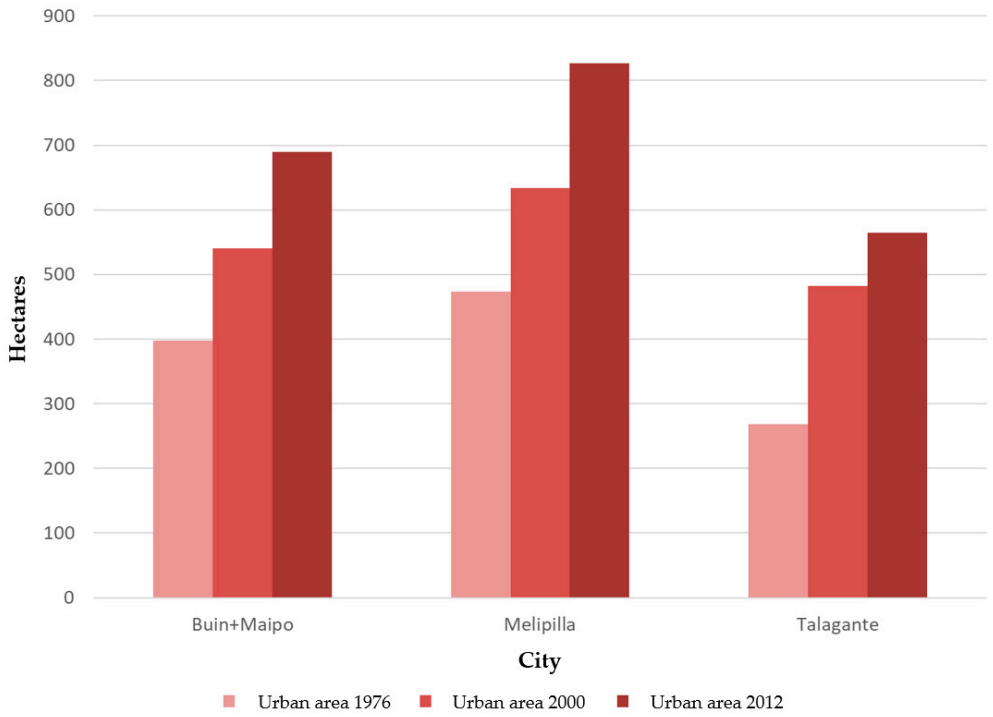

Figure 3. Geospatial variations of urban surface area in the cities of Melipilla, Talagante, and Buin in the 1976–2012 period. Source: Author's own elaboration based on [44,57,58].

INE Chile, like its counterparts in Latin America, uses the categories of urban and rural for its populated centers. However, other categories of human settlements are used as proposed in the conceptual framework of other studies [32,33]. Thus, Figure 4 illustrates the proportion between the surface areas of urban areas (divided into cities and towns), rururban areas (divided into villages and hamlets), and suburban areas (parcelas de agrado) for the three communes.[3] Based on microdata from INE Chile [59], it is observed that the three communes have most of their surface area in suburban areas, where Melipilla and Talagante each concentrate approximately 9000 ha, while Buin had around 5000 ha in 2016. Another relevant fact is that Melipilla and Buin also have a large surface area associated with hamlets (between 3000 and 5000 ha), while Talagante has very little (131 ha). In all three cases, urban areas (cities and towns) account for a proportion between 1000 and 2000 ha. One final point to highlight is the internal distribution of these uses in the commune of Talagante where suburban areas represent 88% of the total, allowing for the assertion that it is predominantly a suburban commune.

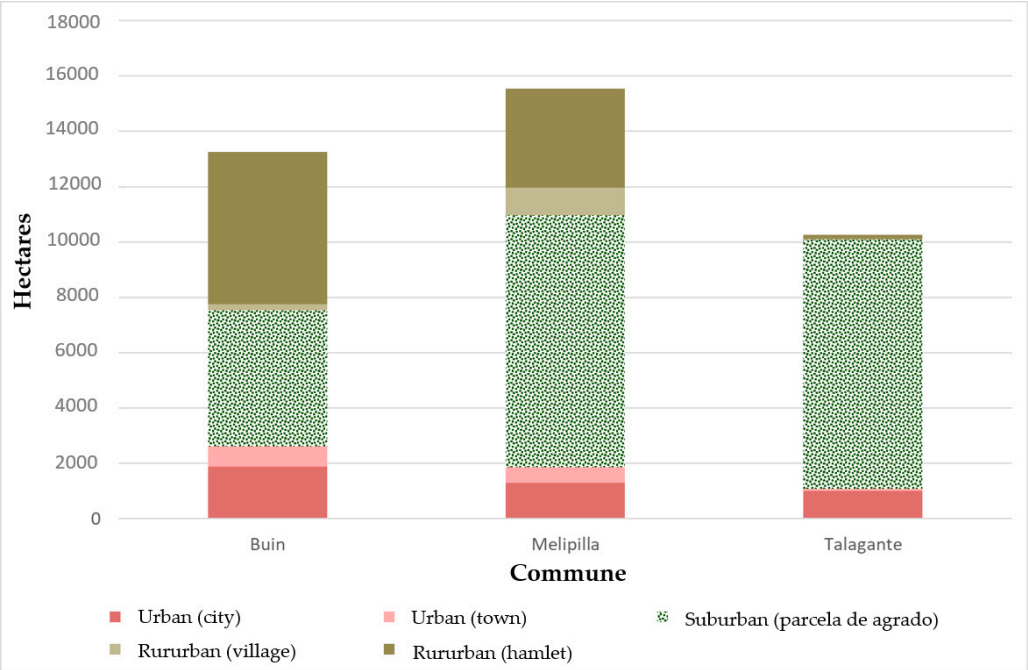

Figure 4. Distribution of the surface area of urban, rururban, and suburban areas in the communes of Melipilla, Talagante, and Buin in the year 2016. Source: Author's own elaboration based on [59].

3.3. Evolution of Land Use and Cover in the Peri-Urban Area

In Chile, the term "periurban" is not officially recognized in public nomenclature [4]. However, thanks to sociodemographic, socioeconomic, and land use indicators, it contributes to the characterization of its composition. Additionally, the category of interior periurban is considered as proposed by Ubilla and Chia [48], who rely on urban regulation instruments, which in this case is the Metropolitan Regulatory Plan of Santiago. This corresponds to the area between the consolidated urban area of 2016 and the urban limit imposed in the inclusion of the modification of the Metropolitan Regulatory Plan of Santiago [41]. With these considerations in mind, we return to the question that guides this subheading: what is the dynamic of land use and cover patterns in the three communes? The following section describes the dynamics of the interior periurban area of the three cities.

In 2016, the city of Melipilla covered an area of over 1000 hectares, which accounts for more than 30% of the 2953 hectares within the urban limit (see Figures 5a and A2).[4] In the future, the city will expand to occupy nearly 2000 hectares due to urban expansion (interior periurban, within the urban limit). However, within this urban limit, there are hills, the area adjacent to the Maipo River, and two hamlets. Regarding the hills and the area contiguous to the river, the Metropolitan Regulatory Plan of Santiago [41] has already defined them as inter-municipal parks (Cerro Esmeralda, Cerro Cementerio, and Melipilla-Río Maipo). As for the two hamlets, the regional tool has determined that they are located in an Urbanizable Priority Development Area. This may imply that the residents of the hamlets could be displaced due to the anticipated densification (up to a threshold of 160 inhabitants per hectare). This could potentially lead to conflicts with the inhabitants of the two hamlets. An area beyond Cerro Esmeralda to the west (Santa Amelia de Huechún) is already designated for suburban housing (16 inhabitants per hectare) within the urban limit [41]. Adjacent to this, beyond the city limits of Melipilla, there are some service lots along the Autopista del Sol to the north of the city (see Figures 5a and A2). In this case, these parcelas de agrado are and will continue to be maintained thanks to the Mixed Agricultural Interest Area [41]. Other geospatial elements hinder urban growth in these two directions: the Maipo River constitutes the natural boundary of the area to the southeast, and the Autopista del Sol forms the northern limit.

