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Article

Closing the Gap Between Urban Planning and Urban Ecology: A South African Perspective

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Abstract
Ecological considerations should be an integral part of the decision-making processes of urban planners. Specifically, ecological aspects used in urban ecology, such as green infrastructure and ecosystem services, are substantiated by literature as strategies for improving quality of life, human health, and well-being. Studies dealing with such concepts in the Global South recently gained interest; however, these lack empirical evidence on the integration thereof in mainstream South African urban planning practice. This article conducts a preliminary investigation into the knowledge of ecological aspects of a sample of South African urban planners and their willingness to implement ecological aspects in urban planning practice. The new environmental paradigm scale is employed to determine the environmental worldview (ecocentric or anthropocentric) among respondents and how this relates to their knowledge of ecological aspects. The initial research sample consisted of a total of 283 questionnaires distributed. Although findings of this article are based on a low response rate (15%) of 42 documented responses, it did not affect the validity of the data collected in this context. The initial findings indicated that the environmental worldview of the sample of planners is only one factor influencing their perspective on incorporating ecological considerations. Low to moderate knowledge and awareness regarding ecological aspects such as ecosystem services, green infrastructure, and multi-functionality are argued to be main factors preventing integration in urban planning practice. Findings emphasize the need for context-based implementation strategies and broad recommendations are made for the planning profession as a point of departure to introduce or ingrain ecological considerations.

Keywords
ecosystem services; green infrastructure planning; multi-functionality; South Africa; urban ecology; urban planners; urban planning practice

Issue
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1. Introduction

Scientific understanding and support for the potential of more ecologically-minded approaches to address multiple issues faced by urban areas are gaining momentum in multiple disciplines (Escobedo et al., 2011). There has been a mounting emphasis on the discipline of urban planning, as the discipline concerned with the spatial arrangement of social, economic, and environmental spaces and activities within urban areas (Huxley & Inch, 2020), to become more holistic. In addition, urban planning should also integrate advanced urban ecological concepts, knowledge, and aspects (e.g., Osmond & Pelleri, 2017, p. 31; Tan & Jim, 2017, p. 15) related to urban ecology, as an interdisciplinary field that aims to understand how human and ecological processes could coexist in human-dominated environments to guide societies to become more sustainable (Marzluff, 2008).

