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Review

Multiple Roles of Green Space in the Resilience, Sustainability and Equity of Aotearoa New Zealand's Cities

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Abstract: Green space is needed in urban areas to increase resilience to climate change and other shocks, as well as for human health and wellbeing. Urban green space (UGS) is increasingly considered as green infrastructure and highly complementary to engineered urban infrastructure, such as water and transport networks. The needs for resilient, sustainable and equitable future wellbeing require strategic planning, designing and upgrading of UGS, especially in areas where it has been underprovided. We explore the implications of these needs for urban development through a detailed review of cited UGS analyses conducted on the larger cities in Aotearoa New Zealand (AoNZ). There are important differences in UGS availability (i.e., quantity), accessibility and quality within and between cities. Some of these differences stem from ad hoc patterns of development, as well as topography. They contribute to apparently growing inequities in the availability and accessibility of UGS. Broader health and wellbeing considerations, encompassing Indigenous and community values, should be at the heart of UGS design and decisionmaking. Most of AoNZ's cities aim (at least to some extent) at densification and decarbonisation to accommodate a growing population without costly sprawl; however, to date, sprawl continues. Our findings indicate a clear need for the design and provision of high-quality, well-integrated UGS within and servicing areas of denser housing, which are typically areas in cities with a demonstrable UGS deficiency.

Keywords: urban green space; equity; resilience; accessibility; climate change adaptation

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1. Introduction

In early 2023, many regions of Aotearoa New Zealand (AoNZ) experienced severe rainfall and flooding events, resulting in the loss of lives and unprecedented losses in infrastructure and agricultural production across urban, rural and peri-urban areas [1,2]. Increases in total annual rainfall amounts and intensity are expected to continue for many decades under global climate change scenarios [3,4]. Combined with sea-level rise and vertical land movement, this will significantly affect most of AoNZ's urban areas, including those with the largest concentrations of urban populations, such as Auckland, Christchurch and Wellington. About 13% of Aotearoa NZ's population live in flood-prone areas. This percentage will grow as rainfall increases, storms become more frequent and sea levels rise [5]. These impacts have focused attention on the concept and practice of "sponge cities" [1,6,7], a concept within urban planning that emphasises stormwater and flood management through strengthening green urban infrastructure elements, including green spaces, rather than relying purely on hard infrastructure, like built drainage systems. This example is, however, only one of many ecosystem services provided by urban green space (UGS)[1]. We broadly define UGS as "any urban land that is not covered by a structure or sealed by an impermeable surface such as asphalt or concrete" [8].

UGS is important for ecosystem health and increasing resilience to the urban impacts of climate change [9,10]. An ecosystem services perspective usefully illuminates the complexity of ecosystem processes and functions in cities, as well as human interactions with them, in terms of needs and benefits [11–13]. Ecosystem services, such as air purification, water flow regulation, microclimate regulation and carbon sequestration, are fundamental to human survival and wellbeing [14,15]. Because of these multiple ecosystem service benefits, UGS can be considered an important type of "green infrastructure" (GI), which is defined as "a network providing ingredients for solving urban and climatic challenges by building with nature" [16]. "Green", as used here, includes urban aquatic environments, such as streams, ponds, lakes, wetlands and coastal areas (often termed "blue space"), commonly located within or adjacent to green land areas (such terrestrial and aquatic areas are sometimes referred to as "blue–green"). The focus of this paper, however, is on the land-based components of UGS.

UGS is highly complementary to water infrastructure, especially in response to flooding, as well as many aspects related to connectivity within urban areas. For example, transport routes can provide important biodiversity corridors and also be integrated within or alongside the UGS within many cities [17]. Lepczyk et al. [18] note that there are still many gaps in our understanding of how UGS functions to conserve biodiversity at the city scale, and they propose a research framework to develop such an understanding.

An extensive body of literature has documented the benefits related to health and wellbeing of contact with nature or green spaces [19–21]. The human health benefits associated with accessing UGS include improved mental health and cognitive function; stress reduction; reduced mortality, cardiovascular morbidity and prevalence of type 2 diabetes; improved pregnancy outcomes; and relief during public health crises, including the COVID-19 pandemic [21,22]. The mechanisms underlying the links between access to UGS and health are complex, interactive and, sometimes, synergistic [23,24].

UGS confers a range of further wellbeing benefits specific to urban environments [25,26]. Studies suggest that urban green areas may have greater protective health effects than those in suburban or rural environments [27]. Residing in neighbourhoods that are more walkable and offer better access to UGS (especially those with recreation facilities) and local transport infrastructure has been associated with increased overall physical activity [28,29]. A study in the USA identified the quantity of parks as among the strongest predictors of overall subjective wellbeing at the whole city level [30], while in AoNZ, a recent study involving an assessment of health-promoting and health-constraining environments identified green and blue spaces as critical health-promoting "goods" [31]. The different environments were aggregated such that the most deprived areas in AoNZ often have the most environmental "bads" and less access to environmental "goods", as demonstrated in previous studies [32]. The benefits of UGS have received particular attention worldwide since the onset of the COVID-19 pandemic, with many urban residents becoming more aware and making greater use of neighbourhood UGS, reporting a range of stress relief and health benefits [33–35].

Inequities in the distribution and quality of UGS have been the focus of much recent international research. Some studies assessed accessibility (sensu "proximity") [36] by linking the distribution of UGS to population data, including socio-economic and health statuses [36–38]. Inequity in UGS distribution is only one aspect of environmental injustice; a more pluralistic justice framework has been recognised over the last decade [39]. Several studies have shown inequalities and inequities in opportunities to access UGS, particularly in areas with lower incomes or socio-economic status (SES) and higher population or household densities [36,40–45]. Rigolon et al. [46] showed that, internationally, people who had a lower SES experienced more beneficial physical health outcomes from proximity to public UGS because of their greater dependency on that proximity. They suggest that public UGS provision may be a tool that can be used to advance health equity and address health disparities. But a trend towards more dense and compact urban settings may result in less area per person being available for UGS [43,47,48]. A significant challenge for cities, therefore, is to find an optimal balance between the full range of benefits and costs of UGS. The definition of UGS adopted in this review encompasses both publicly and privately owned land, sometimes an important distinction in relation to sustainability and equity aspects of green space [49].

Green spaces can be very important for cultural identity and creating a sense of place [50–52]. In Aotearoa New Zealand, cultural identity has been critical in framing the management provided by the country's foundational document *Te Tiriti o Waitangi* (the Māori-language version of the Treaty of Waitangi 1840, which formalised governance and other relationships between Indigenous Māori and "the Crown" (colonial and later settlers)). Cultural relationships to place are important not only in relation to wellbeing [53,54] but also to elements of native biodiversity [55] and people's ability to engage in recreation [52,56], especially in coastal environments, which are nearby for most urban inhabitants of AoNZ [56].

