



Urban Green Infrastructure for Poverty Alleviation: Evidence Synthesis and Conceptual Considerations

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The multiple benefits of urban green infrastructure (UGI) that support sustainable cities are increasingly acknowledged, and yet the bulk of research over the past decade or so has focused on only a small subset of the numerous benefits, notably recreation, physical and mental health, and regulating services. In contrast, there is very little information on the contribution of UGI to several of the other Sustainable Development Goals (SDGs), and in particular SDG 1 of reducing poverty, despite the pervasiveness of poverty globally. This paper considers the diverse direct and indirect ways in which UGI can contribute to poverty alleviation, drawing on the limited evidence from various regions of the world. The direct links between UGI and poverty alleviation is *via three* means, namely provision of (1) consumptive or provisioning goods such as wild foods and firewood, (2) employment in UGI development, maintenance, and restoration, and (3) land for urban agriculture, income generation and dwelling. There are also a number of indirect links such as cash savings, improved physical and mental health, improved social networks, improved educational outcomes, and regulation of potential natural disasters. However, the commonly unequal distribution of UGI within and between cities means that the poverty alleviation potential and benefits are inequitably distributed, often against those who are most in need of them, i.e., the urban poor. This demands greater attention to promoting the equitable distribution and quality of UGI and mainstreaming of UGI into poverty reduction strategies and programmes and vice versa, as well as greater examination of the links between UGI and poverty alleviation in a greater range of contexts.

Keywords: employment, non-timber forest products, poverty alleviation, provisioning services, urban green infrastructure

INTRODUCTION

Sustainable development has been a globally accepted goal by international, national, and subnational agencies for over two decades. This was concretised by over 95% of the world's nations adopting an ambitious set of development targets, known as the Millennium Development Goals (MDGs) in 2000. Those targets were monitored nationally and globally over a 15-year period. That experience set the foundation for a more consultative and inclusive process to design and agree the subsequent Sustainable Development Goals (SDGs) for the following 15 years, namely

2015–2030 (United Nations, 2015). The 17 SDGs span all areas of sustainable development, ranging from poverty and inequality to food, health, justice, and climate change (United Nations, 2015). Each SDG has been further subdivided and translated into a series of 169 integrated targets that are monitored at national and global levels *via* 232 different indicators (Le Blanc, 2015; Hák et al., 2016).

Whilst achievement of all the SDGs is important for progressing towards sustainability, the growing proportion of humans living in urban areas requires that SDG 11, namely “to make cities inclusive, safe, resilient, and sustainable” needs increasing attention. When signed in 2015, the world’s urban population was ~3.97 billion (54% of the world population), and only 5 years later it was 4.4 billion, and will be ~5 billion (58%) by the end of the 15 year SDG period in 2030 (Angel et al., 2011), representing a 26% increase in just 15 years. It is further projected that ~68% of all humans will live in urban areas by 2050 (Angel et al., 2011). In other words, the future of humanity is undoubtedly an urban one. Consequently, decisions, and investments made now pertaining to urban design, functionality, quality and livability, and ultimately sustainability, will shape the lived reality and quality of life of urban generations to come. Doing so will also contribute to other SDGs. For example, Gómez Martínez et al. (2020) demonstrate how restoration of the Ladegaardsaa River in Copenhagen (Denmark) contributes to at least 10 of the SDGs, including poverty reduction through green employment, and Turner-Skoff and Cavender (2019) argue that planting trees in urban areas can contribute to 15 of the 17 SDGs to some extent.