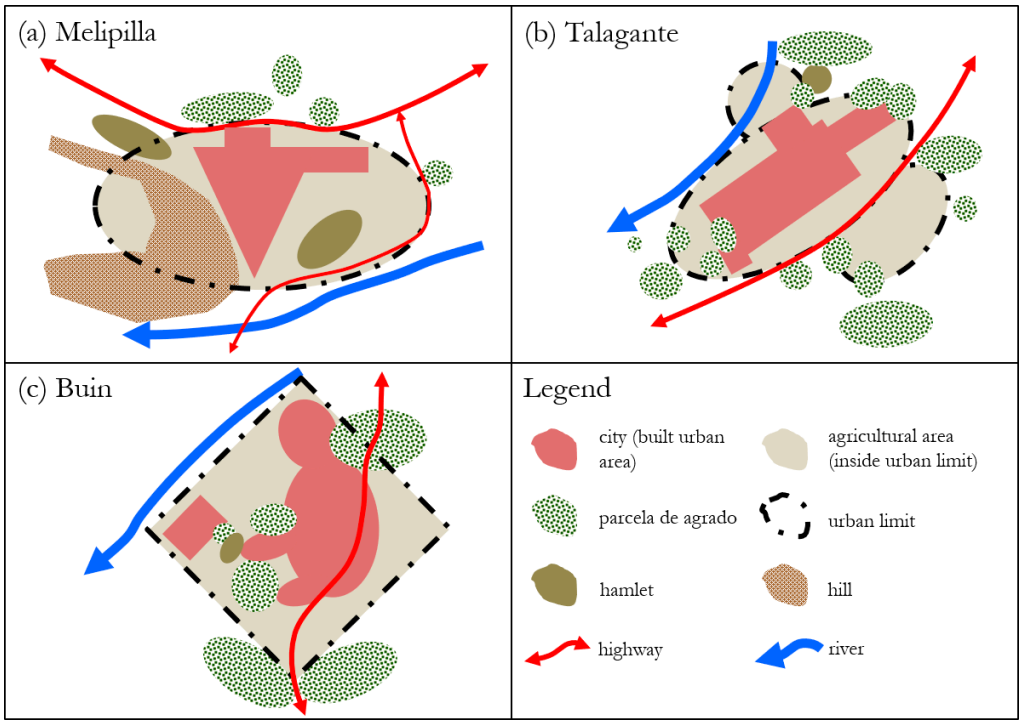

Figure 5. Simplified geospatial model—Chorems of the urban and peri-urban areas of the cities of (**a**) Melipilla, (**b**) Talagante, and (**c**) Buin.

In the case of Talagante, the city covers a slightly larger area of over 1000 hectares of urbanized land, accounting for more than half of the area within the urban limit. Concerning the interior periurban zone, the modification to the Metropolitan Regulatory Plan of Santiago [41] defined over 1000 hectares for the expansion of suburban housing, categorized as the Urbanizable Priority Development Area. However, by 2016, part of this area was already occupied by rural plots of land thanks to Decree Law (DL) No. 3516 [60] in the southeast and southwest areas. One consequence of this is competition for land use and potential neighborly conflicts. In the northeast sector, there is another parcela de agrado (Talagante Norte Ruta El Sol). In contrast to the previous case, these plots complied with the density of 16 inhabitants per hectare imposed by the regulatory instrument [41]. The rest of the Urbanizable Priority Development Area is currently occupied by several rural properties. Beyond the urban limit (exterior periurban), there is a mix of land uses: to the northwest, the Mapocho River forms a natural boundary to urbanization; to the north, there is a hamlet and the highway (Autopista del Sol) intersecting with the consolidated urban area (see Figures 5b and A3).

Unlike the cases of Melipilla and Talagante, in the commune of Buin, there are two localities within the urban boundary: Buin and Maipo. In 2016, both encompassed an area of just over 1600 hectares and have the potential to expand up to 2378 hectares. This extension was foreseen in the definition of the inner periurban area, where 1688 hectares were allocated for urban expansion. The current urban area represents more than half of this potential. Geospatially, two towns are gradually merging, but two areas of parcelas de agrado and a hamlet are situated between them (see Figures 5c and A4). The parcela de agrado to the west borders the town of Buin and is located in an area defined as "area to be urbanized up to 16 inhabitants/ha" [41]. The other parcelas de agrado are in the Urbanizable Priority Development Area, just like the hamlet and the agricultural plots, which implies that the density will need to be increased to 160 inhabitants per hectare in the future. Consequently, the occupations in these spaces are at risk of disappearing. Outside the urban boundary, there are a few plots and parcelas de agrado integrated into the eco-landscape matrix of the periurban area. All of these settlements benefit from good accessibility linked to the high-speed land communication route adjacent to the highway,

Autopista del Sol. It is worth noting that the parcelas de agrado are maintained thanks to the Mixed Agricultural Interest Area [41].

4. Discussion and Proposal of the Periurbanization Geospatial Model

Thanks to the obtained results, the elements for discussion are revealed through three themes. The first allows for a discussion on the dynamics and perspectives of the periurbanization process in Chile. Secondly, the projections are interpreted by identifying three geospatial phenomena. Finally, a geospatial Chorems-based model of periurbanization is proposed for intermediate-sized cities and its contribution to Latin America and the Global South.

4.1. Dynamics in the Periurban Areas of Subregional Intermediate-Sized Cities in Chile

This research was guided by two questions: how have the sociodemographic, socioeconomic, and land use dynamics developed in the periurban areas of communes with intermediate-sized cities? Do these dynamics allow for the identification of periurbanization components around subregional intermediate-sized cities? Regarding the first question, the results confirm sociodemographic and socioeconomic geospatial transformations for the three cities from the 1970s onwards: a continuous growth of the communal urban population and the capitals of the communes. Additionally, the manifestation of the tertiarization process of rural residents' employment, continuous and increasing urban expansion as well as the high percentage of suburban areas (parcelas de agrado) in relation to traditional urban areas have been identified. The second question invites reflection on the composition of the periurbanization process of subregional intermediate-sized cities in Chile, especially in the case of the communes studied within the Metropolitan Region of Santiago. Three geospatial facts confirm the periurbanization phenomenon: the tertiarization of rural residents' employment; the high percentage of suburban areas in the communes due to Decree Law (DL) No. 3516 [60], National Urban Development Policy of 1979 [61], Decree 420 [62]; and the definition of mixed land uses by the Metropolitan Regulatory Plan of Santiago [41]. Regarding its composition, the results demonstrate that the model of geospatial periurbanization growth (working hypothesis) corresponds to the discontinuous type proposed by Pouyanne [42] (p. 590). In recent decades, the dynamics of land use in periurban areas have generally shown a mixture containing both the agricultural matrix, *parcelas de agrado*, and hamlets. Regarding the theories of compact and diffuse cities [9,21], the urban, suburban, and rururban areas of the three study areas exhibit a transition between Gordon and Richardson's [63] compact city form and Ewing's [64] expansion form that resembles Pouyanne's model [42] (p. 590), as illustrated in Figure 6. Current public administration policies in the territory, such as the National Urban Development Policy [65], National Rural Development Policy [66], and National Spatial/Territorial Planning Policy [67], have neither guidelines nor objectives to modify these geospatial structures, leaving the market to make location decisions [68].