All of these benefits contribute to the cultural ecosystem service benefits associated with UGS, as well as to UN Sustainable Development Goal 11, ("Make cities and human settlements inclusive, safe, resilient and sustainable"), in particular target 7 ("By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities). It is not surprising that a recent Parliamentary Commissioner for the Environment (PCE) report concluded that "Planning for and providing urban green spaces should not be optional" [8]. Until recently, it was thought that cities in AoNZ were generally well-endowed with UGS [8,56]. But in the last decade, largely driven by rising population growth and urban densification, particularly in the inner-city areas of Auckland and Wellington, there has been more attention to the perceived loss of UGS in AoNZ's cities, as well as the resilience, sustainability and equity implications of such losses [8,49,57,58]. A number of recent studies have documented the losses in UGS since the 1980s, as examined in more detail in later sections. There are cost implications to maintaining the availability of UGS as a city densifies, as well as important liveability and sustainability considerations [59].

Some important differences in the characteristics of UGS affect their ability to maximise the supply of ecosystem services. We refer here mainly to the characteristics we term availability, accessibility and quality. The term "availability" is used in the sense of the existential capability of being used, i.e., a simple quantitative measure of the area of UGS per person or per household in a defined urban administrative area, suburb or neighbourhood [9]. By contrast, "accessibility" is defined, as per the *Concise Oxford Dictionary,* as the "ability to be reached or entered". Therefore "accessibility" has an additional connotation (which may be expressed qualitatively or quantitatively) of an ability (physically, socially, economically and culturally) to access UGS. The two terms appear to be used somewhat interchangeably and without clear distinction in much of the literature. Also, we use UGS "quality" to refer to characteristics such as the diversity and quality of park facilities, amounts of tree canopy and biodiversity habitats, features that contribute to a sense of place, and adequacy of maintenance. Our terminology, overall, is closest to that of Rigolon et al. [60].

2. Aims, Significance and Approach

The aims of this study were to (a) review and synthesise quantitative and qualitative data on UGS availability and accessibility in AoNZ; (b) relate the availability, accessibility and quality of UGS to equity considerations in AoNZ's social and cultural contexts; and

(c) discuss the implication of our findings for planning urban forms and infrastructure provisions in AoNZ.

Methodologically, the study used narrative review and meta-analysis approaches that considered significant studies on green space, centred on six major cities in AoNZ (Figure 1), with some references to comparator cities internationally. A range of quantitative and qualitative methods were used in the various studies reviewed, which is suggested as a good approach to the analysis of cultural ecosystem services [61]. Tree cover analysis is a prominent quantitative method, which includes the variation in tree cover across a given city, an important indicator of the equity in access to green space, as well as its availability. The extent and type of quantified UGS losses, including whether they are more marked on private than on public land, are also important. Qualitative methods include a range of matters, such as the accessibility and quality of UGS and other characteristics of losses in urban green space, using indicators such as differences in the levels of development in different parts of a city's existing footprint, as well as outside it in cases of peripheral expansion. This dual combination provides insight into significant outcomes regarding the resilience, sustainability and equity of urban development. The cultural dimensions of people's connection to land in these areas are also relevant [53,54] and are illuminated by qualitative commentaries offered by the examined studies.

The context for this study makes the findings relevant for urban development and planning in AoNZ and potentially for urban areas in Australia and *Te Moananui Oceania* (our preferred term for the Pacific Ocean and its islands), as well as in some other small island developing states (SIDS). This analysis is important at a time of increasing inequity in UGS availability and benefits, as well as when the sustainability, resilience and wellbeing of Oceania cities are being challenged, in particular by climate change and urbanisation [35,62]. Our review pays particular attention to these issues of inequity and sustainability.

An important strand of recent thinking behind this study comes from the NUWAO (Nature-based Urban design for Wellbeing and Adaptation in Oceania) programme (https://nuwao.org.nz accessed on 1 July 2024), which aims to develop nature-based urban design solutions rooted in Indigenous knowledges that support climate change adaptation and individual and community wellbeing in different contexts across AoNZ and *Te Moananui Oceania* [63,64]. Earlier work towards this study was undertaken under the auspices of the NZ Centre for Sustainable Cities https://www.sustainablecities.org.nz/ (accessed on 4 July 2024), an interdisciplinary research centre providing innovative research solutions to the challenges of urban development—economic, social, environmental and cultural—facing AoNZ.

Figure 1. Locations of Aotearoa New Zealand's cities for which studies are cited in this review.

3. Aotearoa New Zealand Case Studies

3.1. Overview of UGS Analysis in Metropolitan AoNZ Cities

The metropolitan AoNZ cities examined in this study are Auckland, Hamilton and Christchurch, as well as four cities (Wellington, Hutt, Upper Hutt and Porirua) within the Wellington urban area, with briefer analyses of Tauranga and Dunedin for which there is less data. Some of this review material comes from two recent, comprehensive national overviews [1,8]. The analyses in the studies cited focused mainly on the availability, accessibility and quality of UGS, although some studies analysed and/or commented on other UGS factors. Some of the quantitative data are summarised in Table 1, and characteristics and highlights of selected key individual studies for individual or groups of cities are shown in Table 2. The latter table presents resilience, sustainability and equity conclusions where available, but some of the studies focus only on aspects of availability. An overview of current inequities in the availability of UGS in Aotearoa NZ's cities concludes the section.

Table 1. National overview of green space availability data[1].

City Council	Year of Study	Public Green Space (ha)	Tree Canopy Cover (% of Urbanised Area)	Public UGS (% of Admin. Area)	Public UGS (m²/person)
Auckland	2015, 2016/18	13,438	18%	2.7%	87
Hamilton	2020, 2019	1142	15%	10.3%	65
Tauranga	2018	1549		11.3%	109
Wellington *	2021, 2019	4146	31%	14.3%	191
Upper Hutt *	2018	421		0.8%	93
Hutt *	2021	2781		7.4%	248
Porirua *	2018	998		5.7%	169
Christchurch	2020, 2018/19	10,177	14%	7.2%	260

[1] Adapted from [8], Tables 2.2 and 2.3. * The four cities within the Wellington region.

Table 2. Features of selected key AoNZ studies relating to resilience, sustainability and equity of UGS provision.

