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Housing Supply Limitations, Land Readjustment and the Ecological Performance of the Urban Landscape

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Abstract: Public authorities in developing economies typically have to deal with fiscal stress, lack of resources and an underdeveloped real estate industry. This poses a severe challenge at times of rapid urbanisation. Governments typically react to housing demand shocks by introducing policies that support the real estate market's capacity to supply housing. One prominent policy in this respect is land readjustment. It has been promoted as a best practice and has been extensively discussed from an efficiency perspective; however, little is known about the ecological performance of the urban landscapes that typically emerge with this tool. Therefore, this study developed an assessment framework that allows discussion of the ecological performance of these neighbourhoods as an outcome of the reciprocal interaction between public sector initiatives and real estate market responses. Based on a LEED ND assessment of the cases of Taipei and Seoul, the research identifies four institutional drivers of ecological costs. First, public agencies tend to neglect the ecological costs of greenfield site developments. Second, public agencies to not employ policies that promoe brownfield developments. Third, a weak public sectors' negotiating position can result in an ecologically inefficient urban pattern. And finally, the public sector's construction standardisation policies can impose real estate market limitations and wasteful use of resources in the long run.

Keywords: housing supply; rapid urbanisation; land readjustment; developer strategies; ecological performance; LEED ND; Korea; Taiwan

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1. Introduction

The study presented here analyses the ecological performance of new urban landscapes that emerge during periods of rapid urbanisation and under the difficult conditions of fiscal stress and resource scarcity. The study understands these new urban landscapes as being the result of a complex, reciprocal negotiation between governmental policies employed to stimulate housing supply and the corresponding real estate market actors' response to these policies when developing new neighbourhoods. The existing academic literature on the topic focuses predominantly on the experience of Western economies with relatively stable real estate markets where the Western—particularly the Anglo-Saxon—context is well represented [1,2]. Only a few studies, such as the work of Eamonn D'Arcy and Geoffrey Keogh, conduct comparative research in multiple economies with diverging institutional settings [3], and hardly any studies perform research on non-Western economies during periods of demand shocks. Stephen Mayo and Stephen Shepperd's research on Malaysia, Thailand and Korea is an exception that explores this relationship [4]. However, the sustainability dimension is being neglected in the current discourse on public policy and developer strategies. Considering that rapid urbanisation is one of the biggest challenges of the twenty-first century [5,6] and the prominence given to the topic in international organisations through the New Urban Agenda (NUA) and the Sustainable

Development Goals (SDGs) [7–9], this study provides new insights to fill this gap in the academic discussion.

In order to understand better how government policies and developer strategies typically influence the ecological performance of the built urban landscape during periods of rapid urbanisation, this study employs a two-step research methodology. In the first step, the study analyses governmental policy interventions and the corresponding developer strategies. In the second step, it evaluates the ecological performance of the urban landscape according to a set of sustainability indicators, in line with the LEED ND standard [10]. This methodology clarifies how the ecological performance of the urban landscape relates to intricate interactions between the real estate industry and the complex, multi-layered institutional context of industrial, credit market, land, real estate and local urban planning policies. Based on the findings, the study proposes a set of recommendations as a takeaway for practice that might be beneficial for policymakers in developing economies when confronted with rapid urbanisation processes. These recommendations take the typical constraints of governmental action and the real estate industry during periods of rapid urbanisation into account and suggest improvements to the institutional design of public policies that prioritise the minimisation of ecologic externalities.

Next to its academic relevance, the study also has societal significance. From a societal perspective, understanding the institutional causes of ecological costs is essential for the development of better climate change mitigation strategies in countries experiencing rapid urbanisation. This is especially so since urban patterns tend to remain in place for a long time once property rights have been established [11]. Therefore, it is essential to be aware of the ecological performance of the built urban landscape that emerges in the initial phase of urbanisation. Additionally, as this ecological performance is the result of developers' response to governmental rules and regulations, this study proposes to analyse the ecological costs of the built urban landscape from a comprehensive, institutional perspective rather than as a design issue. With a better understanding of these relations, planning interventions become better equipped to address the sustainability dimension and achieve the urbanisation prospects outlined in the NUA and other intergovernmental policy ambitions.

Only a few policies are equipped to deal with the challenges of rapid urbanisation. Land readjustment is one policy that has proven to be a suitable tool for overcoming the problems of land scarcity and a lack of fiscal resources [8,12]. However, only since the Habitat III conference in 2016 has land readjustment become a best-practice policy in the urbanisation literature and is being promoted to developing economies by international policy entrepreneurs [13]. Uppermost, the United Nations are conducting an information campaign that promotes local, land-based financing of infrastructure and urban development through a range of publications [14,15]. Additionally, other public sector initiatives, such as the 'Apeldoorn Declaration' (2016) [16] follow the ambitions of the NUA and the SDGs in their guidelines for a sustainable application of land readjustment policy. Only, the guidelines that these agencies provide tend to be rather general and omit to talk about the role real estate market actors play in achieving more sustainable urbanisation with land readjustment [13]. Consequently, international studies referring to this guideline focus predominantly on inclusiveness and leave the ecological performance of the built urban landscape largely untouched [17]. Academic studies have been promoting the use of land readjustment in developing economies for a long time [18,19]. Scholars, such as Orville F. Grimes and William Doebele, already discussed the potential of the land readjustment model with an integrated value capture mechanism as early as 1982 [20]. However, land readjustment remained a niche policy throughout the decades [21] and is still today being referred to as a promising institutional innovation despite its long legacy [22]. Since policy entrepreneurs pin their hopes on this tool to overcome the challenges of housing, infrastructure and public service provision as one of the key institutional enablers during times of rapid urbanisation, this study pays special attention to this policy among the range of government interventions employed. Taiwan and Korea form exceptional cases for this

kind of study, as both countries employed the land readjustment policy extensively during the early phase of urbanisation when the two poor, agriculture-based societies transitioned towards wealthy, industrial economies. On the one hand, the experience of both countries with land readjustment is valuable, as their development path inspires policymakers in countries still in the initial phase of development who potentially face similar threats of rapid urbanisation. On the other hand, assessing the ecological impact of those policies during this period is important as the structures that evolve in this phase (for example land use, street network, public spaces and facilities) tend to remain in place for decades [23]. However, land policies have seldomly been implemented with a focus on their ecological performance. In Taiwan and Korea, during the period of modernisation after World War II, the policy has been employed with the focus on urban development and infrastructure provision. The social and ecological side effects of employing the policy have mostly been neglected. Hence, it is valuable for practice to scrutinise how ecological costs emerged in these two cases and identify how the process of housing provision can be optimised from a sustainability perspective.

The main research question this study asks: what can we learn from the cases of Taipei and Seoul about the ecological costs of applying land readjustment in the context of rapidly urbanising cities in developing economies? The study hypothesises is that the ecological performance of the built urban landscape has, in the selected cases, at best played a subordinate role in public policy decisions. Therefore, an assessment in hindsight, with the knowledge of today might allow pinpointing shortcomings and potential improvements to the public policy decisions taken from an ecological performance perspective.

Structure of the Paper

After introducing the topic, the study conducts a cross-sectional analysis of the existing public policy and housing supply theory. Based on the literature review, the research filters out a set of guiding questions (see Tables 1 and 2) according to which the relationship between housing supply limitations, governmental action and the ecological performance of built urban landscapes are analysed (Section 2). It then summarises the methodology and introduces the two empirical case studies of governmental responses to rapid urbanisation (1960–1990) in Taipei, Republic of China and Seoul, the Republic of Korea (Afterwards referred to as Taiwan and Korea) (Section 3). Afterwards, the study presents the results of the analysis (Section 4), discusses the ecological costs of public interventions (Section 5) and closes with a set of conclusions and the related suggestions for institutional improvements to governmental action in a context of rapid urbanisation as a takeaway for practice (Section 6).