These include considering concepts like urban ecosystems, green infrastructure (GI), and ecosystem services (ES; Gómez-Baggethun & Barton, 2013, p. 235). Urban ecosystems in urban ecology reference the interactions between living organisms (biota), and between biota and the abiotic environment, such as water, soil, and air (Pickett et al., 2001), to describe novel ecosystems in which human-induced changes not only affect the abiotic environment but also species diversity and interactions (Kowarik, 2011). Planning for these urban ecosystems centres mainly on the incorporation of ecological knowledge based on "nature-based solutions," as "approaches inspired by, or copied from nature" (van den Bosch & Sang, 2017, p. 373), through the implementation of GI to gain several ES (van den Bosch & Sang, 2017, p. 373). ES refer to the benefits all living species (especially humans) derive, directly or indirectly, from the capacity (function) of urban ecosystems to provide goods and services that satisfy needs and improve human health and well-being (e.g., de Groot et al., 2010, p. 260). GI is interpreted in diverse ways and spatial scales and may include a diversity of green and blue areas (Pauleit et al., 2021, p. 108) with contemporary definitions of GI referencing the "design and management of urban ecosystems to deliver a wide range of ES" (Lindholm, 2017, p. 610). Planning for GI to deliver ES is underlined by the principle of "multi-functionality" (Pauleit et al., 2011), understood as a broader concept referencing a holistic approach to combine economic, ecological, and social objectives within an area (van Broekhoven et al., 2015, p. 1005). GI multi-functionality, as the combination of different functions within a GI element to deliver multiple environmental, economic, and social benefits (Pauleit et al., 2011), is still unfamiliar and often overlooked by urban planners (di Marino et al., 2019, p. 644; Hansen et al., 2017, p. 43). Scholarship on the application of ecological aspects in planning in the Global South is limited, but has gained traction (Cilliers et al., 2021). Within Africa, South Africa has been especially well represented (du Toit et al., 2018). South Africa continues to struggle with the social, economic, and environmental inequalities of its colonial and apartheid history, evidenced in the provision of public and private urban green spaces, which was termed "green apartheid" by Venter et al. (2020), but also presents several advancements to redress these disparities. Environmentally-minded policies and legislation guide development approaches towards more sustainable outcomes, confirming commitments at national and local level (Bobbins & Culwick, 2015). The literature provides several practical examples of ecological advancements. These include a focus on natural areas in urban open space planning through Systematic conservation planning (Compaan et al., 2017) and the use of metropolitan open space systems (Boon et al., 2016), urban biodiversity corridors (Burton et al., 2017), 500 buildings with Green Star South Africa ratings by the Green Building Council South Africa (Simpeh et al., 2021), examples of GI applications such as the green growth concept integrating energy and climate change issues (Bobbins & Culwick, 2015), the development of climate adaptation plans to develop climate resilient cities (Roberts et al., 2012), water-sensitive urban planning and design (Fisher-Jeffes et al., 2017), efforts to enhance water resilience (Sutherland et al., 2019), urban agricultural practices (Steenkamp et al., 2021), and specific examples of local-level planning actions targeting the needs of the poor in terms of urban greening (Sachikonye et al., 2016). Whilst such endeavours show potential, they are rather exceptional and localised, and significant scope exists for broader commitment and application of urban ecological approaches, as is indicative for the entire Global South (Cilliers et al., 2021). This article is specifically interested in the role of urban planning in this regard. For instance, Bobbins and Culwick (2015, p. 33) acknowledge that ecological aspects remain ambiguous and are not yet fully integrated or commonly implemented in mainstream urban planning practice in South Africa, with Schäffler and Swilling (2013, p. 247) noting a lack of empirical evidence in substantiation. Huston (2018, p. 135) posits that GI has been applied to a limited extent amongst South African urban planners given several misconceptions, partly resulting from a lack of education on GI in South African urban planning curricula. Pasquini and Enqvist (2019, p. 9) reciprocally confirm a potential dearth of ecological literacy amongst South African urban planners in this regard. In relation to literacy, skills, and a general orientation towards more ecologically-minded approaches, the concept of an environmental worldview is intriguing. An environmental worldview refers to the "lens or filter" through which an individual makes assumptions about the natural environment (Kollmuss & Agyeman, 2002, p. 239). Whereas research on the proclivity of urban planning professionals with positive ecological views to implement environmentally friendly approaches has shown positive correlations, research gaps with specific reference to environmental worldviews have been noted (Wallhagen & Magnusson, 2017, p. 498). Environmental worldviews and their influence on the ecological considerations and decisions-making of urban planners in South Africa present specific gaps.

Based on these points of departure, this article is initiated with a literature review of the urban planning discipline and its theories to establish a foundation for the inclusion of urban ecological concepts in South African urban planning practice. This is followed by a brief discussion of the concept of environmental worldviews to frame the empirical research completed in the succeeding section. Section 3 elaborates on the quantitative research methodology followed to investigate a sample of South African planning respondents regarding their understanding and inclusion of core ecological aspects in practice and their environmental worldviews. Results and a discussion follow, before main conclusions and related recommendations towards context-based implementation strategies to integrate

ecological considerations in mainstream urban planning practice are delivered.

2. Reflecting on the Interface Between Urban Planning and Urban Ecology

There is considerable debate regarding planning's disciplinary and professional credentials (Davoudi & Pendlebury, 2010, p. 617). For Abbott (1988) a firm core in planning cannot be identified, as it presents a cluster of interconnected theories, methods, propositions, and solutions influenced by multiple disciplines (Behrend & Levin-Keitel, 2020, p. 311). This comes at the expense of a clearly defined and exclusive intellectual foundation (Behrend & Levin-Keitel, 2020, p. 310; Davoudi & Pendlebury, 2010, p. 614). However, this is not necessarily a weakness, as increased specialisation cannot deliver the planning generalists needed to address wicked planning problems (Olesen, 2018, p. 303). The shifting focus in planning scholarship testifies to an ever-evolving and deepening discipline that draws on multiple influences to prepare planners for the complexities of the modern world. In evidence, various strands of planning theory have emerged to discuss the nature of planning and its motivations to provide meta-theoretical and philosophical foundations (Olesen, 2018, p. 304). These theories continue to inform planning curricula internationally.