Author and Year	City	Theme	Methods	Key Points Relating to Resilience, Sustainability and Equity
Auckland Council 2017 [65]	Auckland Metropolitan Area	Distribution, ownership and protection status of urban forest cover	Analysis of LIDAR data	• Urban forest covers 18% of the urban area (11% legal road areas, 24% public lands and 18% private land) • Urban forest cover varies widely across the city • Landforms, soils and development patterns have a large influence on the current distribution • About half of the urban forest has no statutory protection
Martin et al. 2022 [66,67]	Auckland, Hamilton, Wellington	UGS quantification, per person availability and changes over time (1940s to 2016)	GIS-based analysis of aerial and NIR imagery and population data	• Significant and different changes in populations and urban forms among the three cities since 1940s • Total GS as a proportion of the total urban area and the amount and proportion of private GS has declined since the 1940s, especially in Hamilton and Auckland

				• Infrared imagery has enabled better differentiation of vegetation types
Hand et al. 2016 [49]	Auckland, Wellington, Dunedin	Urban biodiversity analysis, also incorporating social values	Derivation of neighbourhood-scale "bioscores"	• The results are oriented towards children's neighbourhoods • Biodiversity across neighbourhoods was significantly related to socioeconomic class, mainly due to the greater cover of high-biodiversity-value gardens in regions with a higher SES • More deprived urban neighbourhoods had less perceptible biodiversity
Blaschke et al. 2019 [47]	Central Wellington City	UGS availability and location	Aerial photos and a field survey	• Very uneven per person UGS availability now • Will be exacerbated by a forecasted growth in population • Access and quality issues also had equity implications
Schindler 2023 [68]	Wellington (4 cities)	Perception of UGS benefits	Online survey and choice experiment	• Residents value and are generally satisfied with UGS available to them • Satisfaction varied according to spatial and socio-economic factors • More holistic approaches to UGS planning that consider both current and future generations are needed to address these contextualities and interdependencies
Morgenroth 2021 [69]	Wellington City	Extent of tree canopy cover	Image (aerial photos and LIDAR) classification	• Overall tree canopy cover was 31% • Very wide range of tree cover between suburbs
Morgenroth 2022 [70]	Christchurch	Extent of tree canopy cover	Image (aerial photos and LIDAR) classification	• Overall tree canopy cover was 14% • Wide range of tree cover between suburbs • Difference between public (19%) and private land (11%) tree coverage • Important roles for parks and reserves, especially in suburbs where overall tree cover is low
Richards et al. 2023 [71]	Christchurch	Inequity of ecosystem services provision	Spatial analysis tools; mapped covariance between indicators of residents' vulnerability and urban ecosystem services	• Overall, the distribution of urban ecosystem services is inequitable to the disadvantage of more socially and economically vulnerable residents • Inequities are present across a wide variety of urban ecosystem service types
Guo et al. 2019 [72]	Christchurch	Property owner decisions on tree removal or retention	Survey questionnaire for owners	• Owners of redeveloped properties were more likely to remove trees to achieve development outcomes • Owners from non-redeveloped properties were more likely to remove trees because they perceived the tree to be in poor health

				• Property owners identified provision of ecosystem services and aesthetics as the reasons for either development or retention of trees • Findings support the use of legislation, bylaws and financial disincentives to limit tree removal during property redevelopment
Van Heezik et al. 2014 [73]	Dunedin	Residential garden diversity	Woody plant species richness and diversity analysis, household survey	• Complex drivers of garden diversity and structure, reflecting the diversity in the characteristics of the current and previous householders and their gardening practices • The presence of tall trees was weakly (positively) associated with the extent and proximity of neighbourhood green space

3.2. Auckland

Meurk et al. [74] documented the character of residential vegetation in residential areas of Auckland, analysing the vegetation's composition, succession and weed threats to what they interpreted as woodland ecosystems dominated by exotic (71%) and indigenous (29%) trees and shrubs. Their analysis of the urban indigenous character of Auckland's residential vegetation and implications for the conservation of biodiversity considered some of the socio-economic and cultural factors influencing the vegetation typologies.

Auckland Council [65] analysed Auckland's UGS in terms of 2013 forest cover (defined as woody vegetation over 3 m high detected with LiDAR), finding that "urban forests" covered 18% of the urban area but with considerable variation (7% to 40%) between areas and suburbs, and 40% was located on public land and 60% on private land. Factors influencing the amount and quality of vegetation included the underlying topography and soil fertility, as well as the amount and type of development. This analysis was further developed by Martin et al. [8,66,67]. The amount of tree canopy cover was much less (around 50%) than the total UGS amount, even when allowing for the loss of UGS experienced since 2011.

UGS per person in Auckland was about 240 m^2/person in 2011 [8], comprising 87 m^2/person of the public UGS and around 153 m^2/person of the private UGS. These amounts have likely decreased significantly since 2011, mainly due to reductions in private UGS as parts of the city's population increased. It was estimated [8] that an approximately 20% decrease in private UGS per person occurred between 1980 and 2016, which was partly masked by local government acquisition of land for new public UGS related to greenfield development.

A detailed analysis of the UGS loss in one Auckland administrative area [75] estimated that approximately 13,000 individual "clearance events" resulted in the loss of 61 hectares of tree canopy cover between 2006 and 2016. Tree removal occurred primarily on private land and was slowly cumulative, with 90% of individual clearance events less than 0.01 hectares in size but accounting for almost two-thirds of the total decrease in tree canopy cover over the decade.

3.3. Hamilton and Tauranga

Hamilton's topography and location situated on a relatively flat, fertile alluvial plain have resulted in a different history and current UGS status than those of most other AoNZ cities. Almost all native vegetation was cleared early on, leaving indigenous remnants confined to steep and narrow river gullies [76]. All current indigenous vegetation in other parts of the city was reestablished relatively recently. The population has grown faster than in most AoNZ cities, with a 30% increase between 1981 and 2018, while the population density rose by 13% between 2013 and 2018 [67].

The total tree cover in Hamilton in 2019 was 15% [8], with a range of 3.5–29% between suburbs. Total UGS currently accounts for 45% of the urban area. Hamilton's residents have about 220 m^2 UGS per person. The rate of UGS loss has been largely stable, at approximately 15% annually between the early 1940s and 2016, similar to that of Auckland. Recent losses in UGS have been significant, and they mainly comprise garden (suburbs) or farmland (i.e., greenfields) vegetation rather than original indigenous vegetation. Martin et al. [67] note the very high increase in the area of impervious surfaces in Hamilton.