4.2. Projection of the Three Cases of Subregional Intermediate-Sized Cities

The projection of trends takes into account urban regulation instruments, the geospatial dynamics of the analyzed period, and the relationship between land use and the regional urban regulation instrument. Three main geospatial phenomena linked to the periurbanization process are identified: (i) the horizontal expansion of urban growth in cities, (ii) the dispersion and high proportion of parcelas de agrado, and (iii) the development of potential conflicts with established or developing human settlements.

The horizontal expansion of urban growth is a phenomenon that has developed steadily over time [69]. In all three cases, thanks to the modification of the Metropolitan Regulatory Plan of Santiago [41], National Urban Development Policy of 1979 [61] and Decree 420 [62], urban growth will become the main geospatial dynamic in the inner periurban of each analyzed city. Considering the implementation of the Urbanizable Priority Development Area category, with a projected maximum density of 160 inhabitants

per hectare, the three cities will go from a total of 150,000 inhabitants in 2016 to a total of approximately 650,000 inhabitants. However, this geospatial process leads to a reduction of agricultural plots in the inner periurban.

Regarding the second geospatial projection phenomenon, the dispersion and high proportions of parcelas de agrado are the result of free-market land policies. Parcelas de agrado have gained more surface area in the outer periurban in the cases of Melipilla and Talagante as well as in the inner periurban for Talagante. In the future, it is expected that parcelas de agrado will continue to multiply thanks to the Mixed Agricultural Interest Area [41]. In the case of Talagante, it will be necessary to observe if the normative instrument regarding land use (Urbanizable Priority Development Area) has been respected.

The third phenomenon is the emergence of potential conflicts with already established or developing human settlements. The term "potential" refers to the possible consequences of changing the provisions of the Metropolitan Regulatory Plan of Santiago [41] on the geographical space of the inner periurban. In this way, both parcelas de agrado and hamlets could change land use, as already observed in Melipilla, to become urban areas with a density of 160 inhabitants per hectare, unless the inhabitants of these areas wish to preserve them. Nevertheless, a previous study already noted disputes, opposition, and rejection by periurban inhabitants in relation to their local authorities [26] and a low level of collective learning among actors [27]. Power relations can be of the bottom-up type when the capacity for traditional exercise of power by local authorities and officials is lost. In summary, Figure 7 shows the simplified geospatial distribution of the main territorial phenomena analyzed for each commune. The chorems allow for the interpretation of three principles of geospatial organization—hierarchy, tropism, and contact—as described in the materials and methods.

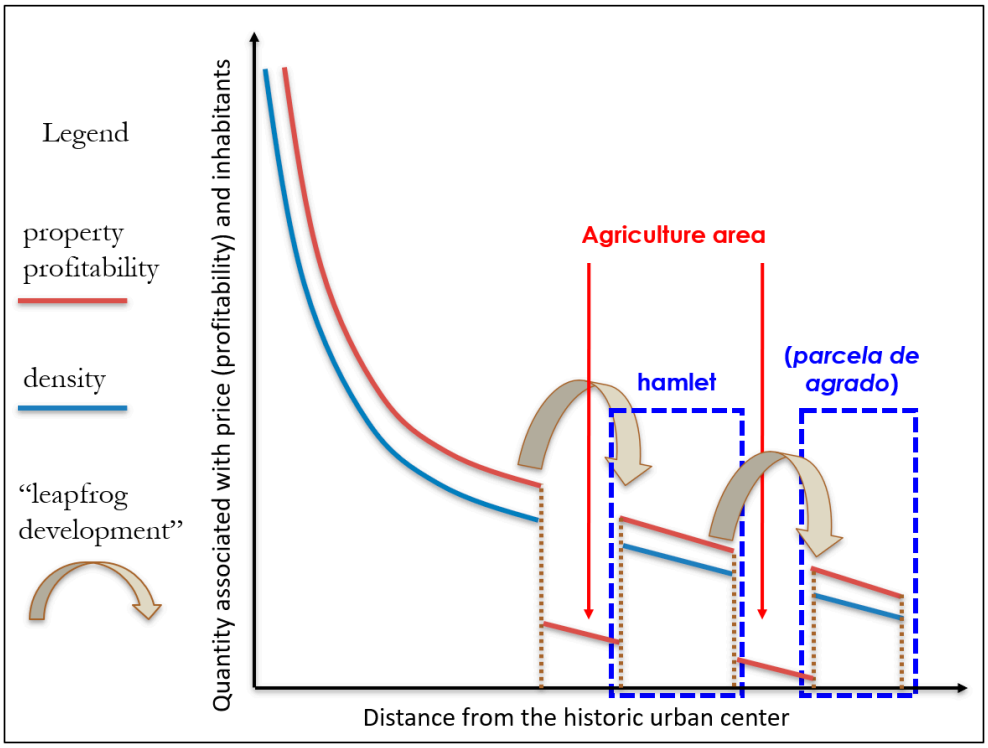

Figure 6. Model of urban discontinuity types, modified and adapted from the cases of the cities of Melipilla, Talagante, and Buin.

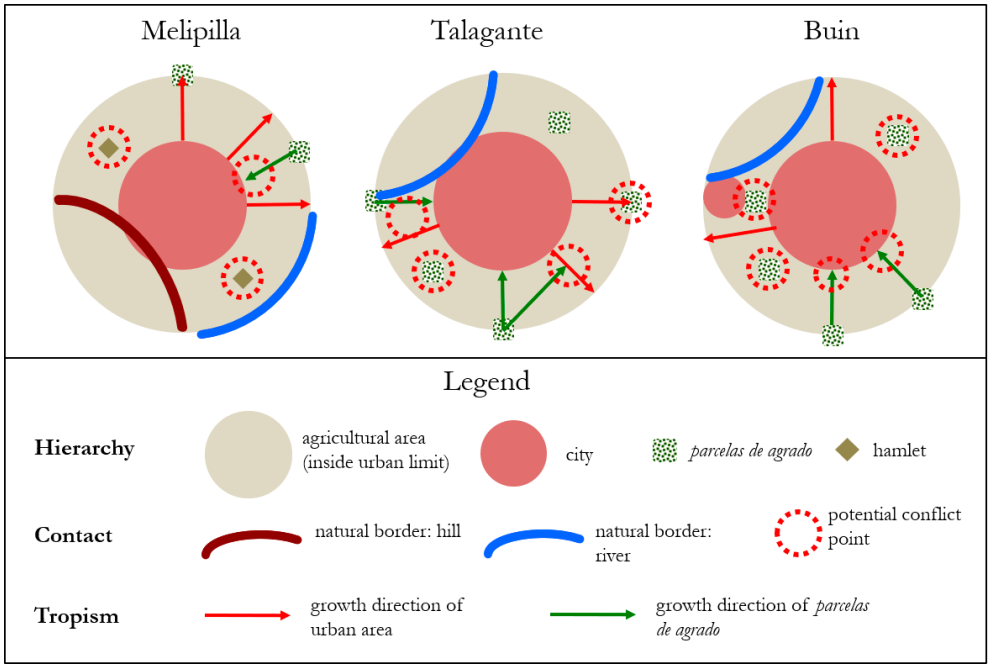

Figure 7. Chorems of urban and peri-urban areas in the cities of Buin, Melipilla, and Talagante and the projection of trends.