The planning, provision, maintenance, conservation, and restoration of Urban Green Infrastructure (UGI) is increasingly acknowledged as a vital constituent of any holistic and realistic strategies towards urban sustainability (Breuste et al., 2015; Sharifi, 2021) and the SDGs generally (Gómez Martínez et al., 2020). As the multifunctional, interconnected network of natural and human-made green and blue spaces, corridors, and elements (Kambites and Owen, 2006; Pauleit et al., 2011), UGI provides an array of ecosystem services (and disservices) that contribute to multiple facets of human wellbeing. Despite the wide diversity of ecosystem services provided by UGI, the bulk of research over the past decade or so has focused on only a small subset of the numerous benefits, notably recreation, physical and mental health, and regulating services (Kabisch et al., 2015). In contrast, there is only limited information on the contribution of UGI to several of the other SDGs, and of specific interest in this paper, SDG 1, which is “to end poverty in all its forms everywhere.” This is likely to be because the majority of research on urban ecology generally, and UGI and urban ecosystem services specifically, has been conducted in Global North countries (Kabisch et al., 2015; Nagendra et al., 2018; Shackleton et al., 2021), where poverty is not as pressing an issue as it is in many Global South regions. This demands that Global South researchers take a lead in this regard (Nagendra et al., 2018).

The intention of SDG 1 of ending poverty in all its forms is both ambitious and complex, and further confounded by the use of multiple definitions of poverty (Mabughi and Selim, 2006), which make verification complicated. For example, the

first target under SDG 1 is to eradicate *extreme* poverty (my emphasis), which was defined in income terms of living on less than US\$1.25 per day in 2015 (United Nations, 2015) (currently US\$1.90). Thus, in this target there is no consideration of other forms of poverty relating to basic needs such as food poverty, energy poverty, the lack of dignity or voice, and so on. The second target to “half the number of people living in poverty in *all its dimensions* according to *national definitions*” (my emphasis), acknowledges the complexity but leaves it up to national governments to define poverty and consequently how to measure and monitor it. Most often this is done in cash income terms (Barrett, 2005), thereby elevating economics above other facets of sustainable development. This is because of the *relative* ease of definition, measurement, monitoring and universal understanding of income poverty at a variety of scales and across “wealth” groups (Angelsen and Wunder, 2003).

However, there are cogent arguments for more inclusive definitions of poverty beyond income and asset poverty (Mabughi and Selim, 2006), which are increasingly synonymous with the concept of wellbeing. For example, the World Bank (2001) defines poverty as “a pronounced deprivation of wellbeing related to lack of material income or consumption, low levels of education and health, vulnerability and exposure to risk, no opportunity to be heard, and powerlessness.” Thus, in this article, poverty is considered as a bundle of human wellbeing facets relating to income, dignity, belonging, freedom to make decisions, choice, and participation (in civil, social, economic and cultural activities, and decisions).

When considering the links between UGI and poverty alleviation, it is necessary to differentiate between poverty mitigation and poverty reduction, collectively deemed as poverty alleviation (Angelsen and Wunder, 2003; FAO, 2003). The former relates to strategies and actions that prevent a decline into deeper poverty. The latter constitutes initiatives and practises that result in a lasting improvement in circumstances, asset base and wellbeing. It is also necessary to recognise that poverty is not static, but that poverty rates and ratios vary in time and space in response to national- and international-scale drivers (e.g., economic performance, wars, or epidemics), as well as dynamics at more local and even household scale (e.g., illness, loss or gain of a job). Whilst focus should be on the most poor, there is often a sector of any community that moves in and out of poverty (i.e., above or below a particular poverty line measure) as circumstances change, i.e., the transient poor (Ward, 2016).

Within this context, the objectives of this paper are to (i) assess the state of knowledge on the links between UGI and poverty alleviation, (ii) consider the conceptual links between UGI and urban poverty alleviation, and (iii) prompt future research into this relationship.

A RESEARCH LACUNA ON THE LINKS BETWEEN UGI AND POVERTY ALLEVIATION

Although research on the links between ecosystem services generally and poverty alleviation has taken off in the last 5 years