The Tauranga/Papamoa urban area is now the most rapidly growing large urban area in AoNZ, but there is little documentation or analysis of its pattern and growth. Some information is available concerning sprawl and UGS loss from Tauranga City Council data for 2018 [8]. The amount of public UGS in Tauranga City (1549 ha) in 2018 was 11.3% of the urban area, a density of 109 m^2/person. Most of the current urban development is peri-urban; only 20% of the dwelling consents granted since 2016 were inside the existing urban footprint. There are few apartments and little or no land acquisition for UGS purposes, although there are levies for general development purposes.

3.4. Wellington

Morgenroth [69] documented the extent of tree canopy cover in 56 urbanised areas (roughly equating with individual suburbs) within Wellington City, comprising 40% of the total city area. The overall tree canopy cover was 31%. While about two-thirds of the suburbs had tree covers of 10–40%, tree cover among the suburbs ranged very widely, from 1% to 71%. Only two suburbs had tree cover greater than 50%, while six suburbs had tree cover less than 10%.

Martin et al. [66,67] quantified the changes in vegetation cover in urban areas of Wellington and the Hutt Valley between 1941 and 2021, distinguishing between public and private UGS. Overall, urban expansion has been slower, especially in Wellington City, than in the other cities studied, such that UGS areas, as a proportion of total urban area (63%), saw smaller declines and increased near the city's margins, which contain relatively large reserves. These trends mean that the total city-wide UGS per person has also stayed static at a generous 337–341 m^2/person. UGS loss has been much more marked on private than on public land.

Blaschke et al. [47] analysed in detail the UGS distribution within three census area units (CAUs) in central Wellington City, conducting a desktop aerial photography review. The authors categorised a total UGS area of 41.2 ha according to land-use categories and vegetation cover classes. The per person UGS in 2013 was 20 m^2/person, with marked differences among the three CAUs. The future per person availability (to 2043) was also considered, based on the estimated population growth and an assumption of no new supply of UGS. On the basis of these assumptions, the future per person green availability would shrink to as low as 3 m^2/person in the most densely populated CAU, with marked and increasing differences in the future availabilities among the CAUs over time. Whitburn [77] analysed 20 Wellington City neighbourhoods (located throughout the city) that differed in their greenness level and found wide variation in the vegetation cover levels of the neighbourhoods, varying from 32 to 57% of the total area. Private gardens were a very significant part of the total vegetation, and the proportion of mature tree canopy vegetation varied from 23 to 83%, which was highly correlated with the total vegetation cover.

Schindler [68] presented a detailed analysis of the benefits of UGS as perceived by the respondents to an online survey across urban Wellington (Table 2). Almost three-quarters were satisfied or very satisfied with the provision of UGS where they currently live. The benefits of UGS were widely perceived by respondents, and proximity to UGS was highly valued by most as an important criterion of choice. However, house price was not included as a choice criterion, and respondents were skewed to above average incomes. The study distinguished between public and private UGS and examined quality, as well as amount and accessibility. Forty percent of the respondents had access to a private garden, and those residents were more likely to value local UGS in general.

Freeman et al. [52] studied an aspect of UGS access related to a specific population demographic, aiming to objectively assess the use of UGS in both public and private settings by Wellington children (aged 11–13) during their summer leisure time, through the use of wearable cameras. The children in the sample spent an average of nearly 10% of their leisure time in UGS over the summer months, were physically active two-thirds of that time and usually in the company of other children or adults. The researchers concluded that green spaces are important for children's health because they are places where they spend time and are physically active and sociable.

3.5. Christchurch

The status of UGS in Christchurch, AoNZ's second-largest city, is anomalous to the rest of the country due to the effects of the major Christchurch earthquake of February 2011, which killed 185 people and caused widespread damage to buildings and infrastructure, including green spaces throughout the city. Widespread soil liquefaction, in combination with damage to houses and infrastructure, left significant areas vacated by most residents and essentially uninhabitable. The largest such area, bordering the Ōtākaro Avon River, affected more than 8000 properties and 10,000 residents and was considered as infeasible to rebuild on, resulting in considerable governance and community discussions about future UGS development and use [78,79]. The combined effects of earthquakes and decisions regarding the uninhabitability of areas affected by soil liquefaction have resulted in both losses and gains in UGS.

Stewart et al. [80,81] studied the composition and structure of diverse pre-earthquake vegetation across Christchurch. Urban forest canopies were dominated by exotic tree species in parklands and in street tree plantings. The remnant indigenous vegetation was degraded and fragmented, and native tree and shrub species were not as common in public spaces, but their overall density was high in residential gardens and they were growing in popularity.

Morgenroth [70] analysed the tree cover in Christchurch using broadly similar methods to those in Wellington [69]. A total of 13.6% of all Christchurch (excluding Banks Peninsula) is covered by trees. Canopy cover ranges from 6.5% to 27.6% between the suburbs, while on the larger electoral ward scale five wards had tree canopy cover exceeding 15%, and four wards had tree canopy cover less than 10%. Some 19% of publicly owned land in Christchurch was covered by trees compared with 11.2% of privately owned land. Parks and reserves play important roles in maintaining and enhancing tree cover in areas where the overall tree cover is low. Christchurch City Council reported that in 2020 there was a total of 10,177 ha of public UGS, accounting for 7.2% of the city's area and 260 m^2/person [8], a higher per person amount than for any of the other cities cited in the PCE analysis.

Analysis of the gains and losses in Christchurch is complicated by the Christchurch earthquakes described above, as well as by methodological considerations [8,70]. Guo et al. [82] studied the dynamics of tree canopy loss in Christchurch between 2011 and 2015/16. The strongest predictor of tree retention was whether the property had been redeveloped, with the percentage of trees removed on redeveloped and non-redeveloped properties being 44% and 13.5%, respectively. Other important predictors of tree loss were the distance of the trees from redeveloped trees or driveways and the capital value of the property. Guo et al. [72] further investigated the implications of property owner decisions on tree removal or retention (Table 2).

3.6. Dunedin

Dunedin was the location of two of the earliest AoNZ studies on urban vegetation cover based on the quantitative analysis of remotely sensed data [83,84], for which the researchers used digital aerial photos and high-resolution multispectral imagery, respectively, to map the extent, distribution and density of private gardens, as well as other vegetation. In the latter study, the vegetated garden areas were calculated as comprising 46% of the residential area or 36% of the total urban area, the most extensive land use type. The study's methods enabled broad discrimination of garden types based on vegetation.