4.3. Composition of the Periurbanization Process in Chile: Proposal of a Geospatial Choremat Model for Subregional Intermediate-Sized Cities and Its contribution to Latin America and the Global South

This research observed a process of periurbanization in the cases of the cities of Buin, Melipilla, and Talagante over the past decades. As pointed out by Sereno et al. [30], this phenomenon also occurs in intermediate-sized or medium-sized cities [70]. This is the case for the three selected examples. While it is noted that there is no concrete definition of periurban in the public nomenclature of the Chilean state, which only considers urban and rural categories [36,40,66,71], the analysis of these three communes allows us to understand the composition of periurban spaces and the dynamics that reinforce them. Indeed, the analyzed indicators enable the characterization of the periurban, particularly by examining the evolution of land use and the evident tertiarization of rural population employment. Conceptually, the Chilean State only defines urban and rural areas [36,40,66,71], therefore there is no formalization of periurban, suburban, or rururban areas [4]. Addressing this conceptual gap, this article proposes some definitions based on the case of the Metropolitan Region of Santiago, Chile. The periurban area is contiguous to an urban area and is also the geospatial expression of periurbanization. In more detail, two categories have been adopted—the inner periurban and outer periurban. The inner periurban is the area surrounding the urban area of a city up to the urban limit imposed by the urban regulation instrument, and in this particular case, it corresponds to the modification of the Metropolitan Regulatory Plan of Santiago [41]. The outer periurban is the area contiguous or adjacent to the urban limit of the Metropolitan Regulatory Plan of Santiago, and it is recognized that it is difficult to define an outer limit for this. However, a way to address this is by conducting local studies where the communal limit is a criterion, as it is a jurisdictional space from a political and administrative perspective. These two periurbans can be compared to the model created by Bryant, Russwurm, and McLellan [72], complemented by Bryant [73] for North America, and verified in the case of Chile by Ubilla and Chia [48] who also indicated two periurban areas. The periurbanization process is formed by a set of urbanization [69], suburbanization [74], and rururbanization processes [75,76]. This process takes place in periurban areas that contain a mixture of urban, suburban, and rururban forms (see the processes and patterns in the chorematic model in Figure 8).

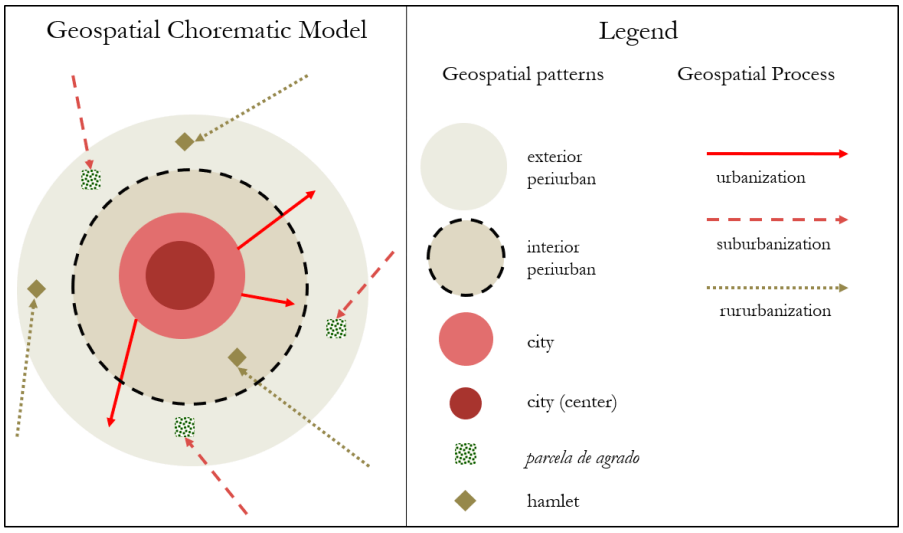

Figure 8. Geospatial chorematic model of periurbanization dynamics based on the cases of Buin, Melipilla, and Talagante (Chile).

This research contributes new reflections to the debate around periurban demarcation in the Global South [25,49,77,78], like others studies in East Asia [79] with China [80] and Vietnam [81], India [82,83], Australia [84,85], and Africa [86–89]. Likewise, this study follows a line of research to broadly understand the periurban area in Latin America. Daga et al. [90] analyzed the environmental implications and the need for a typological classification for the evaluation of sustainability. Lorda [91] studied the socioeconomic dynamics and its vulnerability [70], whereas Pola et al. [92] examined access to periurban land through the purchase and sale of properties.

It is worth mentioning that this chorematic model (see Figure 8) represents a first look at the geospatial phenomena of periurbanization dynamics. In this case, it is clearly established that the chorematic model is based on the three indicated cases and does not immediately propose that it be universal. This research does help understand the phenomenon in intermediate subregional cities for Chile within the Santiago Metropolitan Region and its implications for spatial/territorial planning [67,93].

Beyond the contribution of this research to the scientific knowledge in the field of geography and related spatial planning and sciences, it is considered that the Chilean technical-political world can play an important role by making efforts to appropriately include the concepts of periurban and periurbanization in the public nomenclature of the Chilean State. Currently, the State gives less attention to periurban areas because the priority lies in housing construction in urban zones. It is argued that there will be a need to advance in public policies that take into account the complexity of periurban areas in order to improve the living conditions of the population inhabiting them.

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Appendix A

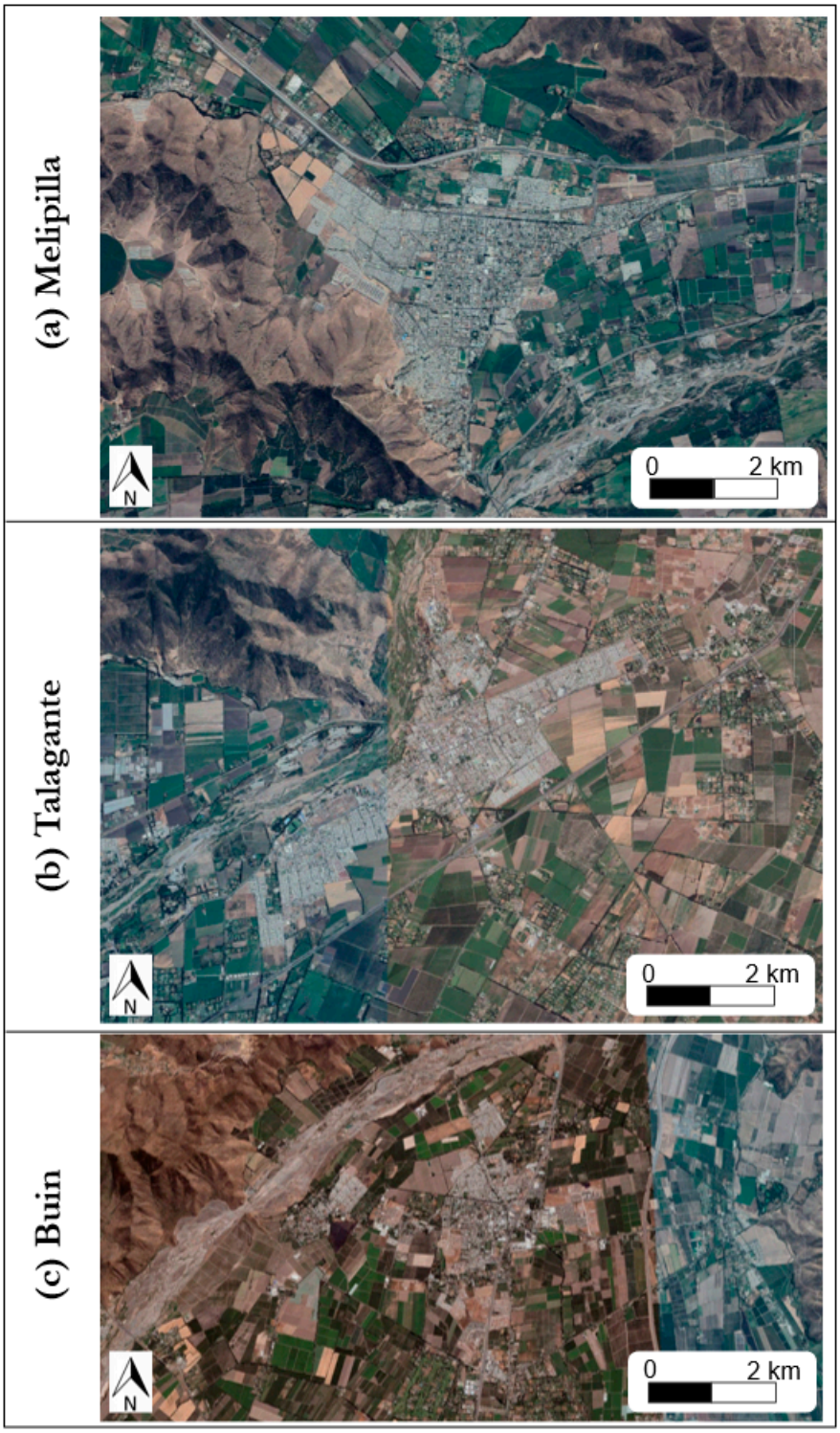

Figure A1. Satellites images of the urban and periurban areas of the cities of (**a**) Melipilla, (**b**) Talagante, and (**c**) Buin. Source: Author's own elaboration based on [94].