Table 1. Land supply limitations. Source: authors.

Type of Land Supply Limitations		Yes	No	Notes/Remarks	Corresponding Public Policy Measures
Geographic Limitations					
Are the geographical limitations of available land for construction reached?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Infrastructural Limitations					
Is there undeveloped land due to a lack of connectivity?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Regulatory Limitations					
Are regulations blocking the development of undeveloped urban land?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Are containment policies (greenbelt, etc.) limiting land development?	Seoul, KR	■	□	Greenbelt (1971); Farmland Preservation & Utilization Act (1972)	none
	Taipei, TW	■	□	Urban Growth Boundary (1959)	none
Are other policies (national security, etc.) blocking land development?	Seoul, KR	□	■	DMZ (1953) as minor obstacle	none
	Taipei, TW	□	■		
Organizational Limitations					
Is land development costly due to small, scattered land holdings?	Seoul, KR	■	□	Land reform (1945-50)	Employing participatory land development with land readjustment
	Taipei, TW	■	□	Land reform (1949-53)	none
Are there holdout problems with private landowners?	Seoul, KR	■	□	Small, scattered landownership	Introducing majority vote (2/3) into land readjustment
	Taipei, TW	■	□	Small, scattered landownership	Introducing majority vote (1/2) into land readjusment
Fiscal Limitations					
Is fiscal stress limiting employment of an active land poliy?	Seoul, KR	■	□	Weak fiscal base; weak tax collection	Embedding value capture tools in land readjustment
	Taipei, TW	■	□	Weak fiscal base; weak tax collection	Embedding value capture tools in land readjustment

Table 1. *Cont.*

Type of Land Supply Limitations		Yes	No	Notes/Remarks	Corresponding Public Policy Measures
Administrative Limitations					
Is the lack of administrative capacity limiting efficient land development?	Seoul, KR	■	□	Lack of well-trained human resources	Employing passive land policies with land readjustment
	Taipei, TW	■	□	Lack of well-trained human resources, fragmented and uncoordinated government agencies	Improving market conditions; Public Housing Act amendments (1982); Building Management Companies (1986); Employing passive land policies with land readjusmtment

Table 2. Housing supply limitations. Source: authors.

Land Assembly Limitations					
Are limitations to land availability jeopardizing project feasibility?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Are containment policies (greenbelt, etc.) limiting land development?	Seoul, KR	■	□	Greenbelt (1971); Farmland Preservation & Utilization Act (1972)	none
	Taipei, TW	■	□	Urban Growth Boundary (1959)	none
Are other policies (national security, etc.) blocking land development?	Seoul, KR	□	■	DMZ (1953) as minor obstacle	none
	Taipei, TW	□	■		
Organizational Limitations					
Is land development costly due to small, scattered land holdings?	Seoul, KR	■	□	Land reform (1945-50)	Employing participatory land development with land readjustment
	Taipei, TW	■	□	Land reform (1949-53)	none
Are there holdout problems with private landowners?	Seoul, KR	■	□	Small, scattered landownership	Introducing majority vote (2/3) into land readjustment
	Taipei, TW	■	□	Small, scattered landownership	Introducing majority vote (1/2) into land readjusment

Table 2. *Cont.*

Fiscal Limitations					
Is fiscal stress limiting employment of an active land poliy?	Seoul, KR	■	□	Weak fiscal base; weak tax collection	Embedding value capture tools in land readjustment
	Taipei, TW	■	□	Weak fiscal base; weak tax collection	Embedding value capture tools in land readjustment
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	Taipei, TW	■	□	Lack of well-trained human resources, fragmented and uncoordinated government agencies	Improving market conditions; Public Housing Act amendments (1982); Building Management Companies (1986); Employing passive land policies with land readjusmtment
Transaction Cost Limitations					
Are the administrative processes (obtaining permits, etc.) delaying housing construction?	Seoul, KR	□	■		
	Taipei, TW	■	□	Ineffective government agencies	none
Cultural Limitations					
Are there limits in terms of preferred housing locations?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Is wrongly located urban land limiting housing production?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Are high land prices limiting housing production?	Seoul, KR	■	□	Cost of land assembly limit small developers' production	Bypassing land assembly costs with land readjustment
	Taipei, TW	■	□	Cost of land assembly limit small developers' production	Bypassing land assembly costs with land readjustment
Are there limits deriving from cultural or lifestyle preferences?	Seoul, KR	■	□	Floor-based living with floor heating	Standardization of single family housing types
	Taipei, TW	□	■		
Is housing supply limited through local height and density regulations?	Seoul, KR	□	■	Supportive regulations	Neighbourhood Unit Plans facilitated urban development
	Taipei, TW	□	■	Supportive regulations	Zoning and land-use regulations facilitated developments

Table 2. *Cont.*

Fiscal Limitations					
Real Estate Market Limitations					
Is the real estate market monopolistic or oligopolistic?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Are the processing costs (administrative fees, etc.) impacting housing provision?	Seoul, KR	□	■		
	Taipei, TW	□	■		
Are there developer obligations (low-income housing, public facilities, etc.) that limit project feasibility?	Seoul, KR	■	□	Supportive regulations	Value capture regulations included in LR policy (no cap)
	Taipei, TW	■	□	Supportive regulations	Value capture regulations included in LR policy (cap = 60%)

2. Reviewing Public Policy Interventions and Developer Strategies

Planning reduces transaction costs [24] and interferes with markets in order to incentivise the development of new, needed neighbourhoods [25]. This study argues that developers adapt their strategies of housing provision according to the institutional context that governmental actions create.

2.1. Preliminary Conceptual Considerations

The organisation and the shape of newly constructed neighbourhoods vary according to the internal dynamics of local real estate markets and their response to government regulations. Developer strategies might not always respond to demand or policy incentives as smoothly as suggested by neo-classical economics [26], and property will not always be put to its most valuable use, which most closely meets the requirements of users and investors [3]. Developers' strategies manifest themselves in the built urban landscape in a multiplicity of functional compositions, diverse locations and a variety of spatial organisations, shapes and facilities [27]. These consequentially affect multiple dimensions of the ecological performance of these neighbourhoods. Hence, in order to answer the main research question, the study must first clarify how government policies typically support housing supply at times of demand shocks and how real estate market actors respond to changes in the institutional framework.

At times of demand shocks, public policies tend to focus on improving housing supply elasticity and therefore support market actors' ability to ramp up housing production. In case housing supply elasticity is high, the real estate industry is able to react to demand shocks in a timely and efficient manner. In the case of inelastic housing supply, however, prices will rise notably [28]. In developing economies facing challenges of rapid urbanisation, insufficient housing supply in combination with excessive demand from migration will result in increasing housing prices and problems of housing unaffordability. Despite this unaffordability, the urbanisation trend will not stop, and informal, sub-standard settlements will emerge. This is politically and ethically undesirable, and the public sector will take measures to overcome limitations to housing supply by supporting the real estate industry.

2.2. Public Policy Interventions to Increase Housing Supply Elasticity

The public sector can improve the elasticity of the housing supply through various interventions. These might take shape as land policies and urban planning regulations, real estate market policies, financial market regulations and even cultural policies directed at incentivising altered consumer behaviour. Each of these types of government interventions deals with a different housing supply limitation (see Figure 1).