Given the prevalence and importance of gardens as private green spaces in many AoNZ cities [85], Van Heezik et al. [73] further investigated the drivers of garden diversity and structure in Dunedin, focusing on native and exotic woody vegetation in relation to the characteristics of the garden owners, the gardens themselves, and their proximity to neighbourhood green spaces. They found few consistent patterns in the vegetation structures; most of the common species were exotic although 12 native species were common. There was significant but weak matching to social and environmental variables, as follows: vegetated area, species knowledge, and education explained the variations in native communities, whereas vegetated area, species knowledge, and householder age explained the variation in exotic communities. The authors suggest that the legacies left by previous owners' gardening practices are important to consider when identifying drivers of garden plant community structure.

3.7. Current Inequities in UGS Availability

As in many studies internationally, several cities in AoNZ show emerging inequalities or inequities in the availability and distribution of UGS and, in some cases, other ecosystem service benefits, as summarised in Table 2. In line with the international literature, there is typically more total UGS and UGS per person in the more affluent areas and suburbs of AoNZ. In some of the studies, these inequalities are associated with inequalities (self-reported or otherwise measured) in health and wellbeing outcomes. Donovan et al. [86] assessed the association between the natural environment and asthma in a large sample of 18-year-old AoNZ children. Children who lived in greener areas (measured by the normalised difference vegetation index (NDVI)), were less likely to be asthmatic, and the NDVI was more protective when the analysis was restricted to children living in more socially deprived neighbourhoods. But there are as yet few AoNZ studies and, as with the international literature, these patterns are not consistent, with some anomalies in the general pattern.

Nutsford et al. [87] carried out a cross-sectional examination of the relationship between access to UGS and counts of anxiety/mood disorder treatments amongst adult residents throughout Auckland City. Treatment counts were associated with the proportion of UGS within 3 km and the distance to the nearest useable (i.e., accessible) green space, interpreted as indicating a protective effect of increased access to UGS against those treatment counts. Access to UGS within 300 m did not exhibit significant associations, leading the authors to suggest that the benefits of green space for mental health may relate both to active participation in useable green spaces near to the home and observable green space in the neighbourhood environment. Some of the same authors, in an earlier national study of 1.56 million people living in urban areas across New Zealand [88], found that deprived neighbourhoods were relatively disadvantaged in total UGS availability but had marginally more accessible UGS. No significant associations between usable or total UGS and mortality were observed after adjusting for confounders. Chuang et al. [89] found that neighbourhoods with a higher deprivation index quintile ranking had lower accessibility to UGS in Auckland. Their study focused on neighbourhoods with higher levels of public housing tenancies compared with those with no public housing. Although these results are statistically significant with respect to equitability, the actual differences in the distances between people's assumed residence and the nearest public space are small.

There is limited information available for Wellington City. Blaschke et al. [47], studying only the three central city CAUs, reported that the CAU with the highest total and per person UGS had the highest household income, while the CAU with by far the lowest total and per person UGS had a lower rate of home ownership and higher rental costs than the other two CAUs but a lower median household income than for Wellington City overall. The authors also reported information for the Wellington region indicating a trend that parks in geographical areas of high deprivation (including those within Wellington City) were less accessible and had fewer amenities than those in areas of low deprivation. Whitburn et al. [77], further investigating the variation in neighbourhood vegetation reported in Section 3.4, by testing the relationships between pro-environmental behaviour (PEB). They found that residents' surveyed connection with nature was more strongly associated with PEB than with other scoiodemographic variables, although household incomes were positively associated with neighbourhood vegetation levels and rather weakly associated with connection to nature. More recently, Schindler [68] presented a detailed analysis of the benefits of UGS as perceived by respondents to an online survey in urban Wellington (Table 2 and previous section).

In Christchurch, Richards et al. [71] analysed the relationships between residents' economic and social vulnerabilities to environmental pressures and a composite indicator of urban ecosystem services termed "Nature's Contribution to People" (NCP). They analysed inequity in nine diverse forms of urban NCP across an index of economic and social vulnerabilities, including four directly related to UGS availability (proportion of time that shade is provided by vegetation, proportion of green cover at the closest school, area of private green space at each residence and distance from each residence to the nearest public green space). For each of these indicators there was a significant negative association with the economic and social vulnerability index (ESVI) [90], used to quantify the socio-economic vulnerability of each census region in their study. Residents of more vulnerable neighbourhoods experienced reduced provision of carbon stock, runoff retention, air quality enhancement, shade, educational green space, public outdoor space accessibility, private green space, and bird biodiversity contributions. The authors concluded, overall, that the distribution of urban NCP is inequitable to the disadvantage of more vulnerable residents, as is broadly consistent with the findings of Marek et al. [31].

Hand et al. [49] compared the biodiversity richness in 13 urban habitat types in Auckland, Wellington and Dunedin Cities, and they also assessed the biodiversity richness, complexity and wildness in relation to socio-economic deprivation. The authors found that the biodiversity across neighbourhoods was significantly related to socioeconomic (deprivation) and cultural (ethnicity) factors, due mainly to the greater cover of mature gardens of high biodiversity value in regions of higher SES. They concluded that while all neighbourhoods provided opportunities for residents to connect to nature through public UGS, those people living in more deprived neighbourhoods are less likely to be exposed to nearby biodiverse spaces and therefore may encounter fewer opportunities to connect to nature and gain the benefits that urban biodiversity can afford.

4. Discussion

Table 2 summarises the key themes and main points particularly relating to resilience, sustainability and equity found in the selected AoNZ studies. This section discusses additional themes in the AoNZ and international literature that complement those already explored, underlining the connectedness of other dimensions of urban green space to overall wellbeing and sustainability outcomes. Sponge-city planning, small-scale GI, the contribution of road reserves and the problems that come with excessive paving of UGS are considered, in addition to opportunities for cultural expression. The impacts of urban population growth and intensification are also discussed, with implications for better urban planning and design and opportunities for further research concluding this section. Furthermore, a perhaps obvious point should be made, that the availability of UGS is a prerequisite for the vital issues of resilience, sustainability and equity in their provision. Figures 2–11 illustrate examples of the multiple roles of UGS in AoNZ.

Figure 2. The Wellington Town Belt provides multiple ecosystem services, including temperature moderation, improvements in water and air qualities, carbon sequestration, biodiversity, human health and wellbeing, amenities and amelioration of noise nuisances. Photo: Wellington City Council (with permission).

Figure 3. An urban park acting as a stormwater detention area in Auckland following the February 2023 flooding events described in Section 1. Photo: Auckland Council (with permission).

Figure 4. Green space offering wetland restoration, recreation and public art. Chaffers Park, Wellington. Photo: Authors'.

Figure 5. Establishing locally rare native dryland species in a specially prepared stressed niche (very-free-draining exposed substrate) on the Christchurch Southern Motorway extension. Photo: C. Meurk (with permission).