(Wang et al., 2021), an examination of the literature indicates relatively little research on the links between UGI specifically (or urban greening) and poverty alleviation. In mid-February 2021 I conducted a literature search using Scopus and the Web of Science using the following search string “urban green *” OR “green infrastructure” AND “poverty*”. This returned 79 unique papers across the two databases. Of these, 10 were inaccessible to me due to being in pay journals or not in English. The abstracts, objectives and methods of the remaining 69 papers were scanned and 57 discarded, mostly because either (i) they did not focus on poverty alleviation, but simply used the word “poverty” to describe the broad context of the study setting, or a cohort of respondents, or (ii) links to poverty alleviation benefits were expressed, but not actually studied. That left 12 papers, to which I added five from my own knowledge, resulting in 17 (Table 1) that I read the entire paper once or more times. Of the 17 papers, 12 were from the USA and South Africa (six apiece), two from Bangladesh, and one each from Mozambique, Spain and Africa (multiple countries covered). There is clearly a need for a significantly greater global coverage. Whilst these sources were informative in shaping concepts of the links between UGI and poverty alleviation, the final number was too small to undertake any systematic review of the themes, trends and conclusions. Nevertheless, this summary of the number of papers itself reveals the research lacuna in this domain and thereby points to the need for more concerted research in this regard.

CONCEPTUALISING THE LINKS

Based on the 17 studies and my own experiences it was possible to identify and conceptualise a number of direct and indirect links between the provision and maintenance of UGI and the potential for poverty alleviation (Figure 1). However, the extent to which UGI does, or might, contribute to poverty alleviation in a particular setting will depend upon the extent of UGI, its functional and compositional quality, its physical, and regulatory accessibility (especially to those most in need), the extent of poverty and the prevalence and effectiveness of other anti-poverty measures. The direct links are those through which the poverty alleviation effects (however small or large) are manifest *via* immediate and useful resources such as food, timber, medicines, shelter, and income. As indicated in Figure 1, they encompass (i) provisioning or consumptive goods (such as food, medicines and construction timber), (ii) formal and informal employment to provide and maintain UGI, and (iii) space for a number of livelihood activities and benefits. The indirect means are where UGI provides longer-term investments in or insurance to human wellbeing, and hence ability to escape poverty or be less vulnerable to it through better health, social connections, and safety. Making the relationship work requires embedding poverty alleviation in the various strategies to promote UGI, and on the other hand promoting the provision of UGI as a part of poverty alleviation strategies (Dunn, 2010). Given that poverty is most pervasive in Global South contexts, recognising and acting on this relationship would be most apposite there, and can bolster

and complement existing arguments and motivations for the provision and maintenance of UGI.

THE CURRENT EVIDENCE BASE

Following Figure 1, I briefly consider the evidence base demonstrating the direct links between UGI and the potential for poverty alleviation. Here I focus on the direct links due to both space limitations for this article, and because some of the indirect links, such as with health and education benefits have been comparatively well researched (e.g., Lee and Maheswaran, 2011; Van den Berg et al., 2015; Li and Sullivan, 2016; Kuo et al., 2018).

Provisioning Services From UGI

There is much literature on the collection of an extensive array of different products from green spaces and elements in urban settings around the world (Shackleton et al., 2017; Synk et al., 2017; Tiwary et al., 2020; Shackleton, 2021). This includes products such as water, firewood, wild foods (e.g., wild fruits, vegetables, herbs, fungi, insects, fish, honey), medicinal plants, plant parts and fibres for crafts and decorative and utilitarian items, and timber for construction. For example, Schlesinger et al. (2015) inventoried the use of use of nine different biological products (i.e., excluding water) or non-timber forest products (NTFPs) in six cities in five sub-Saharan African countries, and found that 74% of urban households collected at least one NTFP locally. In northern Botswana, Joos-Vandewalle et al. (2018) found that 80% or more of the urban households used locally sourced firewood, wild fruits, vegetables, fish, reeds for mats, grass for brushes, and waterlilies for food. In Dhaka (Bangladesh), Uddin (2006) reported that 60% of poor people in the city were totally reliant on locally sourced leaves and firewood for cooking energy, and that the majority of houses in the slums were made of forest and agricultural materials harvested from urban and peri-urban forests and fields. Collection or foraging for such products has been well examined in poorer and Global South contexts, but nevertheless, it is also prevalent in Global North towns and cities too. For example, Kangas and Markkanen (2001) reported that 68% of the urban households of Joensuu (Finland) had collected wild berries in the survey period, with a similar figure of 54% in Poland (Golos and Kaliszewski, 2016). In a large survey of over 17,000 mostly urban households across 28 European countries, Lovrić et al. (2020) found that 28% had collected one or more NTFPs in the previous 12 months from their local environment or further afield. This is similar to the USA, where Short Gianotti and Hurley (2016) reported that 27% of urban households in central and eastern Massachusetts personally collected wild plants or fungi, and Robbins et al. (2008) revealed that 22% of urban respondents in New England had collected plant NTFPs from urban and rural settings in the preceding 5 years.