Whilst it is not the prerogative of this article to discuss planning theory comprehensively, it is important to note two distinct general categorisations: theories *in* planning and theories *of* planning. The literature generally refers to planning theory as the normative meta-theories *of* planning (Olesen, 2018, p. 305) that address why planning exists and what it does or should do (Olesen, 2018, p. 305). These theories were mainly penned in the Global North, from where they have been applied fairly unilaterally (Lategan & Cilliers, 2017). Allmendinger (2009) identifies eight main clusters that represent the non-linear, divergent evolution of planning theory, including (1) systems and rational theories, (2) Marxism and critical theory, (3) new right theory, (4) pragmatism theory, (5) advocacy theory, (6) postmodernism theory, (7) radical planning, and (8) collaborative theory, coupled with collective and communicative planning. Selected behavioural theories have also been linked to planning theory development, for example related to the rational theory and its critique (Kwon & Silva, 2020, pp. 162–171).

The emergence of communicative and collaborative theory in the 1990s coincided with a renewed turn to environmental concerns and underlying scientific approaches in response to increasing environmental awareness and new environmental regulations. This sparked a re-orientation to environmental planning as a new rationale for the profession (Behrend & Levin-Keitel, 2020, p. 306) influenced by the work of park and greenbelt planners, open space preservationists, and conservationists of the past (Campbell, 1996, p. 297). By the end of the decade, following the Brundtland Report, planning's focus shifted from environmental management to an explicit normative goal to achieve sustainable development (Davoudi & Pendlebury, 2010, p. 630). Movements such as new urbanism and smart growth were further influenced by more sustainability-minded orientations (Lategan & Cilliers, 2013). Such approaches were supported and practically implemented by theories *in* planning. Theories *in* planning prescribe methodologies for the actions of planning as substantive theories within sub-fields like land use, urban design, transportation, or environmental planning (Olesen, 2018, p. 305).

Planning's fluid intellectual foundation based on influences form such sub-fields and multiple disciplines in the arts, social, natural, and engineering sciences has resulted in significant progress in theory-making and planning practice (Mazza & Bianconi, 2014, pp. 81–87, 171–184). The addition of new subjects in planning curricula has been celebrated in the name of interdisciplinarity. Yet, results have mostly produced limited multidisciplinarity that meets demands and expectations superficially in the accommodation of conflicting epistemic backgrounds to the detriment of transdisciplinarity (Davoudi & Pendlebury, 2010, p. 639). Thus, there is a need for more targeted theorising and curriculum development that integrates applicable substantive knowledge from other disciplines more specifically for planners, both theoretically and practically, to promote critical and reflective thinking as the basis for action (Davoudi & Pendlebury, 2010, p. 634).

Accordingly, critical new paradigms, sub-fields, and disciplines must be considered. An example related to planning's established interest in the environment is represented in urban ecology (McPhearson et al., 2016; Pickett et al., 2016). Different perspectives of the discipline have evolved, delineating (1) ecology *in* cities, 2) ecology *of* cities, and, more recently, (3) ecology *for* cities (McDonnell & MacGregor-Fors, 2016, p. 936; Osmond & Pelleri, 2017, p. 32). The last is emphasised in recognition that basic ecological knowledge does not provide practitioners with the necessary information and skills (Niemelä, 1999, p. 127) and that an applied outlook on urban ecological knowledge is required (McDonnell & MacGregor-Fors, 2016, p. 936). This supports the foundation of transdisciplinarity in planning (McPhearson et al., 2016, p. 202) through the co-production and synthesis of knowledge (Ahern et al., 2014, p. 255) amongst planners, engineers, designers, urban ecologists, and civic society (Childers et al., 2015, p. 3779). The ecology *for* cities approach advances a holistic view and follows a participatory process to integrate research and practice between these stakeholders as agents in urban ecosystems (McPhearson et al., 2016, p. 202), thereby, linking with communicative planning theory and again reflecting the emergence of such approaches with environmentalism in planning in the past (Behrend & Levin-Keitel, 2020, p. 306). The main aim of the ecology *for* cities approach

is to build on previous interpretations and transform ecological research and knowledge into action-based practices (Childers et al., 2015, p. 3785) to enhance links between (substantive) theory and practice. Thus, strengthening the bonds between urban ecology and urban planning (Tan, 2017, p. 24) through applications such as nature-based solutions, like GI (Pauleit et al., 2017, p. 47). GI presents direct opportunities to incorporate theoretical ecological knowledge within urban planning activities (Mell, 2013, p. 29). The potential to achieve manifold objectives specifically related to the multi-functionality principle of GI has been particularly emphasised in this regard (Andersson et al., 2014, p. 448; Hansen et al., 2019, p. 99).