Figure 6. Green spaces as disaster recovery areas. Latimer Square, Christchurch, after the February 2011 earthquake. Photo: CHC-EQR-USAR-Camp-17, with acknowledgement to Christchurch City Libraries.

Figure 7. A newly created "pocket park" with universally accessible seating and water fountain. Note the prevalence of impervious surfaces. Denton Park, Wellington. Photo: Authors'.

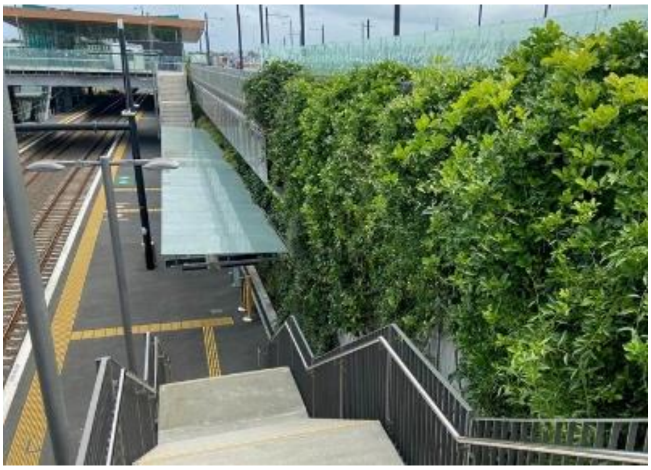

Figure 8. Green wall of ground-rooted native vine species at a new Auckland suburban rail station, 2020. The larger-leafed vine in the right-hand foreground is critically threatened in its native habitat. Photo: R. Simcock (with permission).

Figure 9. A green roof at the Auckland Botanic Gardens, forming part of the Auckland Sustainable Stormwater Trail. Photo: R. Simcock (with permission).

Figure 10. Oruaiti Reserve, Wellington. Located within a harbourside suburb, the reserve is owned by an iwi trust and co-managed with Wellington City Council. It is a significant cultural site that also has important recreational and ecological values. Photo: N. Price for Wellington City Council (with permission).

Figure 11. Raingarden in Auckland waterfront development showing the diverse ground and canopy covers of native species. Photo: R. Simcock (with permission).

4.1. UGS Should Be Considered in the Context of Other Urban Infrastructure

The context for the first part of our discussion is the diversity of the biophysical settings of AoNZ's cities. For example, the hilly (often steep) topographies in Wellington and Dunedin contrast strongly with the flatter topographies and more fertile soils of Hamilton, Tauranga, and Christchurch. Auckland is intermediate between these two extremes [65]. These differences in topographies and soils (frequently expressed in different parts of a city, e.g., between inner and outer areas) also affect hydrology and the nature of flooding susceptibility [1]. All of these differences also affect cities' ability to provide a range of ecosystem services [71]. Here, we mainly focus on UGS and a range of services related to transport and stormwater management; however, Richards et al. [71] considered inequity in the provision of UGS in relation to a wide range of ecosystem services. The contribution of different urban ecosystem services (considered as GI types) to overall environmental quality can be evaluated quantitatively, as shown for two contrasting flood-prone city/catchment areas in AoNZ (Whau catchment in central-west Auckland and Gore in Southland) [91]. These authors found that the implementation of specified GI measures over 10% of subcatchment areas could reduce runoff peak rates and total runoff volumes by around 50–75% on a subcatchment scale, and they concluded that the strategic implementation of small GI areas can be very effective, particularly if multiple measures are combined. They also described how a "social equity dimension" could be applied to these subcatchments to determine the preferred locations for GI alternatives that would minimise green gentrification risks and reduce social inequalities in the distribution of environmental amenities. MacKinnon et al. [92,93] show that strategically placed green roofs, as parts of wider UGS networks, can significantly contribute to reduced flooding risk and to increased biodiversity connectivity pathways in Wellington.

In relation to transport, the most significant theme to emerge from the case studies is the importance of road reserves and transport corridors as current or potential UGS. These areas form a significant proportion of the total area of a range of urban spaces from central city precincts [47] to residential suburbs [77] and of the total UGS of the urban area [8,12,66,67]. Secondly, their widespread and linear natures (transport corridors of all types) and large areas (road reserves) have the potential to form significant areas of biodiversity habitat and/or biodiversity corridors allowing for the dispersal of diverse plant and animal species [12,71]. Stewart et al. [81], describing street trees in Christchurch as "linear parklands", showed that these areas were poorer in species richness and indigeneity than other urban areas of biodiversity that they studied, but they also considered that there is the potential to enhance biodiversity values in this important form of urban vegetation. Other urban vegetated corridors, whether original forest remnants or, increasingly, restored or newly planted areas, are also important for their habitat values and spreading the distribution of bird and other animal species [94–96].

Previous sections have stressed the critical importance of UGS and green infrastructure for many aspects of urban stormwater and flood management. For example, Nieuwenhuijsen [10], in discussing the health benefits of GI, refers to specific components, such as parks, street trees, smaller and larger GI elements, in strategically planned networks of natural and seminatural urban areas. Internationally and in AoNZ, there has been intense interest in the benefits of sponge cities [1,6], in which green spaces of many kinds are essential components. Mercier's recommendations for approaches to sponge cities across AoNZ [1] emphasise the integral connections between the climate and biodiversity crises and the roles of UGS in addressing both in urban areas; they also make a compelling case for treating UGS as essential GI. Mercier sets out a vision and guiding principles for implementing sponge cities in AoNZ, making full use of all knowledge sources, including *Mātauranga Māori (*Māori knowledge) and particularly through the use of nature-based solutions (NbS), including water-sensitive urban design, blue–green infrastructure and sustainable urban drainage systems. To fully integrate UGS into the sponge cities approach, integrated planning across multiple sectors is required [1,97]. Smaller-scale approaches, such as bioretention devices, green walls and roofs, and permeable pavements, driveways and paths, complete the continuum of scale. A database and guide to urban nature-based infrastructure strategies suitable for Te Moananui Oceania, including AoNZ, is provided by Pedersen Zari et al. [98]. On a national scale, the National Adaptation Plan [5] is currently the most important vehicle for driving adaptation. It highlights that nature-based solutions are one of three critical actions to facilitate adaptation in AoNZ, of which UGS is key.