Whilst the collection of wild products is well known, relatively little urban research has made the explicit links between the availability and use of such products to household welfare and the role in poverty alleviation (Uddin, 2006; Shackleton et al., 2018). This in contrast to rural research with dozens of papers per year

TABLE 1 | Seventeen studies considering one or more links between urban greening/infrastructure and poverty alleviation, arranged in chronological order (see section on “Research lacuna” for method).

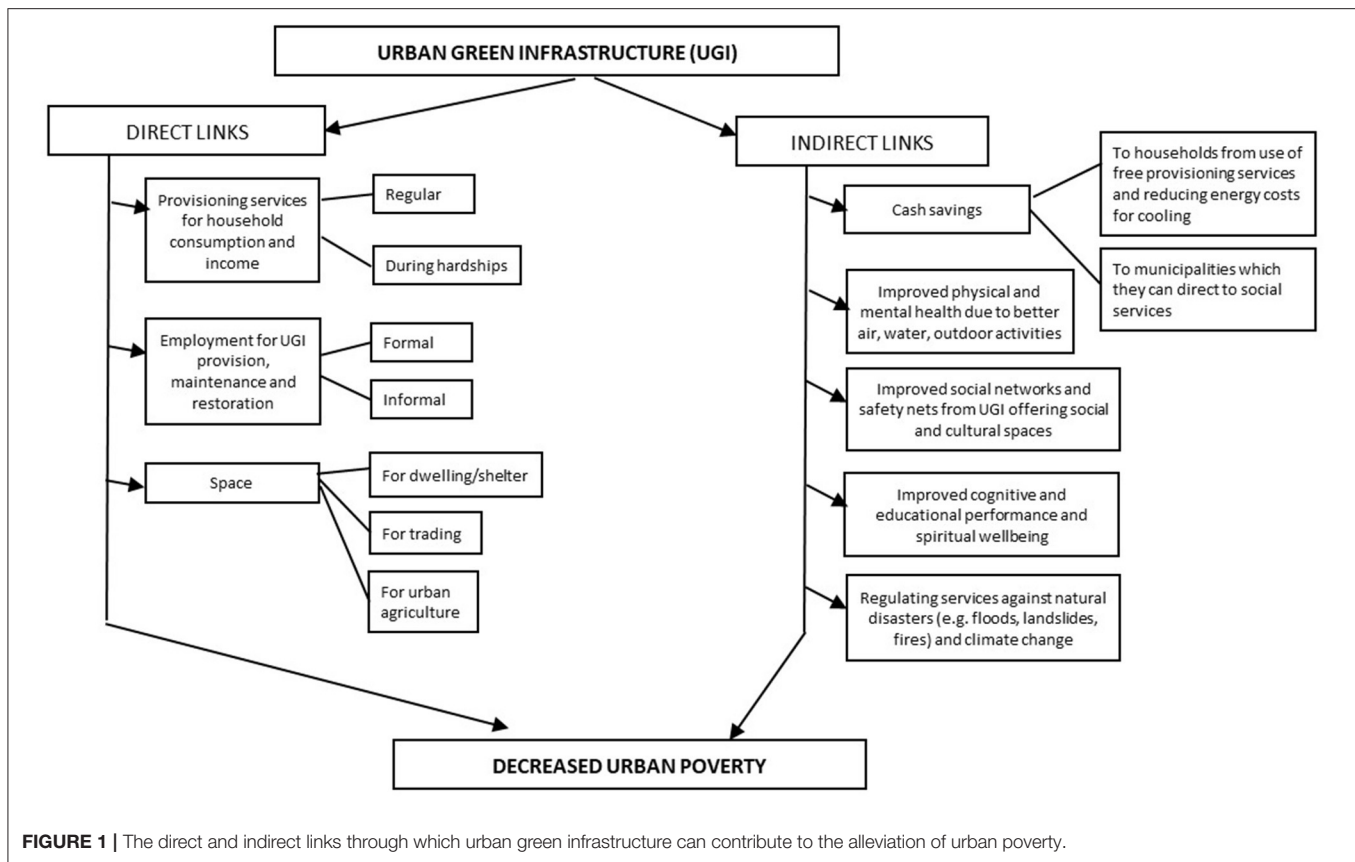
No.	References	Country	Pertinent focus area
1	Kuo (2001)	USA	Effects of UGI on coping with life by inner city poor
2	Uddin (2006)	Bangladesh	Direct and indirect links of urban trees on poverty alleviation
3	Falxa-Raymond et al. (2013)	USA	UGI restoration jobs training as pathways out of poverty for low-skilled workers
4	Kaoma and Shackleton (2014)	South Africa	Collection and use of tree products from UGI as a means of mitigating poverty
5	Kaoma and Shackleton (2015)	South Africa	Estimation of cash and non-cash income from tree products from UGI and how it effects poverty status
6	Shamasunder et al. (2015)	USA	Benefits accruing from a poverty alleviation home-gardening project
7	Cumming et al. (2017)	South Africa	Commentary on use of ecological infrastructure to attain the SDGs, including poverty alleviation
8	Segui et al. (2017)	Spain	Benefits from urban allotments, including poverty mitigation
9	Burdine and Taylor (2018)	USA	Urban food gardens, volunteering and benefits, contrasting poor and less poor areas
10	Cilliers et al. (2018)	South Africa	Review of urban food gardens in alleviating poverty
11	Douglas (2018)	Africa	Poverty as a driver of encroachment on UGI, and thereby increasing vulnerability to ecosystem disservices
12	Quinn et al. (2018)	Mozambique	Ecosystem adaptation to climate change to simultaneously address poverty
13	Shackleton et al. (2018)	South Africa	Commentary and synthesis of studies from South Africa on importance of UGI, including for poverty alleviation
14	Tallis et al. (2018)	USA	Assessment of the relative magnitude of effects of UGI or poverty status on school achievement scores and hence intergenerational poverty
15	Birtchnell et al. (2019)	Bangladesh	Different forms of UGI in helping slum dwellers adapt and reduce their vulnerability to a range of social and environmental challenges
16	Browning and Rigolon (2019)	USA	Analysis of UGI levels during childhood to underpin long-term benefits in terms of income later in life and hence poverty alleviation
17	King and Shackleton (2020)	South Africa	Quantification of income in formal and informal sectors from maintenance of UGI