Several studies have commented on the ignorance of planners, or their misconceptions regarding urban ecological concepts such as GI in terms of terminology, examples, benefits, and implementation strategies (La Rosa, 2019, p. 1) that prevent broader incorporation into mainstream planning practice (di Marino et al., 2019, p. 644). Mention has been made of the general predominance of research on GI and ES from and focusing on the Global North (du Toit et al., 2021) and a lack of holistic and cross-sectoral cooperation to integrate disciplinary knowledge leading to a dearth of contextual evidence in the Global South for theorists and practitioners (Culwick et al., 2019). The need for broader research on the interface between urban ecology and planning and the translation of ecological knowledge into context appropriate planning implementation strategies has been highlighted (McDonnell et al., 2009, p. 10; Steiner, 2016). Such endeavours should investigate the knowledge and views of planning practitioners to identify barriers and challenges that prevent the incorporation of ecological approaches in planning (La Rosa, 2019, p. 1) towards measures to advance ecological literacy (Pasquini & Enqvist, 2019, p. 9) through improved education to establish a sufficient "knowledge foundation" (du Toit et al., 2018, p. 256).

2.1. Considering Environmental Worldviews Towards the Inclusion of Ecological Aspects in Urban Planning

The spectrum of an individual's environmental worldview is anchored by either an anthropocentric worldview, in which humans consider themselves independent from other organisms in the natural environment (Ntanos et al., 2019, p. 239), or an ecocentric environmental worldview indicating that humans recognise that they have an ethical responsibility towards environmental protection through co-development (Colby & Mundial, 1989, p. 8). The "new ecological paradigm scale" (NEP-scale), developed by Dunlap et al. (2000), provides a widely employed method to measure the degree of an individual's environmental worldview (Ntanos et al., 2019, p. 239). Wilhelm-Rechmann et al. (2014, p. 206) utilised the NEP-scale to investigate the relation between the environmental worldviews of South African municipal officials (including planners) and the implementation of conservation projects, establishing a positive correlation between these variables (Wilhelm-Rechmann et al., 2014, p. 206). Research on whether environmental worldviews influence the inclusion of ecological aspects such as GI, multi-functionality, and ES, more specifically in South African urban planning practice, has not yet been undertaken. The following section discusses the research methodology followed to address the issues raised in this literature review.

3. Methodology

3.1. Data Acquisition

Data acquisition took place in two phases. Firstly, a purposive sampling technique was employed to identify a sample of planning practitioners registered with the South African Council for Planners (SACPLAN). It must be noted that the planning profession in South African is still emerging and given its relative size has been classified as a "scarce skill" (Andres et al., 2018). For the first phase, 201 questionnaires were distributed via email based on a database of contact details. For the second phase, a snowball sampling technique was employed. The objective of snowball sampling is to generate a sample from a small population (Lavrakas, 2008), as presented by the small size and limited data sources available on planners in South Africa (Todes, 2009, p. 246). Participants from phase one were utilised to recruit more participants through a request to provide the email address of a fellow urban planner. The questionnaire was then distributed to the email addresses provided by the respondents from the first phase. These respondents were also requested to provide the email address of a fellow urban planner. This process was repeated until no new email addresses were gathered. As a result, an additional 82 new email addresses were obtained and 82 questionnaires distributed. A total of 283 questionnaires constituted the initial research sample with a 15% response rate (42 completed questionnaires). As highlighted by Templeton et al. (1997) a low response rate does not necessarily affect the validity of the data collected, and could still be valuable to test for non-response effects.

The questionnaire comprised of 14 main questions (both Likert-scale and open-ended questions) and one question with 15 sub-sections. Questions were categorised into three main sections: Section 1 related to the professional background of the respondent; Section 2 determined the general understanding among respondents regarding ecological aspects (GI planning, multifunctionality, and ES) and the state of inclusion of these in South African urban planning practice; and the final section focussed on the respondents' environmental worldviews and consisted of the 15 NEP-Scale-questions revised from Dunlap et al. (2000, p. 433) and Wilhelm-Rechmann et al. (2014, p. 208; included in Table 2).