One of the most striking features of the case studies is the extent of impervious surfaces in AoNZ cities, as well as the loss of pervious surfaces accompanying the loss of UGS. The extent of impervious surfaces appears to be common to both private and public lands, as follows: on private land, the loss of gardens and grassy areas to buildings and paved areas; and on public land, the loss of grassy areas including road reserves to more paved areas. This occurred even within park developments, especially in more highly used parks, to the extent that within central Wellington City, one of the most extensive types of UGS is paved surfaces [47]. An important initial aim for ongoing UGS development in AoNZ would be the "greening of green spaces", i.e., ensuring that all areas designated as parks and public open spaces have the maximum vegetation cover and pervious surfaces, while accommodating essential paved surfaces. This would also assist efforts to address the urban heat island effect, which to date has been little considered in AoNZ [64,99].

4.2. UGS Should Be Designed for Wellbeing, Equity and Cultural Expression

The multidimensional importance of green space for health and wellbeing in general was discussed in Section 1. Rigolon et al. [46] reviewed the potential of UGS accessibility to reduce health disparities internationally, concluding that people with a lower SES show more beneficial effects than people with higher SES, particularly when considering public UGS such as parks rather than overall greenness. Given this evidence internationally (which shows large differences by continent), the relative abundance of UGS overall in AoNZ may explain some of the AoNZ studies that show poor associations between UGS availability and overall health outcomes [87,88].

UGS typically reinforces a "sense of place" [50], as well as health, wellbeing and other cultural ecosystem services. The concepts of sense of place and amenity benefits are linked, and both have a strong cultural dimension. In AoNZ, green spaces have critical cross-cultural importance. For Māori [8,54], UGS are especially valued as places that bring *hauora* (health), provide *rongoa* (medicinal elements), are markers of history and traditional places of significance, and may be *wāhi tapu* (sacred places). For example, *pou* (special marking posts) have become increasingly important in AoNZ's cities as physical markers of place, as well as reminders of the meaning or sense of those places, both for *mana whenua* (people indigenous to a specific place, in that place) and for *mātāwaka* (indigenous people of AoNZ but who are not in their traditional area, i.e., are not *mana whenua*). In Christchurch, a co-governance structure is planned for decision making between the Ngāi Tūāhuriri *Rūnanga* (council), community groups, and community boards towards implementation of the Ōtākaro-Avon River Regeneration Plan [79]. UGS is also important for social determinants of health and social cohesion [100]. It is likely that the health and cultural benefits of UGS depend on the quality of the green space in terms of its biodiversity values, quality of habitat provided, and even species selection. Protection of existing biodiversity habitats in UGS is more valuable than the re-creation of new habitats or the protection of individual trees [94,101].

4.3. Urban Design, Planning and Policy Need to Change to Support More and Better UGS

The results of the case studies on AoNZ UGS have important implications for urban design and planning in a time of increasing densification and need for climate adaptation. Opportunities and challenges for UGS design and planning were examined by the PCE [8], Chapter 3 and Mercier [1]. The AoNZ Ministry for the Environment's first National Adaptation Plan [5] sets out multisector climate change adaptation pathways and responses within a risk assessment framework [102] and references the role of UGS. Current provisions for densification under the Resource Management Act 1991, the main national framework legislation, include the 2022 Medium Density Residential Standards, which support the development of three dwellings of up to three storeys on each site, without the need for resource consent. These provisions have major implications for the amount and positioning of UGS on new residential developments. Varshney et al. [103] examine the implications of policies in AoNZ for urban biodiversity and rapid residential development and how this impacts habitat and UGS. They conclude that current policies, strategies and planning for residential developments in AoNZ are inadequate to support UGS for biodiversity.

Key drivers of the changes in UGS availability have been population growth rates in different cities and different parts of each city. For example, large population increases due to multi-unit housing in central Auckland and Wellington over the last two decades have led to significant reductions in per person UGS availability, even in the face of constant total availability [8,47]. A similar trend could soon be seen in rapidly growing cities such as Hamilton and Tauranga. In both of these cities, the UGS within the central city area is constrained, and there are physically fewer constraints to greenfield sprawl. In other cities' residential areas, there has also been a clear trend of UGS loss since the 1980s. Up to about 2010, the average size of new houses increased steadily ([8], Figure 2.2 therein), and this accounted for some UGS loss, but the loss trend has continued even as average house sizes fell, attributable to both an increase in housing density and loss of private UGS either through subdivisions or an increase in impervious surfaces within individual residential lots. The intensification and loss of UGS are not only linked causally but also in their effects on stormwater management, hence the development of sponge cities and related concepts, as discussed above. Urban design can work with policies and planning for intensification and make an important contribution by promoting regenerative living cities, including through UGS development, as seen internationally in cities such as Singapore [64].

The weak clustering of UGS elements in residents' housing choices [68] and the relatively good UGS supply in most AoNZ cities (with relatively small absolute differences between cities) reinforce that the relationships between UGS availability, accessibility and wellbeing outcomes are indeed complex, possibly unique to AoNZ, and require further study. Accessibility is as important as availability in order to deliver most ecosystem services (including wellbeing, relationship to place, and nature implications) in equitable ways. Also, the quality of UGS in terms of ease of universal accessibility, available facilities and amenities, maintenance, safety and distinctive features is key to equity in AoNZ [47,71], as has become increasingly evident from international reviews [36,60,104,105].

When opportunities for the further supply of UGS are limited, a key potential priority for design and planning is to primarily focus on improving the accessibility and quality of UGS through actions such as street-tree planting, improved delivery of ecosystem services from existing UGS and ensuring that those green spaces are universally accessible [106]. Additionally, finding opportunities to purchase and restore land parcels to new green spaces, for example, through the provision of "pocket park" street corners or areas of road reserve for green space value, or the repurposing of low-value car parking spaces, impervious or vacant spaces as UGS, can provide high-quality accessible UGS when space is limited. As urban areas densify, existing UGS can be optimised for accessibility and quality, even if the increases in quantity are small. This requires attention to the accessibility and quality requirements of all users, remembering that when ensuring equitable outcomes not all green spaces are equal in respect to health and wellbeing. Therefore, diverse needs relating to age, ethnicity, health status, cultural attitudes, and personal safety need to be taken into account. In providing for those who are currently limited in their ability to access UGS [107,108], it should be remembered that availability is only one component of the wellbeing requirements of the full range of urban residents [9]. The priorities and values of *tangata whenua* (indigenous peoples of AoNZ) and particularly *mana whenua* should also be better integrated into UGS design, given the partnership obligations and aspirations outlined in *Te Tiriti* and the under-representation of *tangata whenua* in UGS design and decision-making roles [54].