Appendix B

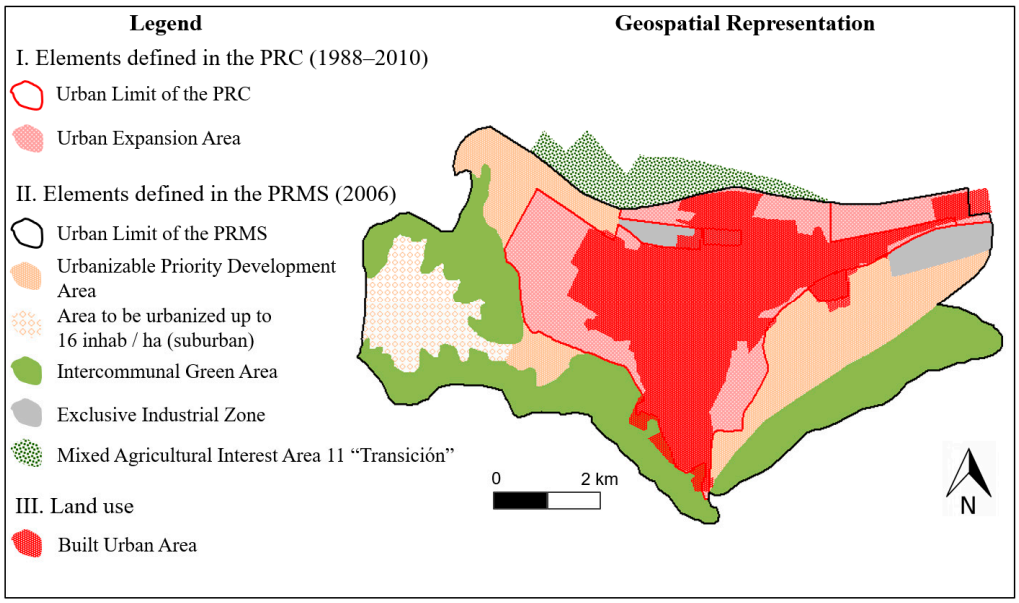

Figure A2. Geospatial elements defined by the Communal Regulatory Plan (PRC) and the Metropolitan Regulatory Plan of Santiago (PRMS) of the urban and periurban areas of Melipilla. Source: Author's own elaboration based on GORE RMS and [48].

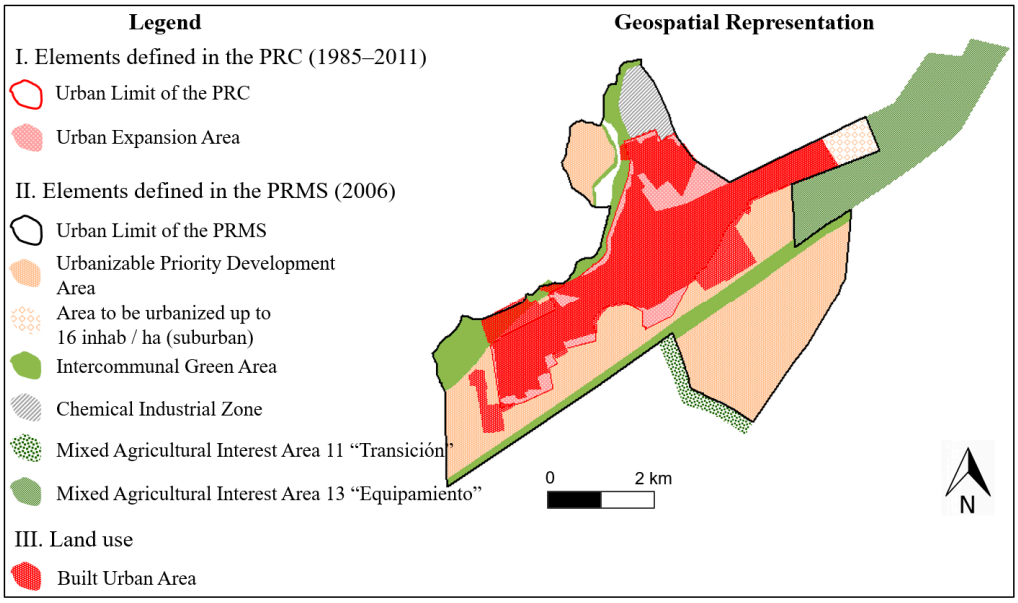

Figure A3. Geospatial elements defined by the Communal Regulatory Plan (PRC) and the Metropolitan Regulatory Plan of Santiago (PRMS) of the urban and periurban areas of Talagante. Source: Author's own elaboration based on GORE RMS and [48].

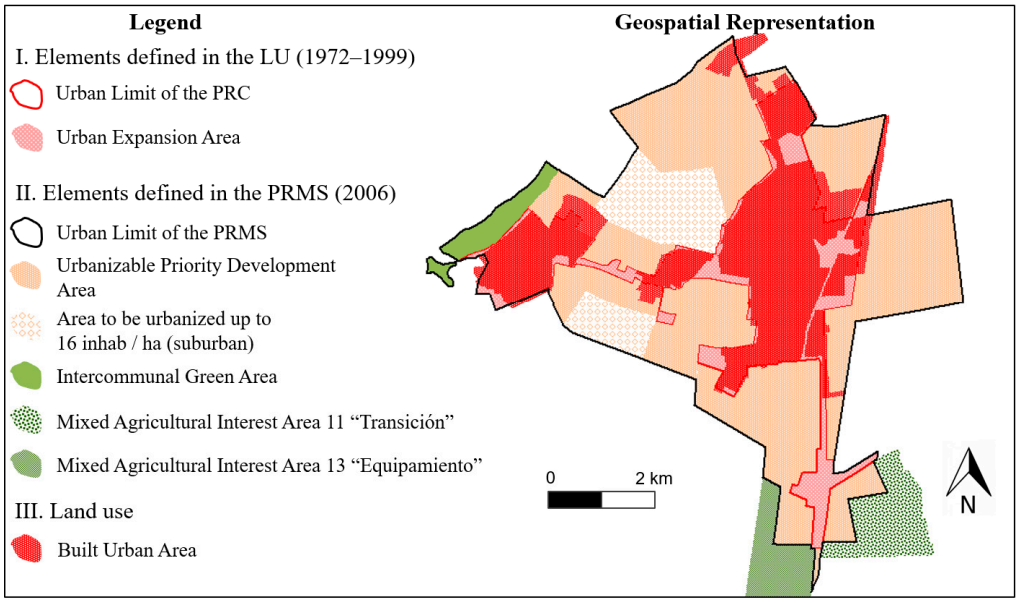

Figure A4. Geospatial elements defined by the Urban Limit (LU) and the Metropolitan Regulatory Plan of Santiago (PRMS) of the urban and periurban areas of Buin. Source: Author's own elaboration based on GORE RMS and [48].