3.2. Data Analysis

Data from Sections 1 and 2 were analysed to determine frequencies within responses. Data from Section 3 were analysed based on the methodology employed by Dunlap et al. (2000) and Wilhelm-Rechmann et al. (2014). Eight of the 15 items (unevenly numbered) were meant to reflect an ecocentric worldview. The seven other questions (evenly numbered) represented an anthropocentric worldview (Anderson, 2012, p. 260; Dunlap et al., 2000, p. 432). Each of the 15-items were measured on a scale from 1 to 5. The unevenly numbered questions were scored with 5 = Agree; 4 = Mildly Agree; 3 = Neutral; 2 = Mildly Disagree; and 1 = Disagree. According to Dunlap et al.'s (2000) methodology, for an ecocentric worldview the mean score for the unevenly numbered questions should present relatively high scores out of five or relatively high responses in "Agree" or "Mildly Agree" categories. The scores of the evenly numbered questions were inverted and scored as 1 = Agree; 2 = Mildly Agree; 3 = Neutral; 4 = Mildly Disagree; and 5 = Disagree, with a low score out of five or high responses in "Mildly Agree" or "Disagree" reflecting an ecocentric worldview. The overall environmental worldview of the sample was determined out of a score of 75 (the 15 items equalling the five-point scale).

For further analysis and to reach an improved understanding of respondents, the findings of selected questions were cross-tabulated and practically significant relationships determined between variables employing Cramer's V-test. A Cramer's V-test of V ~ 0.5 represents a large effect or practical significance, while a V-test of V ~ 0.3 indicates a medium effect or practical visible significance and a V-test of V ~ 0.1 only represent a small effect or practical non-significance (Ellis & Steyn, 2003, p. 52). The following section presents the results delivered.

4. Results

The data gathered were analysed as discussed (Section 2.2), interpretations were made, and conclusions were drawn as presented in the succeeding discussion. Table 1 captures the results obtained from the responses gathered.

In response to the third (environmental worldview data) and Question 14 ("please indicate your level of

Table 1. Results of the online questionnaire.

	Questions	Results
Section 1. Demographical background data	Sector of employment: • Public sector • Private sector	 • 79% employed in the private sector • 21% employed in the public sector
	Professional registration (SACPLAN registration): • Technical planner • Candidate planner • Professional planner	 • 86% registered as professional planners • 14% registered as candidate planners • Zero technical planners
	The year an undergraduate degree was received: • Before 1990 • Between 1991 and 2000 • Between 2001 and 2011 • After 2011	 • 41% after 2011 • 12% between 2001 and 2011 • 21% between 1991 and 2000 • 26% before 1990
	Years of practical planning experience: • More than 20 years • 16 to 20 years • 11 to 15 years • 5 to 10 years • 4 years or less	 • 29% less than 4 years' experience • 19% between 5 to 10 years' experience • 5% between 11 to 15 years' experience • 9% between 16 to 20 years' experience • 38% more than 20 years' experience
Section 2. Ecological perceptiveness data	Familiarisation with the ES concept: Likert-scale between 1 and 5: 1 = "Very familiar" and 5 = "Never heard of it before''	• 10% between 1 and 2 ("very familiar") • 66% ranked 3 and 4 (in between "very familiar" and "never heard before") • 24% ranked 5 ("never heard" of the ES concept before)
	Defining ES: Ranked respondents' definition based on the similarity to formulated definition: "The benefits all living species (especially humans) derive, directly or indirectly, from the capacity (function) of ecosystems to provide goods and services that satisfy needs and human well-being.''	• 32% high level of similarity • 36% moderate level of similarity • 32% a low level of similarity

Table 1. (Cont.) Results of the online questionnaire.