examining poverty dynamics in relation to provisioning services and NTFP use (e.g., Leßmeister et al., 2018; Pullanikkatki and Shackleton, 2018; Hoang et al., 2020; Walle and Nayak, 2020). In urban contexts, ecological studies (e.g., Hurley and Emery, 2018) focus primarily on the species available and quantities harvested, possibly along with the potential ecological impacts. Social studies on the other hand, mostly consider who harvests, their motivations for doing so, and knowledge levels and transfer (e.g., Synk et al., 2017; Garekae and Shackleton, 2020). Some consider urban markets and the potential supply and demand dynamics, or the policy and urban planning, and management implications (e.g., McLain et al., 2014).

With respect to the contribution of such harvesting to household income (cash and non-cash), there are relatively few studies. Kaoma and Shackleton (2015) quantified the value of only tree products harvested by urban households in three towns in northern South Africa, and reported that they provided an average of 20% of total household income, and more than 30% for the poorest households (it would be much higher if non-tree products had been included too). Additionally, they found that inclusion of the value of harvested tree products in household income estimates reduced the proportion of households living below the poverty line by 5–10% per town. Expressed as the inverse, if there was not any UGI in these towns, a further 5–10% of households would be struggling below the poverty line. This echoed the findings of Davenport et al. (2012), also in South Africa, in valuing NTFPs collected from

peri-urban commonages by urban residents in three small towns, that without local NTFPs 11–13% more households would fall below the poverty line. Lannas and Turpie (2009) quantified the value of provisioning services (mostly grazing, firewood, wild vegetables, and medicines) from Mfuleni wetland in Cape Town at US\$2,003 per user household per year, which was well above the national poverty line. These estimates do not include the poverty mitigation dimensions, in which many urban households’ use of urban NTFPs helps ease their poverty but not sufficiently to move them above the poverty line. For example, the qualitative study of Birtchnell et al. (2019) considers the innovative and intimate care and management of individual trees and containers to supply medicinal and culinary herbs, foods and firewood to slum dwellers in Dhaka (Bangladesh).

The significance of urban NTFPs from UGI is further emphasised during times of hardship and shocks. These may be at the level of the household (such as retrenchment, illness or death of the primary breadwinner, or loss or significant damage to property through fire or floods), or to entire neighbourhoods and communities through natural disasters (such as floods, earthquakes, tornados), large price increases in basic foodstuffs, or civil strife, and armed conflict. During such times many households turn to natural capital found in UGI to cope until they are able to re-establish themselves. In the absence of wild products from UGI many would not be able to cope, and so would have a greater likelihood of falling into poverty, or intensification of existing poverty. Thus, provisioning products



from UGI act as a safety net or buffer against poverty in times of distress. This is illustrated by Dalu and Shackleton's (2018) investigation of the coping responses of urban dwellers of informal housing zones in three coastal towns to a major flooding event resulting from above-normal rainfall. Locally collected resources (timber for building and fencing, and thatch for roofing) provided the equivalent of 57% of the costs of repairing or rebuilding the damaged structures, ranging from a mean of 46 to 70% in the three towns. In another example, a survey of 420 NTFP traders (of which 65% were in urban settings) in five southern African countries, Weyer et al. (2018) found that almost one-third had started trading in NTFPs because of death or illness of the main income earner in the household, starkly illustrating the importance of UGI as a safety-net in times of need. A particular harsh example is the increased reliance on wild foods during armed conflicts, such as the siege of Sarajevo in Bosnia (Redžić, 2010).

The findings of Weyer et al. (2018) also illustrate that the value of provisioning services from UGI in mitigating or reducing poverty is not solely *via* household use, but also through cash generation from trade in NTFPs in their raw or processed forms. There are markets for various NTFPs such as medicinal plants, wild foods, crafts, and household utensils in many cities of the world for those knowing where to look. However, the source of the goods on sale is unlikely to be solely from UGI, but may also be brought in from neighbouring rural regions. Yet there is undoubtedly use of UGI to collect NTFPs for income generation

as reported, for example, by Grabbattin et al. (2011) in the USA and Kaoma and Shackleton (2015) in South Africa. The levels of income earned specifically from urban sourced NTFPs are unknown and hence the real or potential contribution to poverty alleviation is solely conjecture at this time.

Employment in UGI Provision, Maintenance, and Restoration

Most formal green spaces on public and private lands in towns and cities require human capital to manage and maintain them. This may also apply to some informal green spaces too. The employment creation potential of UGI is rarely mentioned as a benefit of UGI in academic literature detailing or listing the contributions or values of UGI, or urban forestry, to urban sustainability and human wellbeing (King and Shackleton, 2020). This is because it is either taken for granted, or because the employment of skilled and unskilled workers to develop and maintain (or restore) UGI is regarded as a financial cost to city budgets. Hence, the growing number of cost-benefit analyses demonstrating that in most settings the benefits outweigh the costs. However, King and Shackleton (2020) argued that in settings of high unemployment, typical of many Global South regions, that hiring of workers to maintain or restore UGI could be viewed as an investment against poverty and in skills development and work experience. Indeed, they found that the "green collar" sector of developing and maintaining public and

private UGI accounted for 3–5% of all employment per town across 12 towns in the Eastern Cape province of South Africa. The number of green collar employees was positively related to town size and relative development or affluence. Indeed, Shackleton and Blair (2013) found that amongst respondents to a survey on the benefits of public green spaces, approximately one-third of poor households mentioned employment creation as a benefit, compared to <3% of affluent households doing so. The majority of the jobs are unskilled, which means low barriers to entry to some of the poorest citizens and hence an attractive poverty alleviation opportunity. The preponderance of low-skilled jobs in the sector was also noted in the USA by Pinderhughes (2007).