Notes

1 Satellites images of each city are in Appendix A, Figure A1.

2 Only the years 1992 and 2002 were taken into consideration, as this question was not included in the 2017 Census. Consequently, they represent the most recent publicly available data.

3 It should be noted that the surfaces of the urban, suburban, and rururban categories were employed for human settlements. Thus, the percentage pertains to these categories and does not encompass the entirety of the commune, which includes other uses and coverages.

4 Geospatial elements defined by the Communal Regulatory Plan (PRC) and the Metropolitan Regulatory Plan of Santiago (PRMS) of the urban and periurban areas of each city are in Appendix B.

References

1. Li, X.; Zhou, Y.; Hejazi, M.; Wise, M.; Vernon, C.; Iyer, G.; Chen, W. Global Urban Growth between 1870 and 2100 from Integrated High Resolution Mapped Data and Urban Dynamic Modeling. *Commun. Earth Environ.* **2021**, *2*, 201. [CrossRef]
2. Seto, K.C.; Fragkias, M.; Güneralp, B.; Reilly, M.K. A Meta-Analysis of Global Urban Land Expansion. *PLoS ONE* **2011**, *6*, e23777. [CrossRef] [PubMed]
3. Lang, R.; Knox, P.K. The New Metropolis: Rethinking Megalopolis. *Reg. Stud.* **2009**, *43*, 789–802. [CrossRef]
4. Ubilla-Bravo, G. Gouvernance Territoriale et Politiques D'aménagement. Cas du Périurbain au Chili, 1960–2015. Ph.D. Thesis, Université Paul-Valéry, Montpellier III, Montpellier, France, 2020. Available online: https://hal.archives-ouvertes.fr/tel-03094889/ (accessed on 30 July 2023).
5. Bolay, J.C. Planning the Intermediate City, or How to Do Better with Little: The Case of the City of Nueve de Julio, Argentina. *Curr. Urban Stud.* **2018**, *6*, 366–400. [CrossRef]
6. Brenner, N.; Theodore, N. Neoliberalism and the Urban Condition. *City* **2005**, *9*, 101–107. [CrossRef]
7. Precedo, A. Capítulo 1. Las respuestas de los territorios locales a la globalización. In *Nuevas Realidades Territoriales para el Siglo XXI: Desarrollo Local, Identidad Territorial y Ciudad Difusa*; Espacios y Sociedades. Serie Mayor; Editorial Síntesis S.A.: Madrid, Spain, 2004; pp. 13–32, ISBN 978-84-9756-163-1.
8. Zhou, Y.; Varquez, A.C.G.; Kanda, M. High-Resolution Global Urban Growth Projection Based on Multiple Applications of the SLEUTH Urban Growth Model. *Sci. Data* **2019**, *6*, 34. [CrossRef] [PubMed]
9. Hanlon, B. Sprawl. In *The Wiley Blackwell Encyclopedia of Urban and Regional Studies*; Wiley-Blackwell: Hoboken, NJ, USA, 2019; Volume 4, pp. 1–8. [CrossRef]
10. Iracheta Cenecorta, A.; Jaloma López, L.; Soto Alva, E. *Suelo Urbano en México: Retos y Oportunidades para su Administración y Registro*; Universidad Nacional Autónoma de México: Mexico City, Mexico, 2019; ISBN 978-607-30-1624-7.
11. Coq-Huelva, D.; Asián-Chaves, R. Urban Sprawl and Sustainable Urban Policies. A Review of the Cases of Lima, Mexico City and Santiago de Chile. *Sustainability* **2019**, *11*, 5835. [CrossRef]

12. Usach, N.; Gallo-Rivera, M.T.; Garrido-Yserte, R. *La Dinámica Espacial en el Área Metropolitana de Buenos Aires: ¿De la Dispersión al Policentrismo?* XXXIX Reunión de Estudios Regionales: Oviedo, Spain, 2013; pp. 1–35.
13. Li, S. Change Detection: How Has Urban Expansion in Buenos Aires Metropolitan Region Affected Croplands. *Int. J. Digit. Earth* **2018**, *11*, 195–211. [CrossRef]
14. Silva, C.; Vergara-Perucich, F. Determinants of Urban Sprawl in Latin America: Evidence from Santiago de Chile. *SN Soc. Sci.* **2021**, *1*, 202. [CrossRef]
15. Pérez-Criado, F.; Ubilla-Bravo, G. Movilidad en transporte privado y emisión de CO_2: Patrones geoespaciales e implicancias en el ordenamiento territorial para el Área Metropolitana de Santiago, Chile. *Rev. Transp. Territ.* **2023**, 169–199. [CrossRef]
16. de Lima, G.N.; Magaña Rueda, V.O. The Urban Growth of the Metropolitan Area of Sao Paulo and Its Impact on the Climate. *Weather Clim. Extrem.* **2018**, *21*, 17–26. [CrossRef]
17. Inostroza, L. Informal Urban Development in Latin American Urban Peripheries. Spatial Assessment in Bogotá, Lima and Santiago de Chile. *Landsc. Urban Plan.* **2017**, *165*, 267–279. [CrossRef]
18. Salazar, E.; Henríquez, C.; Durán, G.; Qüense, J.; Puente-Sotomayor, F. How to Define a New Metropolitan Area? The Case of Quito, Ecuador, and Contributions for Urban Planning. *Land* **2021**, *10*, 413. [CrossRef]
19. Buzai, G.D. Urban Models in the Study of Latin American Cities. In *Die Welt Verstehen-Eine Geographische Herausforderung: Eine Festschrift der Geographie Innsbruck für Axel Borsdorf*; Innsbrucker Geographische Studien: Innsbruck, Austria, 2016; pp. 271–288, ISBN 978-3-901182-43-3.
20. Allan, A.; Soltani, A.; Abdi, M.H.; Zarei, M. Driving Forces behind Land Use and Land Cover Change: A Systematic and Bibliometric Review. *Land* **2022**, *11*, 1222. [CrossRef]
21. Jenks, M. Compact City. In *The Wiley Blackwell Encyclopedia of Urban and Regional Studies*; Wiley-Blackwell: Hoboken, NJ, USA, 2019; Volume 1. [CrossRef]
22. Russo, A.; Cirella, G.T. Modern Compact Cities: How Much Greenery Do We Need? *Int. J. Environ. Res. Public Health* **2018**, *15*, 2180. [CrossRef] [PubMed]
23. Mouratidis, K. Compact City, Urban Sprawl, and Subjective Well-Being. *Cities* **2019**, *92*, 261–272. [CrossRef]
24. Precedo, A. Capítulo 7. La ciudad regional difusa. In *Nuevas Realidades Territoriales para el Siglo XXI: Desarrollo Local, Identidad Territorial y Ciudad Difusa*; Espacios y Sociedades. Serie Mayor; Editorial Síntesis S.A.: Madrid, Spain, 2004; pp. 165–180, ISBN 978-84-9756-163-1.
25. Bartels, L.E.; Bruns, A.; Simon, D. Towards Situated Analyses of Uneven Peri-Urbanisation: An (Urban) Political Ecology Perspective. *Antipode* **2020**, *52*, 1237–1258. [CrossRef]
26. Ubilla-Bravo, G. Relaciones de poder entre los actores del periurbano en torno al Plan Regulador Comunal: Analizando la gobernanza territorial. *Cuad. Geogr. Rev. Colomb. Geogr.* **2020**, *29*, 455–472. [CrossRef]
27. Ubilla-Bravo, G. Aprendizaje en la gobernanza territorial: Construcción de lenguaje, coordinación y acuerdos entre los actores del periurbano. *Rev. Geogr. Norte Gd.* **2023**, 1–25. Available online: https://revistanortegrande.uc.cl/index.php/RGNG/article/view/38655 (accessed on 20 October 2023).
28. Chapuis, R. *Géographie. Agrégation-Capes D'histoire et de Géographie. Crises et Mutations des Agricultures et D'espaces Ruraux*; Institut de Vanves du CNED: Vanves, France, 1997.
29. Allen, A. La interfase periurbana como escenario de cambio y acción hacia la sustentabilidad del desarrollo. *Cuad. Cendes* **2003**, *20*, 7–21.
30. Sereno, C.A.; Santamaría, M.; Santarelli, S. El rururbano: Espacio de contrastes, significados y pertenencia, ciudad de Bahía Blanca, Argentina. *Cuad. Geogr. Rev. Colomb. Geogr.* **2010**, 41–57. [CrossRef]
31. Ávila Sánchez, H. Periurbanización y espacios rurales en la periferia de las ciudades. *Estud. Agrar.* **2009**, *15*, 93–123.
32. Ubilla-Bravo, G. Rururbanización, suburbanización y reconcentración de la tierra: Efectos espaciales de instrumentos rurales en las áreas periurbanas de Chile. *AGER Rev. Estud. Sobre Despoblación Desarro. Rural.* **2020**, *28*, 75–106. [CrossRef]
33. Armijo, G. La urbanización del campo metropolitano de Santiago: Crisis y desaparición del hábitat rural. *Rev. Urban.* **2000**, 1–19. [CrossRef]
34. Ubilla-Bravo, G.; Rodríguez-Seguel, V. *Asentamientos Humanos en Chile: Revisión General en Torno al Cambio Climático y Ambiental para Ciudades Grandes e Intermedias. Estado de la Materia en 2022*; Universidad de Chile: Santiago, Chile, 2022; p. 50. [CrossRef]
35. Villamizar-Santamaría, S. Gated Communities/Fortified Enclaves. In *The Wiley Blackwell Encyclopedia of Urban and Regional Studies*; Wiley-Blackwell: Hoboken, NJ, USA, 2019; Volume 2. [CrossRef]
36. Decreto Nº 47. In *Fija Nuevo Texto de la Ordenanza General de la Ley General de Urbanismo y Construcciones*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 1992; p. 237.
37. Ubilla Bravo, G. Entidades rurales aisladas de la Región Metropolitana de Santiago de Chile-RMS: Localización y vulnerabilidad. *Cuad. Geogr. Rev. Colomb. Geogr.* **2012**, *21*, 127–147. [CrossRef]
38. INE Chile. *Chile: Ciudades, Pueblos y Aldeas. Censo 1992*; Instituto Nacional de Estadísticas: Santiago, Chile, 1995; ISBN 0717-1463.
39. INE Chile. *Chile: Ciudades, Pueblos, Aldeas y Caseríos. Censo 2002*; Instituto Nacional de Estadísticas: Santiago, Chile, 2005.
40. INE Chile. *Chile: Ciudades, Pueblos, Aldeas y Caseríos 2019*; Instituto Nacional de Estadísticas: Santiago, Chile, 2019.
41. Resolución Nº 76. In *Deja Sin Efecto Resolución Nº 115, de 2005 y Modifica Plan Regulador Metropolitano de Santiago*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 2006.
42. Pouyanne, G. Théorie économique de la ville discontinue. *Rev. D'économie Régionale Urbaine* **2014**, 587–611. [CrossRef]