The barriers to accessibility of UGS in the context of intensification point to the utility of better integrated spatial planning. Schindler [109] examines planning considerations for medium-density housing in Aotearoa New Zealand and emphasises the need for a stronger focus on health promotion, equity and community health in rapidly growing urban environments. Whitburn and colleagues [77,110] found that the practical modalities of life in busy urban environments were seen as major barriers to connection with nature, reinforcing the need for easily accessible UGS for the wellbeing benefits of connection. An example of an integrated planning approach to the provision of UGS is Wellington City Council's Green Network Plan [111]. WCC has a strong interest in UGS provision in its rapidly growing central city area amid concern that some residents are experiencing a decrease in UGS to levels that are detrimental to their health and wellbeing [47]. The Council's planning strategies generally seek to provide for UGS protection while enabling a significant population intensification under the vision of a "compact, liveable city" [112]. This work was influenced by the requirement for increased urban density in the central government's National Policy Statement on Urban Development under the Resource Management Act [113]. The national policy contains mandatory requirements for growth planning, well-functioning urban environments and greenhouse gas emission reductions.

Planning effective UGS requires a close relationship between private and public efforts, especially in conjunction with new housing development. Local government, *mana whenua* and local communities must all be involved. Cost effectiveness is important at a time when local government spending is under great pressure. Regulation and incentives need not be onerous for private providers, especially given that good outcomes should contribute to neighbourhoods with a stronger sense of place. The bottom line is that the role of the public sector cannot be limited to compensate for loss of private UGS, and this would certainly not be affordable by councils under current conditions. The current situation in which cities such as Hamilton and Tauranga simply "meet housing demand" [8] without considering infrastructure (particularly GI) is neither sufficient nor adequate. A policy mix is required, including integrated planning and design, incentives and regulation.

4.4. UGS Is a Key Part of Urban Nature-Based Solutions (NbS)

Findings from the NUWAO programme [53,63,64] could be applied to UGS analysis, design and planning in *Te Moananui Oceania* including AoNZ. This research programme points to the importance of developing a participatory, localised sense of place as part of nature-based urban design, which should be centred on equitable and just wellbeing. In the AoNZ context, such development should be a process of re-asserting indigeneity and avoiding accidental neocolonisation through inappropriate urban adaptation interventions [53,114]. NUWAO work and recommendations centre *Mātauranga Māori* and Pacific Indigenous knowledge, but such re-indigenisation does not need to obliterate the sustainable ecological processes and valued exotic biodiversity introduced by indigenous settlers [80,115]. NUWAO's focus on urban NbS encompasses both public and private lands and can be applied on different scales from the individual household to the neighbourhood and to the regional and national scales, as is needed in housing and other urban development and in regeneration and resilience building processes [1,98]. NUWAO's focus and principles provide a useful lens to look at climate adaptation and a justice context for GI provision, informed by traditional knowledge sources, as well as Western science and local community knowledge. This complements innovative work on AoNZ public policy wellbeing approaches, culminating in the presentation of the 2019–2023 AoNZ "Wellbeing budgets" [116].

An NbS approach would recognise the historical context for the current extent and state of UGS in AoNZ. The ad hoc historical development of AoNZ's cities [47,117], as well as significant differences in biophysical properties and changing proportions of green, grey (impervious) open spaces and built environments, has led to large differences in the availability and distribution of UGS among cities, as already discussed [8,66,67].

Many of the historical differences between urban developments in different Aotearoa NZ cities reflect aspects of those cities' colonial past and the ongoing impacts of colonisation [114,118] as has occurred in colonial cities throughout the world. Of course, differences between cities' UGS availability matter despite historical reasons, because cross-city comparisons may reflect neighbourhood inequities [60]. AoNZ's most marked inequalities appear to be more recent, resulting especially from population increases and intensification pressures in central Auckland and Wellington over the last 30 years, while some of the inequalities documented by Richards et al. [71] in Christchurch may relate to patterns of loss and rebuild since the 2012 earthquake.

4.5. Strengths, Weaknesses and Further Research

This review covers a range of UGS dimensions, including studies on the quality, quantity and distribution; equity in availability; functionality, including relationships with hydrology and stormwater drainage; biodiversity importance; and contribution to individual and societal human wellbeing. Our research, as well as the earlier work reviewed, highlight the difficulties of comparing the disparate sources and quality of available information; for example, different types of remotely sensed land cover information, partial and inconsistent information on different tenure and vegetation types and incomplete information regarding permeability.

There are still many gaps, therefore, in our understanding of UGS in AoNZ, particularly concerning its role as GI. Addressing these gaps is vital for realising the critical roles of UGS in the linked climate and biodiversity crises in urban environments, including responding to the increasing number of extreme weather and flooding events and the intensification of the urban heat island effect. Extension of this study and the work undertaken by the PCE [8] would be valuable, particularly to other large and rapidly growing urban centres in AoNZ, as well as peri-urban and satellite cities that are still relatively small but exhibit rapid population growth and urban sprawl patterns, often into areas with fertile soils that have a high food-producing capacity. Further research is needed on criteria for UGS quality and quality in the AoNZ context, especially the aspects of quality that are most important to wellbeing, such as cultural values, contact with nature, recreation and enhancement of a sense of place.

5. Conclusions

New information on UGS in AoNZ's cities has been growing over the last decade, with research undertaken on its distribution, accessibility and quality. This work has been completed in the context of a better understanding internationally of the wider health and wellbeing benefits of contact with UGS for urban residents, alongside an awareness of the importance of climate mitigation and adaptation. These advances, as summarised and discussed in our review, should enable an equitable wellbeing and climate change resilience framework to be the focus of future UGS studies, as well as assisting in the planning of UGS provision.

Addressing the many gaps in our understanding of UGS in AoNZ is vital for realising the critical roles of UGS in addressing the linked climate and biodiversity crises in urban environments, including responding to the increasing number of extreme weather and flooding events. It is clear, however, that simply providing more UGS, even if that were economically feasible, would not be sufficient to maximise the benefits of such provision, without paying close attention to the distribution, accessibility and quality of that UGS and addressing the emerging inequities in access to UGS. Also of great importance is the strategic linking of UGS into connected urban networks of green, blue, blue–green, and other nature-based solutions. Ensuring that all green spaces are vegetated and pervious to the greatest extent possible would be a good first step. So would ensuring the judicious provision of small green spaces and street trees in intensifying areas. There are many uncertainties in addressing these challenges within AoNZ's rapidly changing planning system amid the urgency of addressing long-standing deficiencies in other areas of urban infrastructure. One of the most important challenges is ensuring that urban biodiversity and the habitats of that biodiversity are integrated into the infrastructure and planning for other priorities and not set aside as lower priorities.

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Note

[1] The terms 'green space' and 'green spaces' (in full) are used when green space generically is referred to, as opposed to the abbreviation UGS for green spaces specifically within urban areas.

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