The direct poverty alleviation contribution of green collar employment will depend upon the nature of the jobs and their respective wage levels. In economically strong contexts and in countries with strong labour and minimum wage regulations, most or all such jobs are likely to pay above the poverty line, including for unskilled jobs (Pisani and Yoshkowitz, 2005; Pinderhughes, 2007). This is not necessarily so in poorer countries or cities. In South Africa, those employed in the public sector are protected by minimum wage regulations, however, due to excessive unemployment nationally and many unskilled workers, those working in the informal sector may not enjoy adequate wage levels or job security. Across the 12 towns surveyed by King and Shackleton (2020), approximately two-thirds of the jobs were in the informal sector, mostly as gardeners employed to maintain private gardens at homes of more affluent residents, with most earning at or below the national minimum wage (King and Shackleton, 2021). However, there may be non-cash remuneration benefits for some household gardeners, such as food and accommodation, as reported from case studies in Ghana (Awumbila et al., 2017) and Brazil (Chase, 2008). King and Shackleton (2021) estimated that there are likely to be between 700,000 and 1 million such gardeners in South Africa (with a population of ~66 million people), making it one of the largest employment sectors nationally. In Dhaka (Bangladesh), Uddin (2006) states that there are thousands of people involved in roadside nurseries, mostly owned and run by people with no, or limited, education and formal skills, but generally earning an income above the poverty line, and with the larger ones employing several other people in their business.

The focus on employment is because it provides a vehicle for income generation through engagement with UGI (Dunn, 2010). However, Browning and Rigolon (2019) show that the positive indirect effects of neighbourhood greenness during childhood, even in poorer neighbourhoods, can translate into higher incomes later in life and hence reduce intergenerational poverty. This is because of the indirect effects of exposure to and experience of UGI as a child of improving potential academic achievement, creativity and emotional intelligence, all of which are important in gaining employment and performance later in life (Browning and Rigolon, 2019). This echoes the benefits of “green collar” employment, where jobs defined by working with or in nature are frequently valued beyond just the income earned, but also the psychological and health benefits of being in nature (Falxa-Raymond et al., 2013). This resonates with the seminal work of Kuo (2001) who revealed that those living in greener

environments, even in poor neighbourhoods, felt that they were better able to identify and deal with major issues affecting them and thereby regarded such issues as less severe and less persistent.

Space

By its very definition UGI occupies space within and adjacent to the urban matrix, and such space may be sequestered for a variety of purposes that may contribute to poverty alleviation, including urban agriculture, food stalls, informal trading or even space for people to live. The use of UGI for such purposes is typically driven by a combination of rapid rates of urban population growth in many regions and low formal employment opportunities, meaning that the space that UGI occupies offers opportunities to contribute to livelihood needs, such as shelter, food and income generation. This is particularly so for the urban poor, although there is much literature reporting on unauthorised encroachment on UGI by economic and political elites (e.g., Mensah et al., 2018), but which cannot be viewed through a poverty alleviation lens.