43. Contreras Alonso, M.; Opazo, D.; Núñez Pino, C.; Ubilla Bravo, G. *Informe Final del Proyecto "Ordenamiento Territorial Ambientalmente Sustentable" (OTAS)*; Contreras Alonso, M., Ed.; Gobierno Regional Metropolitano de Santiago, Universidad de Chile y Agencia Técnica Alemana: Santiago, Chile, 2005. [CrossRef]
44. Ubilla Bravo, G.; Robles Vargas, R.; González, D.; Garay, N.; Norambuena Vega, P.; Sandoval Verdugo, G.; Muñoz Muñoz, F. *Carta de Cobertura y Uso del Suelo en la Región Metropolitana de Santiago*; Plan Regional de Ordenamiento Territorial de la Región Metropolitana de Santiago. Etapa 2: Diagnóstico Prospectivo Territorial; Gobierno Regional Metropolitano de Santiago y Edáfica: Santiago, Chile, 2012; p. 117. [CrossRef]
45. CONAF Chile; Sud-Austral Consulting SpA. *Diagnóstico de la Desertificación en Chile y Sus Efectos en el Desarrollo Sustentable: Alineación de los Contenidos del Actual PANCD Con la Estrategia Decenal de la Convención (CNULD), la Iniciativa de Degradación Neutral de la Tierra y Los Objetivos del Desarrollo Sostenible*; CONAF: Santiago, Chile, 2016; p. 32.
46. Davies, W.K.D. Centrality and the Central Place Hierarchy. *Urban Stud.* **1967**, *4*, 61–79. [CrossRef]
47. Rossetti Gallardo, M.P.; Saa Vidal, R.; Rodríguez Rojas, J.; Contreras Alonso, M.; Montecinos Concha, T.; Ibáñez Zamora, J.; Núñez Pino, C.; Ubilla Bravo, G. *Atlas Socioeconómico de la Región Metropolitana de Santiago*; Gobierno Regional Metropolitano de Santiago: Santiago, Chile, 2006; ISBN 956-8583-00-9. [CrossRef]
48. Ubilla-Bravo, G.; Chia, E. Construcción del periurbano mediante instrumentos de regulación urbana: Caso de ciudades intermedias en la Región Metropolitana de Santiago-Chile. *Cuad. Geográficos* **2021**, *60*, 275–296. [CrossRef]
49. Sahana, M.; Ravetz, J.; Patel, P.P.; Dadashpoor, H.; Follmann, A. Where Is the Peri-Urban? A Systematic Review of Peri-Urban Research and Approaches for Its Identification and Demarcation Worldwide. *Remote Sens.* **2023**, *15*, 1316. [CrossRef]
50. Brunet, R. La composition des modèles dans l'analyse spatiale. *Spgeo* **1980**, *9*, 253–265. [CrossRef]
51. Brunet, R. *Sustainable Geography*; Geographical Information Systems Series; ISTE; Wiley: London, UK; Hoboken, NJ, USA, 2013; ISBN 978-1-118-55784-6.
52. INE Chile. *Resultados Generales. Censo de Población y la Vivienda. Chile 1992*; Instituto Nacional de Estadísticas: Santiago, Chile, 1993.
53. INE Chile. *Chile: XVII Censo de Población y VI de la Vivienda año 2002. Volumen I: Población, País-Región*; Morales, H., Ed.; Instituto Nacional de Estadísticas: Santiago, Chile, 2003; Volume 1.
54. INE Chile Resultados de Comunas–Censo 2017. 2017. Available online: http://www.censo2017.cl/descargue-aqui-resultados-de-comunas/ (accessed on 30 July 2023).
55. Apey Guzmán, A. El proceso de reestructuración económica nacional y su impacto en el sistema regional: 1976–1981. *Investig. Geográficas* **1983**, 83–97. [CrossRef]
56. Riffo Rosas, M. Globalización de La Economía e Impacto Espacial En Las Áreas Rurales de La Zona Central de Chile. *Rev. Chil. Hist. Geogr.* **1998**, 157–172.
57. CNR Chile; Agrolog Chile Ltda. *Estudio de Suelos del Proyecto Maipo año 1976. Tomo I*; Comisión Nacional de Riego: Santiago, Chile, 1981; Volume 1.
58. GORE RMS; Universidad de Chile; GTZ. *Carta Uso del Territorio. Región Metropolitana de Santiago*; Gobierno Regional Metropolitano de Santiago: Santiago, Chile, 2003; p. 15.
59. INE Chile. *Cartografía Precenso 2016 Región Metropolitana de Santiago 2016*. Available online: https://www.ide.cl/index.php/sociedad/item/1740-cartografia-precenso-2016-region-metropolitana-de-santiago (accessed on 14 July 2023).
60. DL Nº 3.516. In *Establece Normas Sobre División de Predios Rústicos*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 1980.
61. MINVU Chile. *Política Nacional de Desarrollo Urbano*; Ministerio de Vivienda y Urbanismo: Santiago, Chile, 1979.
62. Decreto Nº 420. In *Modifica Plan Intercomunal de Santiago y su Ordenanza*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 1979.
63. Gordon, P.; Richardson, H.W. Are Compact Cities a Desirable Planning Goal? *J. Am. Plan. Assoc.* **1997**, *63*, 95–106. [CrossRef]
64. Ewing, R. Is Los Angeles-Style Sprawl Desirable? *J. Am. Plan. Assoc.* **1997**, *63*, 107–126. [CrossRef]
65. Decreto Nº 78. In *Aprueba Política Nacional de Desarrollo Urbano y Crea Consejo Nacional de Desarrollo Urbano*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 2014.
66. Decreto Nº 19. In *Aprueba Política Nacional de Desarrollo Rural*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 2020.
67. Decreto Nº 469. In *Aprueba Política Nacional de Ordenamiento Territorial*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 2021.
68. Gasic Klett, I.R. Mercado del suelo urbano y reserva financiera de terrenos para producción de vivienda en el Área Metropolitana de Santiago. *Rev. Geogr. Norte Gd.* **2020**, 71–94. [CrossRef]
69. Vinuesa Angulo, J.; Vidal Domínguez, M.J. Capítulo 1. Los procesos de urbanización desde una perspectiva geográfica. In *Los Procesos de Urbanización*; Espacios y Sociedades. Serie General; Editorial Síntesis S.A.: Madrid, Spain, 1999; pp. 9–31, ISBN 84-7738-110-0.
70. Méndez-Lemus, Y.; Vieyra, A.; Poncela, L.; de la Tejera, B.; Ruiz-López, C. Peripheralization, Ejidos and Agricultural Livelihoods in Intermediate Mexican Cities: The Importance of Collective Agency to Reduce Vulnerabilities. *Front. Sustain. Cities* **2022**, *4*, 816649. [CrossRef]
71. Decreto Nº 458. In *Aprueba Nueva Ley General de Urbanismo y Construcciones*; Bilbioteca del Congreso Nacional de Chile: Valparaiso, Chile, 1976.