	Questions	Results
Section 2. Ecological perceptiveness data	Provided examples of ES: Open-ended question	• Examples of all four ES categories were provided • 9 examples related to the provisioning services category • 19 examples related to the regulating services category • 5 examples related to the cultural services category • 3 examples related to the habitat and supporting services category
	The importance of planning for ES: Likert-scale between 1 and 5: 1 = "Important" and 5 = "Unimportant''	• 88% ranked it either as "very important" or close to "very important" • 7% ranked "neutral" • 5% ranked it as "unimportant" or close to "unimportant"
	Consideration of ES in planning activities: Likert-scale between 1 and 5: 1 = "Always" and 5 = "Never''	• 43% indicated "always" or near "always" consider ES in their planning activities • 31% indicated "sometimes" • 26% indicated "never"
	Consideration GI and urban ecology in planning activities: • Yes • No	• 71% of the respondents indicated "yes," they have considered GI • 67% of the respondents indicated "yes," they have considered urban ecology
	Reasons for the consideration of the concepts:	• 39%: "own knowledge" • 36%: "the recommendation of a specialist" • 16%: "the result of public participation" • 9%: "client or tender stipulation"
	Challenges encountered in applying these concepts in practice:	• 67%: "financial limitations" • 62%: "lack of implementation strategies" • 43%: "lack of knowledge regarding the concepts" • 26%: "lack of case studies regarding the benefits thereof''
	The best definition for the concept of "multi-functionality" of spaces: • "Multi-functionality as urban land-use concept": To concentrate and combine several land-uses (e.g., residential, commercial, and institutional) to have more than one activity or socio-economic function within the same urban space • "Multi-functionality in an urban landscape": To concentrate and combine several land-uses (e.g., residential, commercial, and institutional) within the same urban space • "Multi-functionality as the GI planning principle": The GI planning principle that entails the capacity of a space to provide multiple ES within the same space.	• 71% indicated "multi-functionality as urban land-use concept" • 10% indicated "multi-functionality in an urban landscape" • 19% indicated "multi-functionality as the GI planning principle"

agreement with the following 15 items"), the NEP-scale and related 15 items were utilised to determine the environmental worldview of respondents. Table 2 presents the 15 items, as well as related responses. The results of each of the 15 items are expressed as percentages and as a mean average out of 5.

In relation to Table 2, the average mean scores for the 15 items ranged between 2.9 and 4.5 out of 5. The "ecocentric view" items (unevenly numbered questions) averaged scores between 3.8 and 4.5 out of 5, thus reflecting an ecocentric worldview. The "anthropocentric view" items (evenly numbered questions) indicated relatively low scores out of 5 (ranging between 2.4 to 3.5) that also reflected an ecocentric worldview. These results were utilised to calculate the general environmental worldview amongst respondents (a score out

Table 2. Responses of the sample of South African urban planners to the NEP-scale items.

		Cumulative Percentage					
	Nep-Scale Items	Agree	Mildly Agree	Neutral	Mildly Disagree	Disagree	**Mean**
1.	We are approaching the limit of the number of people the earth can support.	42.9	23.8	14.3	9.5	9.5	**3.8**
2.	Humans have the right to modify the natural environment to suit their needs.	9.5	14.3	28.6	14.3	33.3	**3.5**
3.	When humans interfere with nature, it often produces disastrous consequences.	47.6	33.3	9.5	4.8	4.8	**4.1**
4.	Human ingenuity will ensure that we do NOT make the earth unliveable.	7.1	35.7	31.0	14.3	11.9	**2.9**
5.	Humans are severely abusing the environment.	54.8	31.0	4.8	7.1	2.4	**4.3**
6.	The earth has plenty of natural resources if we just learn how to develop them.	35.7	33.3	7.1	7.1	16.7	**2.4**
7.	Plants and animals have as much right as humans to exist.	54.8	28.6	9.5	4.8	2.4	**4.3**
8.	The balance of nature is strong enough to cope with the impacts of modern industrial nations.	4.8	7.1	16.7	26.2	45.2	**4.0**
9.	Despite our special abilities, humans are still subject to the laws of nature.	54.8	42.9	2.4	0.0	0.0	**4.5**
10.	The so-called ecological crisis facing humankind has been greatly exaggerated.	42.9	23.8	14.3	9.5	9.5	**3.8**
11.	The earth is like a spaceship with very limited room and resources.	28.6	33.3	31.0	4.8	2.4	**3.8**
12.	Humans were meant to rule over the rest of nature.	19.0	23.8	26.2	9.5	19.0	**2.8**
13.	The balance of nature is very delicate and easily upset.	42.9	38.1	11.9	4.8	2.4	**4.1**
14.	Humans will eventually learn enough about how nature works to be able to control it.	7.1	14.3	33.3	23.8	21.4	**3.4**
15.	If things continue their present course, we will soon experience a major ecological catastrophe.	42.9	23.8	14.3	9.5	9.5	**3.8**

of 75). The lowest score was 39 out of 75, while the highest score was 73 out of 75. An average score of 56.1 out of 75 was determined. From these results the conclusion is drawn that respondents presented ecocentric worldviews. This result, according to Colby and Mundial (1989) indicates that subjects recognise that they have an ethical responsibility to the environment through co-development between nature and human activities.

To further analyse findings, selected questions were cross-tabulated and practically significant relationships determined between variables, expressed in terms of Cramer's V-test (V). Table 3 illustrates the questions selected for cross-tabulation and the results obtained.