Land supply constraints may derive from topographical, infrastructural, administrative or financial limitations [29]. Public authorities can lift some of the policy restraints when making changes to land use regulations. However, land supply limitations deriving from the lack of public land ownership in desired locations cannot be lifted by governmental action alone but require the cooperation of private landowners in the development process. Hence, land readjustment is an attractive tool for developing economies with insufficient public land ownership when confronted with a scarcity of developable urban land, fragmented private land holdings and a lack of public resources. Land readjustment requires hardly any fiscal funds for land acquisition [30] and internalises the transaction cost of negotiations and coordinating land assembly [31]. It is considered an inclusive and participatory land tool, as landowners take decisions collectively and democratically [20]. The policy provides infrastructure and public services at virtually no cost for the public when integrating value capture policies [32] and avoids the political costs of eminent domain [33]. Additionally, even though land readjustment can become entangled in processes of ground rent dispossession [34], its intrinsic regulations tend to distribute the development gain back to the original landowners fairly after development [18]. Furthermore,

public authorities can easily support the development of land readjustment projects by adjusting local height, density and land use regulations.

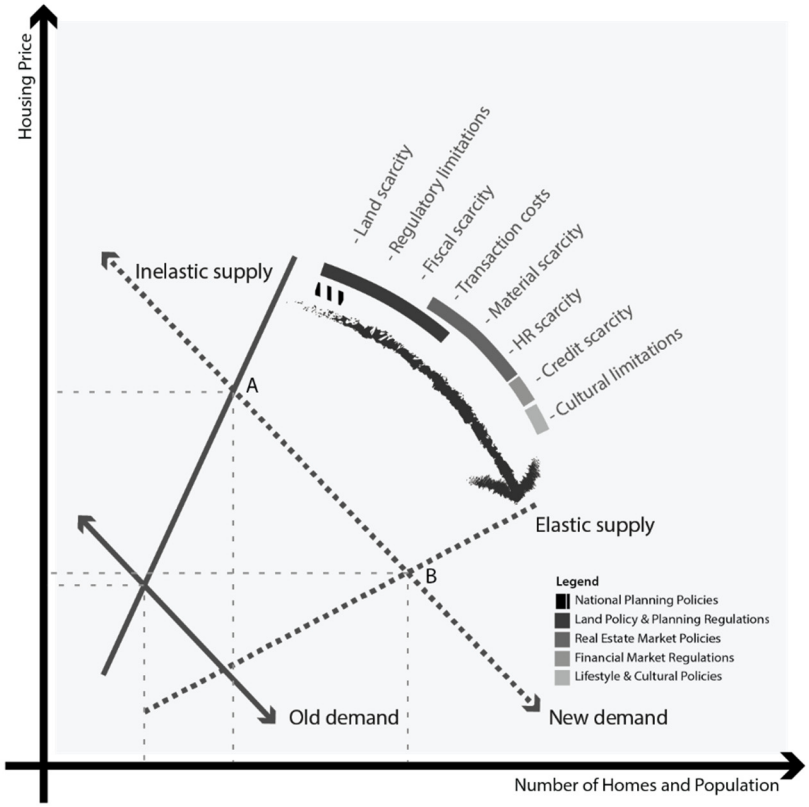

Figure 1. Limitations to housing supply elasticity. Source: authors.

Public policy interventions can also support housing supply elasticity by reducing transaction costs, for example, through minimising fees and charges [35] or lifting restrictive planning regulations [4]. Especially in developing economies with immature real estate markets, public policy interventions might support the real estate industry by guaranteeing the operation of supply chains for construction materials, engaging in capacity development as a means to enhance efficiency and human capital or enhancing access to credit or other financial support. Furthermore, the public can increase the private sector's responsiveness to housing demand shocks by enhancing access to credit. Working credit markets are needed to ensure developers' ability to supply housing smoothly and provide households with the capital to purchase the newly developed dwellings. Credit market policies, therefore, affect land as well as real estate markets. Finally, public authorities can also intervene in socially established norms and customs that might create limits to housing supply. These can include the promotion of a particular family structure, household income restraints related to gender norms or architectural preferences deriving from cultural heritage and lifestyle preferences.

2.3. Internal Real Estate Market Limitations to Housing Supply

Housing supply limitations might also derive from the institutional character of the real estate market. Examples of the limitations to housing supply deriving from real estate market aspects include the monopolistic or oligopolistic character of real estate markets [1,36,37], land ownership constraints due to asymmetric land distribution [38], the influence of 'mood or sentiment' on market participants' decision-making behaviour (leading to non-rational herd behaviour or clustering) [2] and the influence of subsidiarity principles on governance processes [3] or place-making strategies [3,37,39], which create geographically segmented rather than uniform land markets [37]. The distribution of transac-

tion costs within these markets, such as information asymmetries [1], the interdependences among actors in land and real estate markets [24], the uncertainty concerning holdout problems that might prevent efficient land acquisition [24,40] or speculative land/option holdings by developers [36,41] illustrate how markets do not always respond rationally or efficiently to demand.

2.4. Developer Strategies

The property market is an artificial construction of institutions, which reflects participants' patterns of power and influence embedded in the larger institutional framework of political, economic, legal and social systems [3] (see Figure 2). Property market mechanisms, particularly the production, exchange, distribution, use [42] and maintenance of built structures [26], affect the output of the property market. Developer strategies define which locations to target, what quantity and typologies of housing to provide, the amount of overhead capital investments and the timing of housing provision in practice [43].

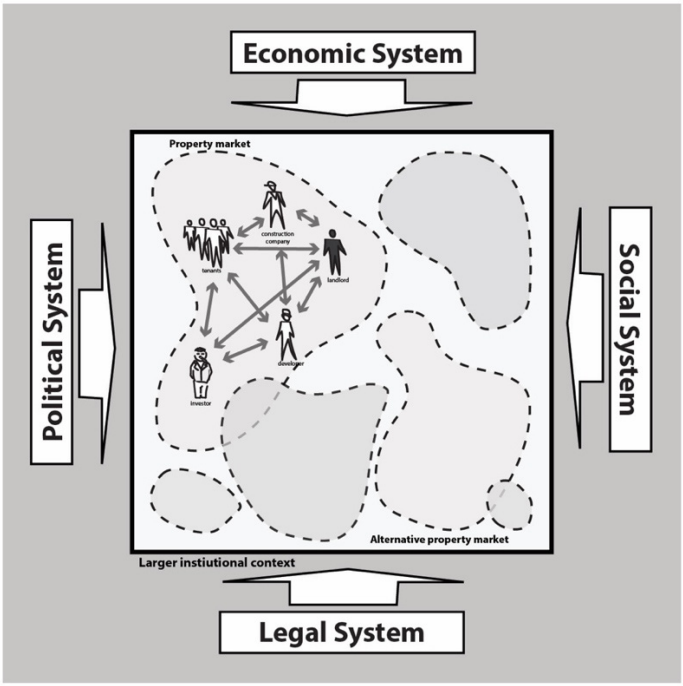

Figure 2. Institutional embeddedness of real estate processes. Source: authors.

Policy entrepreneurs often overlook the predominantly local network interactions between, for example, developers, construction companies, tenants and investors, and the inherent institutional mechanisms as well as transaction costs that guide territorial competition in real estate markets [3] when promoting particular policies. The quality of the newly developed urban landscape is not purely the outcome of supply and demand factors operating in a framework of government policies and regulatory frameworks, as suggested by neo-classical economic theory, but also subject to the behaviour of land and real estate market participants and their interactions [3,36,42]. Additionally, developer strategies are dynamic, as they might evolve according to changes in demand, new investment strategies, altering regulations for market participation or fluctuations in consumers' tenure preferences [3]. The physical form of the built urban landscape is therefore not simply a response to demand but has an inherent location-specific logic that is created by market participants' interactions.