72. Bryant, C.R.; Russwurm, L.H.; McLellan, A.G. *The City's Countryside: Land and Its Management in the Rural-Urban Fringe*; Longman: London, UK; New York, NY, USA, 1982; ISBN 978-0-582-30045-3.
73. Bryant, C.R. L'évolution de la ville régionale en Amérique du Nord: Le cas de Toronto. *Geo* **1986**, *95*, 26–42. [CrossRef]
74. Ekers, M.; Hamel, P.; Keil, R. Governing Suburbia: Modalities and Mechanisms of Suburban Governance. *Reg. Stud.* **2012**, *46*, 405–422. [CrossRef]
75. Aydalot, P.; Garnier, A. Périurbanisation et suburbanisation: Des concepts à définir. *disP-Plan. Rev.* **1985**, *21*, 53–55. [CrossRef]
76. Thomsin, L. La reprise démographique rurale en Wallonie et en Europe du Nord-Ouest. *Espace Popul. Sociétés* **2000**, *18*, 83–99. [CrossRef]
77. Follmann, A. Geographies of Peri-Urbanization in the Global South. *Geogr. Compass* **2022**, *16*, e12650. [CrossRef]
78. Phadke, A. Peri-Urbanization, Global South. In *International Encyclopedia of Human Geography*, 2nd ed.; Elsevier: Oxford, UK, 2020; pp. 71–77.
79. Webster, D. An Overdue Agenda: Systematizing East Asian Peri-Urban Research. *Pac. Aff.* **2011**, *84*, 631–642. [CrossRef]
80. Shi, Y.; Sun, X.; Zhu, X.; Li, Y.; Mei, L. Characterizing Growth Types and Analyzing Growth Density Distribution in Response to Urban Growth Patterns in Peri-Urban Areas of Lianyungang City. *Landsc. Urban Plan.* **2012**, *105*, 425–433. [CrossRef]
81. Friedmann, J. Becoming Urban: Periurban Dynamics in Vietnam and China—Introduction. *Pac. Aff.* **2011**, *84*, 425–434. [CrossRef]
82. Arif, M.; Gupta, K. Mapping Peri-Urbanization in a Non-Primate City: A Case Study of Burdwan, India. *Eur. Acad. Res. Rom.* **2018**, *5*, 6065–6081.
83. Singh, A.K.; Narain, V. Lost in Transition: Perspectives, Processes and Transformations in Periurbanizing India. *Cities* **2020**, *97*, 102494. [CrossRef]
84. Buxton, M.; Choy, D.L. Change in Peri-Urban Australia: Implications for Land Use Policies. In Proceedings of the 3rd State of Australian Cities National Conference, Adelaide, Australia, 28–30 November 2007; pp. 291–302. Available online: https://apo.org.au/node/60246 (accessed on 10 December 2023).
85. Liu, Z.; Robinson, G.M. Residential Development in the Peri-Urban Fringe: The Example of Adelaide, South Australia. *Land Use Policy* **2016**, *57*, 179–192. [CrossRef]
86. Adedire, F.M. Peri-Urban Expansion in Ikorodu, Lagos: Extent, Causes, Effects, and Policy Response. *Urban Forum* **2018**, *29*, 259–275. [CrossRef]
87. Afriyie, K.; Abass, K.; Adomako, J.A.A. Urbanisation of the Rural Landscape: Assessing the Effects in Peri-Urban Kumasi. *Int. J. Urban Sustain. Dev.* **2014**, *6*, 1–19. [CrossRef]
88. Amoateng, P.; Cobbinah, P.B.; Owusu-Adade, K. Managing Physical Development in Peri-Urban Areas of Kumasi, Ghana: A Case of Abuakwa. *J. Urban Environ. Eng.* **2013**, *7*, 96–109. [CrossRef]
89. Bartels, L.E. Peri-Urbanization as "Quiet Encroachment" by the Middle Class. The Case of P&T in Greater Accra. *Urban Geogr.* **2020**, *41*, 524–549. [CrossRef]
90. Daga, D.Y.; Vazquez, P.; Sequeira, N.D. Sistemas hortícolas del periurbano de Mar del Plata (Argentina): Implicancias ambientales y necesidad de una clasificación tipológica para la evaluación de la sustentabilidad. *Papeles Geogr.* **2021**, 115–134. [CrossRef]
91. Lorda, M.A. Lógicas socioespaciales en el espacio periurbano de Bahía Blanca. *Huellas* **2008**, 90–112.
92. Pola-Villaseñor, S.; Méndez-Lemus, Y.M.; Vieyra Medrano, A. Acceso al suelo ejidal periurbano: Análisis desde el capital social. *Econ. Soc. Territ.* **2017**, 429–460. [CrossRef]
93. Ubilla Bravo, G. Diagnóstico y Propuesta de Ordenamiento Territorial para la Comuna de Melipilla, Región Metropolitana de Santiago-Chile. *Terra Aust.* **2008**, 191–215. [CrossRef]
94. Maxar Technologies Inc. Constellation-WorldView Legion-Earth Observation Satellites. Available online: https://www.maxar.com/constellation (accessed on 10 December 2023).