5. Discussion

Due to the response rate reported this paper does not attempt to make broad generalisation, nor does it claim to be representative of all planners in South Africa. This research should be regarded as a preliminary investigation into and novel discussion of the links between urban planning and urban ecology, the views and application of core ecological concepts by a selection of planners and importantly, their environmental worldviews. Although the sample is small, the diversity of respondents, as evidenced by the demographic data (Table 1) suggests limited concern for bias. Results provide important initial findings that need to be tested in the future after the issue of non-responsiveness has been addressed by increasing the response rate, possibly through more personal contact with prospective respondents as suggested by Toepoel and Schonlau (2017). It is important to note that the non-responsiveness encountered amongst planners may be caused by several factors, including ignorance and lack of knowledge about the issues investigated in the survey. The majority of

Table 3. Cross-tabulations between selected questions of the online-questionnaire to the sample of South African urban planners (V refers to the results of the Cramer's V-test).

Questions Cross-Tabulated	Objective	Results
Q1 with Q10	If planners in public and private sectors consider ecological concepts in urban planning practice differently.	a) The GI planning concept: • V~ 0.073: A small effect or practical non-significance • A low correlation was found between frequency of considering the GI planning concept between planners in the public and private sector b) The urban ecology concept: • V~ 0.246: Medium effect or practical visible significance • The public sector considers the urban ecology concept more often than the private sector
Q1 with Q12	If planners in public and private sectors indicated different challenges encountered in the application of ecological considerations in planning practice.	• V~ 0.132: A small effect or practical non-significance • The most significant challenge identified by the sample of private sector planners was "financial limitations" • The most significant challenge identified by the sample of public sector planners was "lack of political will''
Q2 with Q8	If different professionally registered planners ranked the importance of planning for ES differently.	• V~ 0.127: A small effect or practical non-significance • There was no real difference between the opinion of a candidate planner or professional planner regarding the importance of planning for ES
Q3 with Q5	If the year planners received their undergraduate degree had an influence on their familiarity with the ES concept.	• V~ 0.285: Medium effect or practical visible significance • No clear correlation was indicated
Q4 with Q9	If planners' years of experience related to their consideration of ES in their planning activities.	• V~ 0.271: A medium effect or practical visible significance • Results indicated that no matter the planners' years of experience, most considered planning for ES as important • The planners with four years or less of experience were the majority group to consider planning for ES as "unimportant"
Q8 with Q9	A correlation between respondents' indication regarding the importance of ES and how often they consider ES in their planning activities existed.	• V~ 0.426: A large effect or practical significance • It was evident when planners considered ES as important (Question 8), they also indicated that they considered it in their planning activities (Question 9)
Q10 with Q13	If planners who answered "yes" in Question 10 also indicated the "multi-functionality as the GI planning principle" as the agreeable definition for multi-functionality.	• V~ 0.325: A medium effect or practical visible significance • It was evident that the 27% of respondents that answered "yes" in Question 10 also indicated "multi-functionality as a GI planning principle''
Q8 with Q14	To draw conclusions regarding the sample's environmental worldview and a correlation to how important planning for ES was ranked.	• V~ 0.325: A medium effect or practical visible significance • Respondents with a high score out of 75 (ecocentric worldview) also considered it important to plan for ES
Q10 with Q14	To draw conclusions regarding the sample's environmental worldview and connection with the consideration of ecological concepts in planning practice.	• V~ 0.176: A medium effect or practical visible significance • The sample of planners with an ecocentric worldview also considered ecological considerations in their planning activities

respondents presented low to moderate knowledge and comprehension of ecological aspects, but the majority were also adamant that it is important to plan for ES. Findings on the integration of ES as an ecological aspect in South African planning activities indicated that the ES concept is only sometimes specifically included by respondents. This result may be due to the low to moderate knowledge and literacy of the ecological concepts reported (e.g., Bobbins & Culwick, 2015; Pasquini & Enqvist, 2019). A significant finding relates to the statistical correlation between how important respondents ranked planning for ES and how often they considered ES in their planning activities. It was evident that when planners considered ES as important, they also indicated that they considered it in their planning activities. This was also reflected in the international literature, presenting that the preservation and enhancement of green spaces and their associated ES partially depend on the importance they are assigned in urban planning practice (Langemeyer, 2015, p. 45). In terms of the multi-functionality concept, findings comparable to the results obtained by di Marino et al. (2019, p. 644) and Hansen et al. (2017, p. 43) in Europe were established in that the majority of respondents were more familiar with the "multi-functionality as urban land-use concept," while "multi-functionality as a GI planning principle" was largely overlooked. To further investigate this finding, Question 13 was cross tabulated with Question 10 (Have you previously taken GI planning into consideration in your planning activities?). The results emphasised that respondents needed to be familiarised with the GI planning concept and the incorporation thereof in order to recognise "multi-functionality as the GI planning principle'' as an agreeable definition for multi-functionality.