2.5. The Ecological Performance of the Urban Landscape

The urbanisation process overlays the natural landscape with a new urban environment [44]. Additionally, as every change in the use of a piece of land has its biophysical

consequences, the character of the interaction between public policy and real estate market actors has its location-specific ecological effects. Urban environments and their related socio-economic activities are intimately related to effects such as climate, hydrology, soil contamination and geomorphology, among others. Consequently, rapid urbanisation will intensify processes that drive climate change modifications [45]. However, as Graham Haughton and Colin Hunter point out, the ecological costs of urbanisation depend largely on the capacity of cities to manage the surge of migration and provide basic services and infrastructure for their residents [46]. Land readjustment can—due to its ability to finance basic infrastructure and services with land values—be an adequate policy instrument for developing economies facing rapid urbanisation if the ecological costs of employing the policy are sufficiently understood. First, one needs to quantify those ecological costs deriving from this policy before one can analyse and make recommendations for improvement [47]. Many different evaluation frameworks on different scales exist. International organisations have developed a range of sustainable indicator frameworks (see Shemlev for an overview [48]), and also several national assessment frameworks for the neighbourhood scale exist (for an overview, see: [49,50]). These make use of detailed, local indicators that are more appropriate for the study conducted here.

3. Methods and Empirical Cases

In order to understand how public policy initiatives and developer strategies relate to the ecological performance of the built urban landscape, the study introduces a two-step approach. First, the study collects the scattered findings of the existing theoretical discourse on public policy interventions and developer strategies and compresses them into a set of questions that works as an assessment guideline. The resulting tables contain 9 levels of analysis in 6 categories for policy interventions addressing land supply limitations and 17 levels of analysis in 5 categories for public policies addressing housing supply limitations. Based on this framework, the study can discuss how land supply constraints (Table 1) and real estate market limitations (Table 2) relate. In the second step, the study provides an assessment framework for the ecological performance of the built urban landscape that emerged from developer strategies operating in this institutional context according to the LEED ND standard.

LEED ND is a sustainability standard developed by the US Green Building Council in 2009. It promotes the use of natural resources, regenerative and restorative strategies, minimisation of the negative impact of the construction industry and high-quality indoor environments [10]. Compared to other neighbourhood sustainability indicator frameworks, the LEED ND standard focuses more on the planning and design of neighbourhoods as well as their locational aspects than other frameworks [49], which qualifies the tool for use in this study. In their research on the relation between the NUA, the SDGs and the LEED ND framework, Diaz-Sarachaga et al. detect a bias related to an overrepresentation of aspects such as efficient resource management, pollution and climate change effects deriving from urbanisation in LEED ND [51]. As our focus is the ecological performance of the urban landscape (and not fulfilling all criteria of the SDGs), we accept this limitation for our study.

A range of academic studies has made use of the LEED ND standard. Most of these studies are located in the United States and other stable Western economies (see, for example, ref. [52,53]). However, incidental studies on neighbourhoods evolving under rapid urbanisation, such as Tulin Vural Arslan's study on Bursa in Turkey, have been assessed with LEED ND [54]. We have chosen to employ this standard in this research because it enables us to distinguish between locational choices (Smart Location and Linkage—SLL) as well as the use and impact of urban form (Neighbourhood Pattern and Design—NPD). On top of that, the LEED ND framework takes scale differences among sites into account. The LEED ND framework either makes use of relative dimensions (such as dwelling units/ha, intersections/mi^2, etc.) in the analysis or uses separated assessment categories for different sizes when absolute dimensions are being evaluated. In the assessment conducted here, the

content of the LEED ND categories has been followed faithfully. However, we developed a new graphic representation of the LEED ND dimensions in order to facilitate visual accessibility of the scores in the two categories (see Section 4). Finally, a limitation of the LEED ND assessment was found in its inability to take dynamic changes into account. We address this shortcoming in the discussion and the conclusions.

Data Collection and Case Study Selection

We illustrate the workings of the methodological framework through the experiences of Taipei and Seoul. The two cities share a history of Japanese colonisation that left its mark on the cities' institutional and spatial legacy. Both countries went through land reform after the end of the Japanese occupation and entered a similar trajectory of population growth, migration and structural economic transformations that led to a surge in land and housing demand [55].

Moreover, both cities have utilised a policy of land readjustment as one of the main tools to cope with the urbanisation challenge (Figure 3). We selected three land readjustment projects from Taipei (Songshan, Neihu, Zhongshan 2nd district) and three land readjustment projects from Seoul (Amsa-dong, Yeonhui-dong, Hwayang-dong), which we chose for their representative character (Figure 4). In general, the land readjustment projects in Taipei tend to cover less land area than the ones in Seoul. Especially, the Zhongshan 2nd and the Neihu district are significantly smaller than their Korean counterparts. The difference in scale, however, does not impact the sustainability score, as the LEED ND framework takes scale differences into account. Based on a discussion of the findings, this study draws conclusions that highlight the ecological costs of public policy interventions using land readjustment during rapid urbanisation. Yet, to draw conclusions with certainty, more studies of this kind would need to be conducted in a larger number of institutional contexts, looking at more empirical cases. Such an effort exceeds the scope of this study, however.

Taipei (271.8 km2)	Projects	Area (ha)	(%)
Government initiated	41	927.7	96.4
-			
Landowners initiated	9	34.6	3.6
total	50	962.3	100.0

Seoul (605.2 km2)	Projects	Area (ha)	(%)
Government initiated	32	11,305.0	88.4
Public developer initiated	3	301.6	2.4
Landowners initiated	9	1,179.9	9.2
total	44	12,786.5	100.0

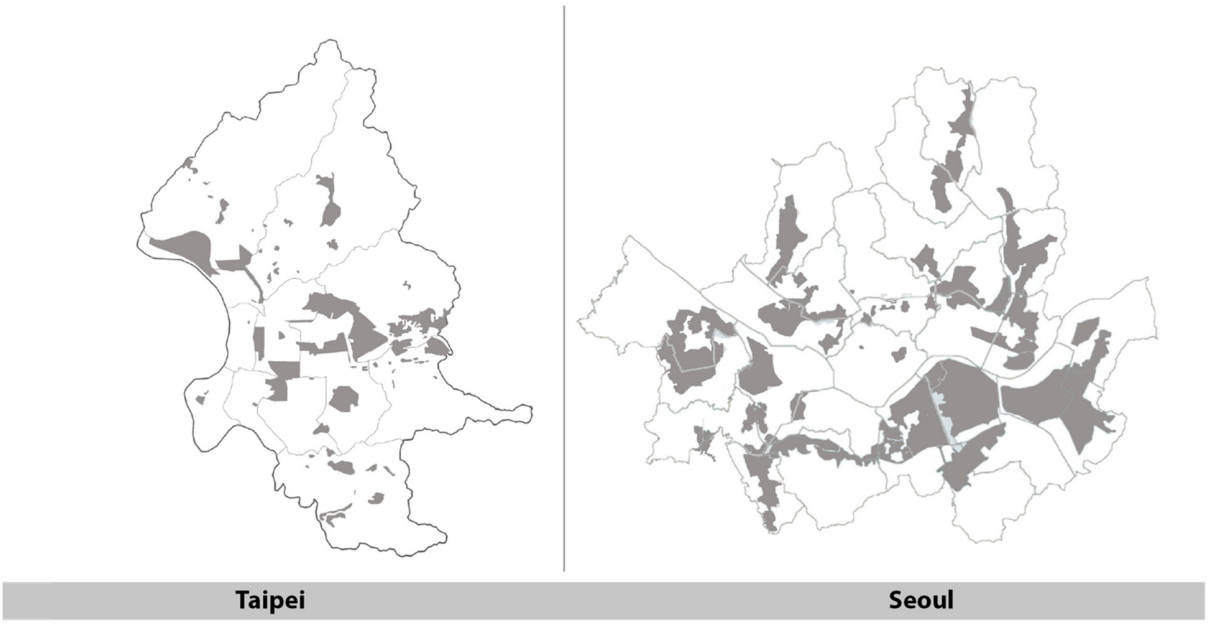

Figure 3. Land readjustment projects in Taipei and Seoul. Source: Taipei City—Department of Land Administration, 2020; Seoul Metropolitan Government, 2017.