A total of 36% of respondents indicated that the recommendation of a specialist, such as an urban ecologist, led them to consider an ecological approach in urban planning activities in the past, emphasising the transdisciplinary interaction required. Thirty nine percent of respondents indicated that their own knowledge regarding the aspects and concepts in question provided the motive for consideration in planning practice. This once again, stresses that perceived knowledge of ecological aspects and concepts influence the attitude of respondents towards the consideration of these concepts in their work. The results of the statistical analyses indicated that neither the sector of employment (private or public sector), nor professional registration, nor years of experience presented any correlation with the integration of ecological considerations in planning practice. Challenges identified by respondents included financial limitations and a lack of implementation strategies. Both Cilliers (2019, p. 455) and du Toit et al. (2018, p. 250) specifically mention budgetary constraints as a challenge to GI planning in the South African context. While du Toit et al. (2018, p. 250) also considered lack of expertise, or strategies, for the implementation and management of ecological aspects such as GI in African cities. It is permissible to suggest that findings raise further questions surrounding the influence of a planner's environmental worldview and the importance ascribed to planning for GI and ES. Research findings indicate that respondents included in this survey did not fail to include ecological aspects such as ES, GI planning, and multi-functionality in mainstream urban planning practice because they present "wrong environmental worldviews," in fact the majority exhibited ecocentric worldviews, but that they present inadequate knowledge of key ecological aspects and implementation strategies to incorporate these considerations into urban planning practice.

6. Conclusions and Recommendations

This study provides a point of departure to call upon a better integration of ecological aspects in urban planning practice, especially pertaining to the South African context. The literature review presents important considerations on the links between planning as a discipline and its theoretical foundation in relation to urban ecology, linkages as part of planning's interdisciplinary underpinning, and potential in terms of the ecology *for* cities approach. The empirical investigation presents a pilot study to further enhance an integrated approach. The scope and sample sizes utilised in future research endeavours may be expanded to substantiate the initial findings presented and address non-response bias. The conclusions drawn from this research provides valuable insight to direct future planning education, research, and practice to shape the planning profession.

This article supports the argument that there is a need to construct context-based implementation strategies to better integrate ecological considerations within mainstream urban planning. To steer such an integrated approach and to introduce or ingrain ecological considerations as part of broader planning approaches the following recommendations are proposed:

1. A *transdisciplinary planning approach* should be prioritised as part of planning decision-making. Transdisciplinary planning approaches can, in this sense, also strengthen resilience in and through planning;
2. The principle of *multi-functionality* should be further investigated and developed for context-based implementation to establish an interface between urban planning and ecological considerations;
3. In an attempt to prioritise ecological objectives as part of mainstream planning approaches, both the *non-monetary and monetary values* linked to ecological considerations should be captured and considered within a local context;
4. Ecological considerations should be better articulated in *spatial planning policy and legislative frameworks* that direct land-use, zoning, and development guidelines, especially within the

Global South where such aspects are applied to a more limited extent than in the Global North;
5. The *educational agenda* should be strengthened and planning pedagogy revised to enable current practitioners and future planners to interpret ecological considerations as part of broader planning approaches.

These recommendations will contribute towards the development of the "ecological wisdom" (Steiner, 2018, p. 124) that urban planners need to be relevant across different scales, communities, and regions. Increasing the ecological knowledge of urban planners will enhance their ability to contribute and develop their skills in stakeholder platforms such as city labs and research action partnerships (e.g., Cockburn et al., 2016), and, in that way, enable them to contribute constructively towards research and the planning, implementation, and governance of urban GI (Pauleit et al., 2021, p. 132). The recommendations presented in pursuit of ecological wisdom are considered a point of departure to gain momentum and close the gap between urban planning and urban ecology, supported by the South African perspective captured in this article.

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Conflict of Interests

The authors declare no conflict of interests.

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