Figure 4. Selected land readjustment projects in Taipei and Seoul. Source: Taipei City—Department of Land Administration, 2020; Seoul Metropolitan Government, 2017.

4. Results

Tables 1 and 2 give an overview of the land and housing supply limitations experienced in Taipei and Seoul and the corresponding public policy initiatives. We find that geographic limitations of land have not been the dominant constraint in either context. Even though in the Korean case, regulatory restrictions deriving from national security policies—such as the creation of the Demilitarized Zone (DMZ, 1953) or the Farmland Preservation and Utilization Act (1972), and also containment policies such as the Green Belt (1971)—were introduced, plenty of greenfield sites in the fringe areas of Seoul were made available by the public sector, which directed the forces of urbanisation towards the fringe areas with the use of zoning plans as primary tools. Similarly, in Taipei, Urban Growth Boundaries (1959) and the implementation of a rigid master planning regime through the Urban Planning Act (1964) [56,57] were utilised to steer the forces of urbanisation. Land availability did not form a significant limitation to housing supply here either, but it was the stiff planning regime in combination with fragmented private landownership—a remnant of the land-to-the-tiller programmes implemented after the end of Japanese colonialism (Taiwan 1949–1953 [58]; Korea 1945–1950 [59])—that induced high costs of land assembly, which resulted in a hampered housing supply.

Furthermore, in both countries, national security policies had an indirect impact on housing supply elasticity because public authorities directed the majority of fiscal resources towards military defence purposes and export-oriented industries [60]. Few financial resources were reserved for an active role of the government in the urbanisation process [56], and the self-chosen restraint of the public sector resulted in underinvestment in housing and infrastructure. The lack of access to credit limited the possibilities of small- and medium-size developers without large cash reserves to provide housing on a large scale, despite the strong demand. The resulting fiscal stress for local governments—especially in the early stages of development—was severe, because at that time, the tax base

was weak, the tax code provided too many loopholes and the tax collection was inefficient (Korea: [61]; Taiwan: [62]).

Table 1 shows that the costly and time-consuming process of land assembly in combination with fiscal and administrative limitations formed the highest barrier to a smooth supply of urban land during the period of rapid urbanisation. Consequently, in both countries, the choice was made to respond to demand shocks by employing land readjustment policies with integrated value capture regulations, which can tackle several land supply limitations at once.

Additionally, limitations to housing supply elasticity derived from intrinsic inefficiencies of the real estate industry. In Taipei, public efforts to provide housing were haphazard, poor in terms of locational choices, of a low technical standard and not backed with a credit policy, which made them widely ineffective [63]. However, this changed when public initiatives started incentivising the private sector to take a more active part in the provision of housing with the Public Housing Act (1975 and 1982) and the Act on Encouragement to Owners for Urban Land Readjustment (1979), which allowed private landowners associations to provide housing [56,64]. Korea, on the other hand, had employed land readjustment as the dominant land policy since the time of the Japanese occupation. It maintained this practice during the period of rapid urbanisation as its virtually exclusive land policy from the early days of modernisation onwards [65,66].

A strong limitation to the supply of housing in both countries was speculation-driven inflated land prices that remained unrestrained by the inefficient taxation system and a weak negotiating position of the public sector [67], effectively withdrawing urban land from the market. On top of that, subsequent land price hikes and a restrictive credit policy [68] encouraged additional speculative purchases and resulted in housing unaffordability (Korea: [69]; Taipei: [70]). Another limitation came with the dependency of self-financing land readjustment policies on landowners' willingness to collaborate, which is a limitation deriving from the inherent regulations of such policies. Both countries' regulations mandated developers to contribute land to public facilities and cost recovery [71,72]. This contribution rate—which is the combined land contribution for public facilities and cost recovery purposes—was capped at a maximum of 60 per cent in Taipei in order to guarantee landowners' participation [73]. In Seoul, the effective contribution rate had a similar limit, even though it was not regulated. Here, landowners started to withhold their cooperation once the contribution rate surpassed the 50 per cent mark [65]. The public sector reacted to this in two ways. First, by minimising the land contributions for public facilities, and second, by phasing out large projects in order to let prices 'mature' and ensure self-financing [74]. This explains the slow pace of housing supply under land readjustment, despite the provision of large development sites in Seoul.

On top of that, the underdeveloped real estate industry had a hard time coping with the surge of demand. Especially in Korea, where land readjustment was employed relatively early, the limitations of know-how, human capital and the scarcity of construction materials limited housing supply. Public authorities reacted to these limitations by professionalising the construction industry, incentivising the production of modern construction materials and reverting to a limited set of low-rise housing typologies and standardised construction materials [75] (Figure 5).

While these policies helped reduce transaction costs and promoted vertical integration in the real estate industry, they limited the efficient use of land by promoting low-density housing developments [76]. It would have been more efficient to revert to walk-up apartments with higher dwelling-to-land ratios, but cultural limitations—specifically the lifestyle of living on the floor—required the use of a floor heating system (ondol) that limited the applicability of mid- or high-rise housing typologies as long as affordable centralised floor heating and elevator systems were not available. Additionally, in Taiwan, housing typologies changed with rapid urbanisation: from the early 1960s onwards, the Bureau of Public Works—with aid from the United States—introduced modern, four-to-six-floor walk-up apartments based on Western models. These typologies were chosen for their

high land-to-dwelling ratio, which could be achieved without the need to provide costly installations such as elevators [77] (Figure 5). Cultural limitations played a lesser role in Taipei, as floor-based living was not common and construction materials, human capital and know-how were less scarce than in Seoul when land readjustment projects boomed in Taipei. However, the fragmented land ownership after land readjustment did not always match developers' demand in Taipei, who preferred to negotiate with a smaller group of landowners [78].

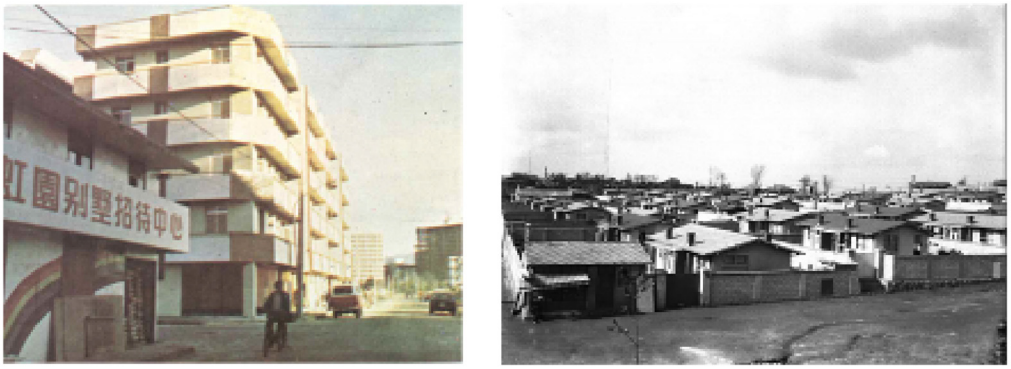

Figure 5. Typical housing typologies in Taipei and Seoul with land readjustment. Source: Taipei City—Department of Land Administration, 2020 (https://www.lda.gov.taipei/cp.aspx?n=D2E1D9AEA59A9979&s=0F9B1A3337F56BC9; accessed on 22 June 2021); Seoul Metropolitan Government, 2017 (https://www.facebook.com/designersparty/photos; accessed on 18 July 2021).

The supply of housing in land readjustment projects in Taipei and Seoul was hardly limited by the local planning regulations. Land readjustment projects in Taipei were commonly part of Grade Three Residential Areas that allowed a Building to Land Ratio (BLR) of 45 per cent and a Floor Area Ratio (FAR) of 225 per cent [72]. In Seoul, they were part of General Residential Type Two zoning regulations that allowed a maximum BLR of 60 per cent and a FAR of 200 per cent. However, technical and cultural limitations—not regulatory ones—formed the bottleneck for the density of housing provision on the available land. In Seoul, regulatory density limitations were often not even reached in the first phase of urbanisation. Only in the second phase of redevelopment, when four-to-six-floor walk-up apartments replaced the older typologies, was the housing supply limited by local density limits [75,79].

The Ecological Performance of Land Readjustment Projects in Taipei and Seoul

The study assessed the ecological outcomes of public policy initiatives and developer strategies at times of rapid urbanisation in six selected sites in Taipei and Seoul. The LEED ND framework provides detailed evaluation standards for each of the assessment dimensions [13]. The research scoured publicly available data, such as official planning documents, maps, satellite images, photographs, census statistics, construction drawings and public transportation schedules, among others, which have been analysed according to the detailed LEED ND guidelines. Due to the large size of the land readjustment sites, part of the questions in the NPD section have been assessed on the basis of a representative sample. Evidence of the calculations of the respective scores for each question has been collected in a digital presentation and is made publicly accessible (see the data accessibility statement). Figure 6 gives an overview of typical assessment sheets for the six selected sites and their calculations in both the SLL and NPD categories.

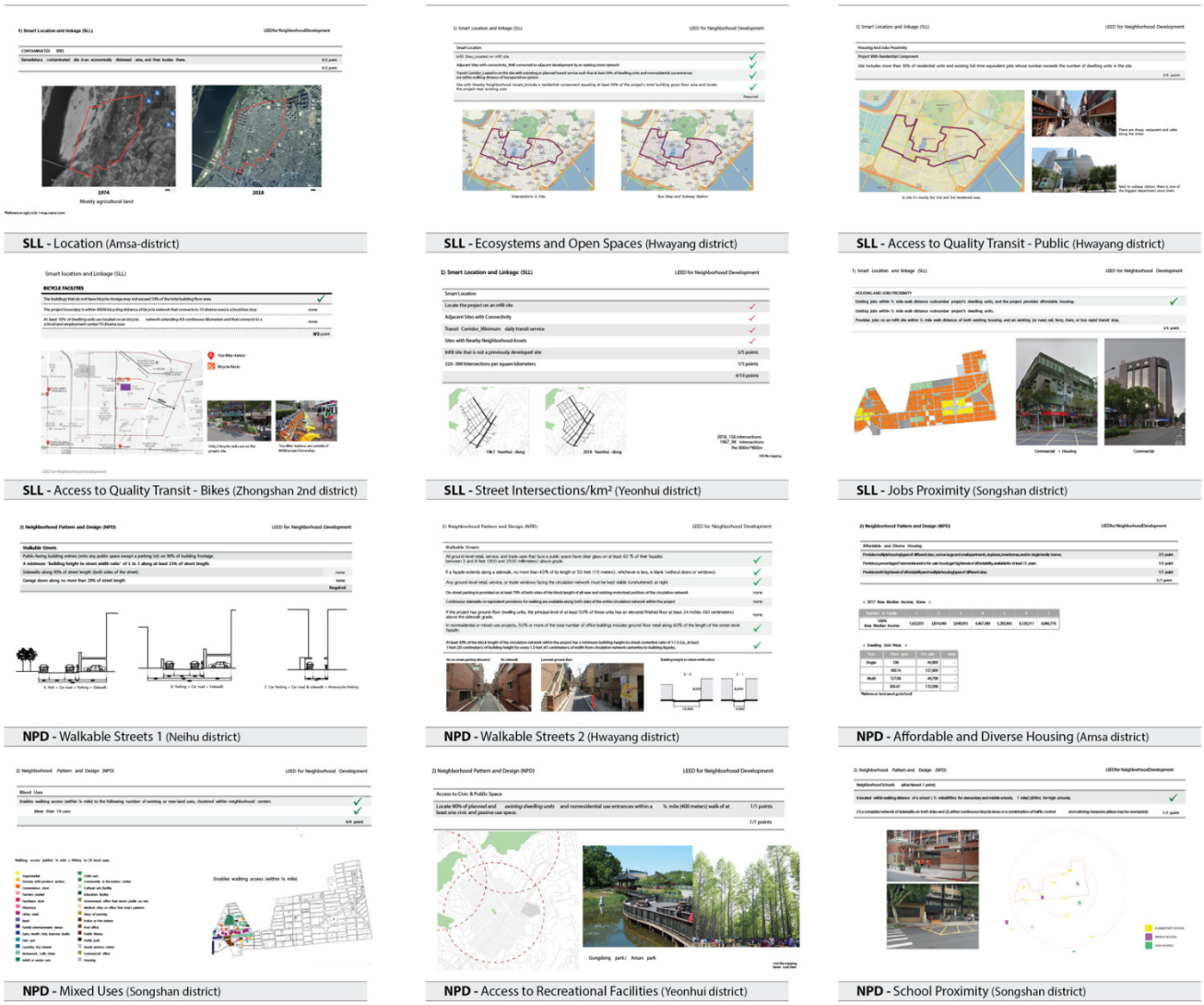

Figure 6. Selected examples of the ecological assessment of sites in Taipei and Seoul with the LEED ND framework.

The first set of diagrams describes the outcome in the SLL category (Figure 7). The scores diverge between 17/25 in Neihu, Taipei and 20/25 in Hwayang district, Seoul. Due to the limited dispersal, we can speak of a high level of coherence in ecological performance among the selected cases in both countries. The distribution of the points within the studied dimensions also shows a high level of coherence. All selected sites score high in the Transit Oriented Locations, the Jobs and Housing Proximity and the Cycling Facilities dimensions. However, scores among the selected sites were low for the Location dimension and very low for the Ecosystems and Open Spaces, as well as the Contaminated Sites dimensions.

The LEED ND assessment shows low scores for the Ecosystems and Open Spaces dimensions because public authorities in both cities chose locations without much concern for urban development's effect on existing wetlands or ecosystems, allowed construction on steep slopes and did not require a management plan for the ecological habitats affected. An exception is Yeonhui-dong in Seoul, which scores points for avoiding wetlands and avoiding construction on steep slopes. Considering the low level of ecological concern at the time, it is questionable whether these were conscious choices based on ecological awareness or whether they emerged coincidentally. The urgency to provide housing led to the development of greenfield sites that could quickly and easily provide urban land for housing without much concern for the impact on the local ecosystem.

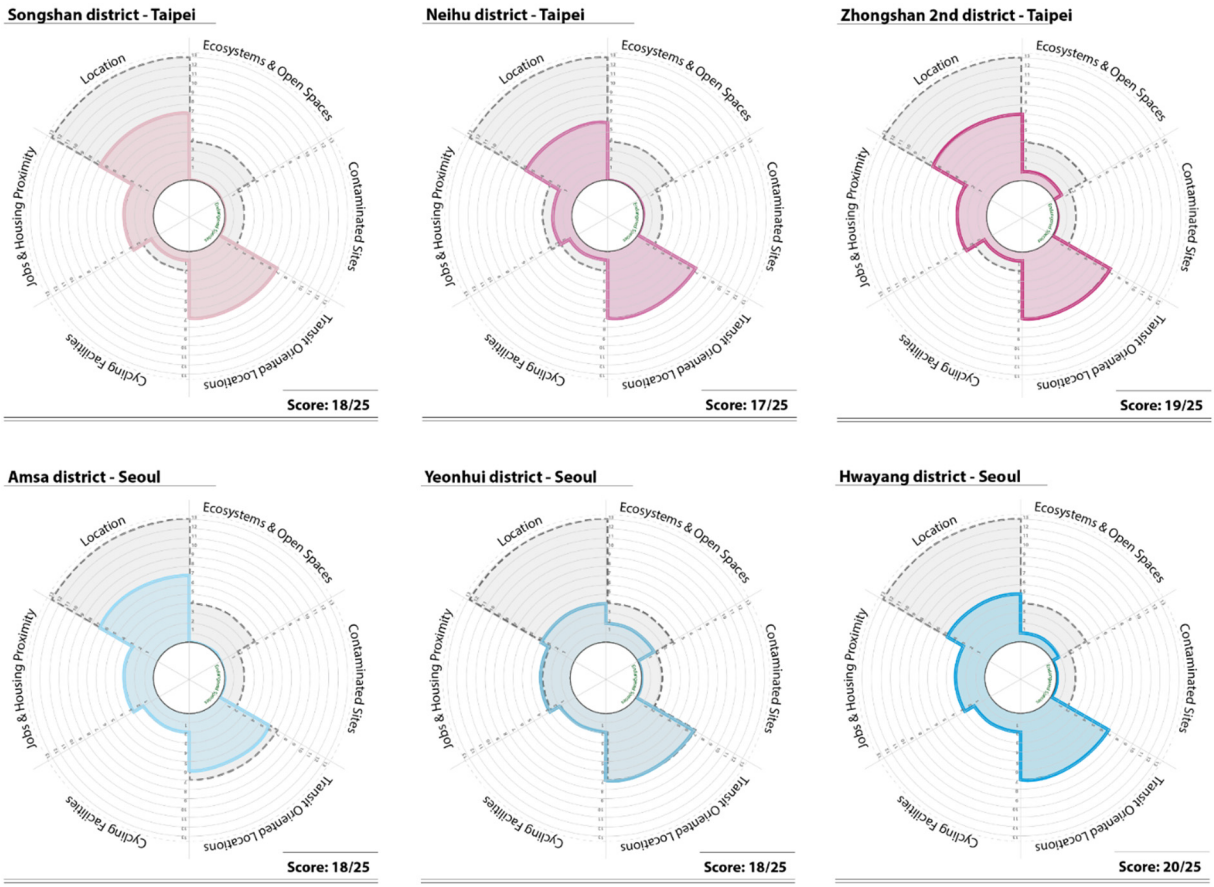

Figure 7. Smart Location and Linkage (SLL) in land readjustment sites in Taipei and Seoul. Source: authors.

Scores for Transit-Oriented Locations, Cycling Facilities and Jobs and Housing Proximity, on the other hand, are high but cannot be credited to developer strategies alone. These high scores derive from a well-integrated public transportation policy and the mixed-use zoning regulations commonly adopted for land readjustment projects. Therefore, they have to be attributed to the public planning regime rather than to developer strategies.

The assessment of the NPD category also shows a high level of coherence among the selected sites in both countries (Figure 8). The divergence between the highest-scoring sites (Songshan and Zhongshan 2nd district) and the lowest-scoring sites (Neihu and Hwayang district) is only 3 points. Scores for the categories of Compact Development, Neighbourhood Connection, Mixed Use, Access to Parks and Recreation and Schools were perfect. On the other hand, the selected land readjustment sites barely score in the Parking and Transportation category and in the Universal Design category. The score for Affordable and Diverse Housing is even among the selected sites. All score 3 points in the Housing Diversity category but fail to score any points in the Affordability and Public Rental Housing dimensions. The lowest points for all sites were scored in the Walkable Streets category, where the score ranges between 4 and 6 points out of a possible 12. The main reasons for the low score in this category are the lack of available space for parking, the absence of sidewalks among the majority of streets and the lack of shade-providing trees in public space.

Figure 8. Neighbourhood Pattern and Design (NPD) in land readjustment sites in Taipei and Seoul. Source: authors.

5. Discussion

We find that Taipei and Seoul employed similar policies to support the housing supply. Figures 7 and 8 illustrate how these policies have typically impacted the ecological score of the investigated sites in Taipei and Seoul according to the LEED ND system. The study reveals how most limiting factors were overcome in the two East Asian cities discussed here (Figure 9). We also find that not all policy interventions necessarily have had side effects that impact the ecological performance of the built urban landscape. Policy measures to overcome regulatory limitations as well as those related to transaction costs are included in the land policy interventions and therefore do not have to be addressed separately. However, some of the ecological effects of the policies supporting housing supply elasticity concern only the case of Seoul, where a standardisation policy was employed to overcome the limitations of material and human resource scarcity, while the limitations deriving from a culturally embedded lifestyle were accepted.

When discussing the ecological effects of government interventions related to land supply, we find that the sustainability score in the SLL category is predominantly determined by locational choices and transportation policies, which are determined by national planning policies—in the case of Korea also national security policies—and dominated by a rigid, top-down planning regime. Developers had little choice but to work with the available sites. Hence, low scores in the SLL category are due to the insufficient ecological awareness at the time, which manifested itself in a lack of concern for local ecosystems and the avoidance of construction on brownfield sites. Consequently, preference was given to easily developable greenfield sites in the fringe areas of the existing cities, which results in sub-optimal scores in the Ecosystems and Open Spaces dimensions. With the choice to develop fringe areas, a low score in the connectivity dimension inevitably follows because these sites often lack a surrounding urban fabric to connect to. It becomes clear that the contradictory public planning goals of quick urban land supply and ecological habitat

protection are incompatible and result in a low score in the SLL category for both assessed contexts. In hindsight, one might assume that ecological performance in the SLL category could be improved with a careful environmental analysis of the available land prior to development in order to mitigate the ecological impact of rapid urbanisation.

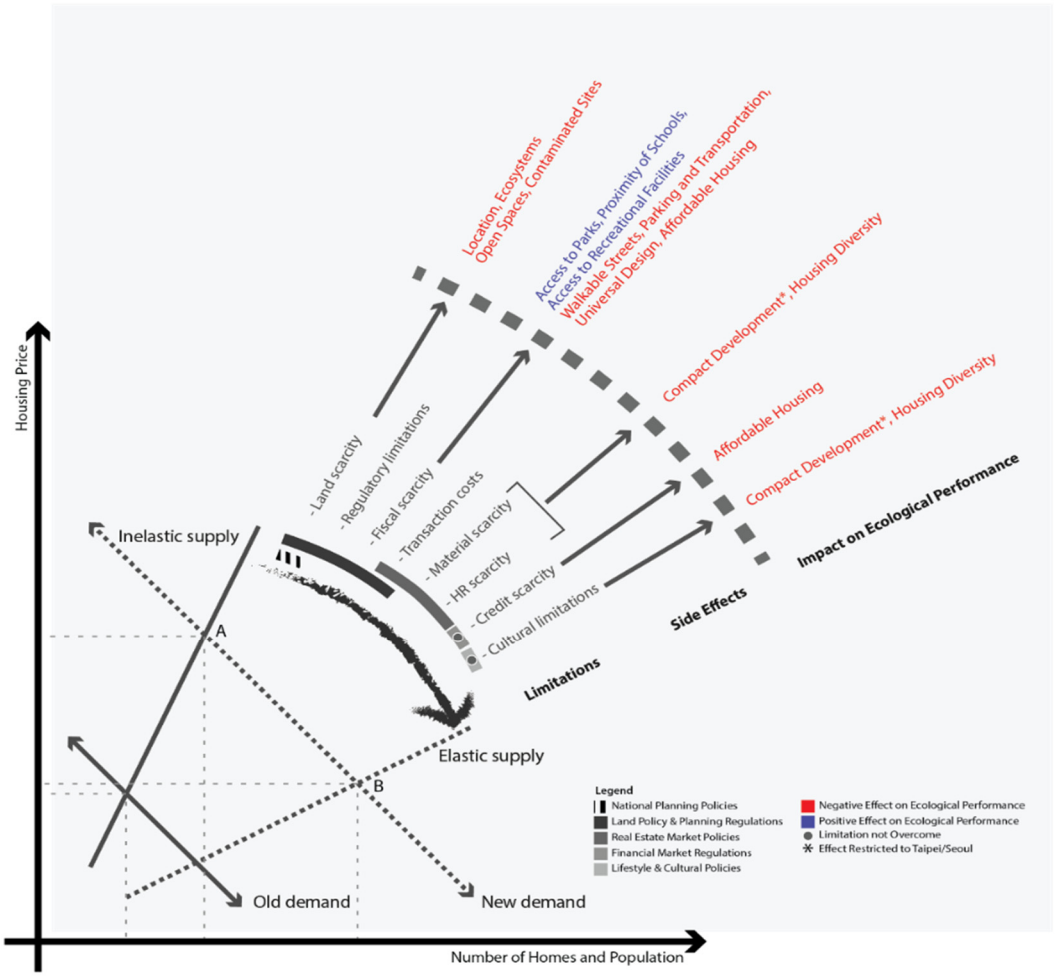

Figure 9. Ecological effects of housing supply elasticity policies. Source: authors.

Furthermore, the study reveals that government interventions, through land policies and real estate market policies in combination with market actors' reactions to these policies, have a clear effect on the ecological performance of the built urban landscape in the NPD category. These effects are being exacerbated by credit market restrictions put in place by the national economic policies of the respective developmental states, which reserve credit for selected industries.

The land readjustment policy keeps its promise of overcoming the limitations of land scarcity by reorganising small, inefficient lots and reducing transaction costs by internalising the expenses of negotiation and coordination. Most prominently, though, land readjustment manages to deal with fiscal limitations, which are typical for developing economies when the policy design manages to internalise the costs of land assembly and finances the provision of infrastructure and public services with embedded value capture regulations. The policy has a positive effect on the Access to Parks, Access to Recreational Facilities and Proximity to Schools dimensions, and can, in some cases, also support ecological performance in the Local Food Markets dimension. However, employing land-based financing with embedded value capture regulations also has a flip side. The collaborative character of the land policy comes with a dependence on landowners' willingness to cooperate, which in the cases of Taipei and Seoul, created second-order limitations. As

governments in the early stages of development tend to have a weak negotiating position, landowners tend to push through their expectation of handsome profits from development. Consequently, contribution rates remain modest, and it is hard for the government to impose higher developer obligations—with which a wider range of ecological goals can be achieved—without losing landowners' cooperation [67]. In order to keep the contribution rates low, only a minimum amount of land has been assigned to the public network. In both contexts, a rather narrow street network—originating from the narrow grid system introduced in both cities during Japanese colonial rule [80]—was chosen as the basic spatial framework for the urban pattern in the readjustment plans. This narrow street network does not allow for sufficient provision of sidewalks, trees, parking spaces and universal design measures, which results in sub-optimal scores in the Walkable Streets, Parking and Transportation and Universal Design dimensions. On top of that, the limit to landowners' willingness to cooperate, exacerbated by the absence of a working credit market and the lack of political will to direct fiscal resources to urban development, resulted in the absence of a large-scale affordable rental housing program in both East Asian metropolises discussed here. This is evidenced by the low score in the Affordable Housing dimension for all assessed sites.

It becomes apparent how land readjustment, as implemented in Taipei and Korea, manages to overcome housing supply limitations when internalising transaction costs of negotiation but fails to exploit the established democratic structures as a tool of resident collaboration. Few of the collaborative structures seem to have remained in both contexts after land readjustment concluded, which results in a low score in the Community Participation dimension.

Other real estate market policies to support housing supply had the purpose of overcoming limitations to housing supply deriving from material scarcity and the lack of know-how. This manifested itself in the form of immature real estate markets and underdeveloped material supply chains, which are typical for developing economies. The Korean Government addressed these limitations with a standardisation strategy for the real estate sector. With the development of steel and concrete industries—in combination with the introduction of standardised low-rise housing typologies—the construction process was modernised, and human resource scarcity was circumvented; therefore, housing supply was supported. The construction industry had little choice but to follow the standardisation policy set out by the government, as hardly any alternative material supply was available and consumer preference shifted towards the newly introduced architecture typologies. These housing typologies embraced local lifestyle preferences—particularly floor-based living—which has been a key characteristic of Korean dwellings ever since. However, the inflexibility of the imposed measures restrained the evolution of a diverse and competitive real estate market and created second-order limitations that had an effect on housing supply as well as ecological performance. As centralised floor heating systems were too technically sophisticated and expensive, the promoted housing typologies were free-standing, single-family homes with one or two floors, which promoted an inefficient use of land and can be seen in relatively low land-to-housing ratios. These governmental policies, therefore, had an additional negative ecological side effect that is not captured in the LEED ND standard. When landowners become aware of the potential ground rent they can earn from building in higher densities on their plot, demolition and reconstruction in land readjustment zones begin. Additionally, this reconstruction, in the form of higher and denser housing typologies, comes with additional ecological costs. The experience of Korea shows how a restrictive real estate market policy can lead to sub-optimal outcomes in terms of land use efficiency and can entail unnecessary ecological costs.

6. Conclusions

Based on the empirical examples assessed here, we find that overall, government policies in Taiwan and Korea have been successful in dealing with demand shocks at times of fiscal and resource scarcity in the early days of both countries development after World

War II. While the top priority of these policies was urban development and infrastructure provision, the policies employed inevitably have a sustainability dimension. And, from this perspective, not all government policies employed were successful. In order to mitigate the negative ecological effects related to locational choices that the study has found in the SLL category, an environmental assessment of potential greenfield sites should be carried out prior to development. This would help avoid locational choices that are bad from an ecological perspective. Additionally, alternative growth strategies that promote the development of brownfield sites in an inclusive manner should be considered. This may include collaborations between public agencies and private developers and innovative financing mechanisms, as well as the promotion of capacity building initiatives that enable construction companies to deal with complex brownfield developments. Furthermore, various limitations to housing supply can be tackled by employing the land readjustment policy in the NPD category. However, the public sector's weak negotiating position can lead to second-order limitations that impact housing supply as well as the ecological performance of land readjustment projects. Particularly, the under-provision of public land, which results in an ecologically inefficient urban pattern, produces ecological costs. From the Korean case, we can learn that strong, top-down government control of the real estate industry can be overly restrictive and comes with ecological costs that could be avoided when markets operate more freely in terms of the methods they employ and housing typologies they offer. When choosing a standardisation policy, involvement of the private sector in the process would allow early detection and quick reaction to inefficiencies in the applied architectural typologies and lead to greater effectivness. Less restrictive credit market policies would also be beneficial to supporting the emergence of a more liberal real estate sector.

Based on the assessment of the two cases, a set of recommendations for policymakers experiencing rapid urbanisation in developing economies and developers operating in this context can be made: first, assess where new developments have the least ecological impact. Second, engage in public–private partnerships and capacity building to promote construction on brownfield sites. Then, rethink the design of the urban pattern—especially the organisation of the street network and the associated pedestrian, parking and public transportation facilities—in order to find more ecologically efficient solutions. Fourth, argue for higher value capture ratios—for example, with an externality mitigation rationale—with which the provisions of sustainable infrastructure can be legitimised, and larger public facility land ratios might be captured. Finally, allow for more liberal real estate markets to emerge. This can be completed by supporting a greater diversity of available construction materials, seeking closer involvement of and feedback from the real estate market actors in public policy decisions, engaging in capacity development, promoting innovative financing mechanisms and liberalising access to credit.

Additional research on public policy interventions in more countries facing rapid urbanization would, however, be necessary to make recommendations for developing economies ith certainty. Specifically, more research is required on the management of participative and inclusive brownfield development, the implementation of more effective value capture mechanisms and the design of an ecologically balanced urban fabric.

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