Urban agriculture can be found in one form or another in every city of the world. It may be practised in public and private spaces. The motivations to engage in urban agriculture are diverse (Hamilton et al., 2014; Di Fiore et al., 2021), including for health, food security, recreation, cultural, and income reasons. But in poor regions and for poor households, there is little doubt about its value to household food security and for some, income, i.e., very basic needs at the heart of poverty alleviation (Simiyu and Foeken, 2014; Pribadi and Pauleit, 2016). The extent to which urban agriculture can alleviate poverty within a household or community is debated (Hamilton et al., 2014; Cilliers et al., 2018). However, both sides of the debate generally fail to acknowledge the extent of poverty alleviation from urban agriculture is generally context specific, based on factors such as size of land available, its productivity, access to and affordability of inputs (e.g., water, fertiliser), tenure security and so on. Thus, for some, urban agriculture is a side activity that offers recreation and some fresh food adding to dietary diversity; yet for others it is a core survival strategy without which the household would be in dire difficulties, and others still it provides both fresh food and some level of income (Cilliers et al., 2018). Availability of land is important for urban agriculture, and can often be a scarce commodity in densely populated areas. But many poor communities find novel ways to mitigate this, such as through vertical and rooftop gardens, container planting indoors, and next to the dwelling, and growing trees in relatively small spaces. All of these contribute to household needs, as illustrated by Birtchnell et al. (2019) in the slums of Dhaka (Bangladesh), Roy et al. (2018) in Dar es Salaam (Tanzania), and Gopal and Nagendra (2014) in the slums of Bangalore (India). The poverty mitigation or alleviation “value” of gardens extend beyond the physical bounds of the garden, with Voicu and Been (2008) reporting that property values in New York (USA) were enhanced if adjacent to a community garden, which in turn resulted in higher taxes payable to the city authority which could, in theory, be invested in social services to the poor. Community gardens may also provide some employment (e.g., Burdine and Taylor, 2018). As with green employment,

engagement in gardening is also usually associated with a number of positive outcomes unassociated with remuneration, in terms of better motivation, stress reduction, social connections and physical health (e.g., Shamasunder et al., 2015).

Equally important for some, is the use of UGI as a space to earn an income through various means, such as selling goods to pedestrians, repair services for electronic or mechanical goods, small-scale plant nurseries, or photographers snapping people in public parks. Using tree-lined streets or the edges of formal and informal green spaces to offer such services is a common sight in many burgeoning cities such as Dhaka (Uddin, 2006), Mumbai (Salès, 2018), and Ibadan (Adebayo and Akinyemi, 2019), whereas in others, urban authorities seek to limit them to certain places, or even ban them (e.g., Kazembe et al., 2018). Being able to occupy attractive places or ones sheltered from the elements by trees, especially in hot tropical climates, close to busy streets and pavements at little or no cost is a vital livelihood opportunity for many, especially the poor (Uddin, 2006; Nagendra and Gopal, 2010). Informal plant nurseries along roadsides are worth mentioning because they are common in many countries of the Global South, they make use of the space and shelter afforded by roadside UGI, but they also contribute to its reproduction by propagating and selling a diversity of plant species to passers-by. Mean incomes are also usually well above the poverty line. For example, in Ethiopia, Molla et al. (2020) calculated net incomes as US\$ 14,628 per nursery per annum, whilst in Kenya, Rutto and Odhiambo (2017) recorded incomes of ~US\$9,474 per nursery per annum.

A significant expression of the “occupation” of UGI space for livelihood needs is that of using it for temporary or permanent dwellings (e.g., Chitonge and Mfune, 2015; Mensah et al., 2018). With rapid urban growth in most Global South towns and cities, many new migrants find themselves living in slums or informal housing areas (Douglas, 2018), which may be for only a short period, but for some it may extend for years or decades. Undeveloped land, typically UGI, is therefore an attractive space for construction of a dwelling (Uddin, 2006), or a place to find shelter and provisioning goods in the face of homelessness (Koprowska et al., 2020). If in large numbers or high densities, such use will transform the inherent nature of UGI, diminishing its accessibility to others and its ability to offer a full range of ecosystem services. But at lower densities, then certain elements of the original UGI might be maintained or enriched. For example, Kaoma and Shackleton (2014) found that in three towns in South Africa, homesteads of informal dwellings had a higher density of trees than formal neighbourhoods with long-established or new housing.

CONCLUSION

Poverty is a pervasive global issue, most pressing in the Global South, but not restricted to it. Urban sustainability is also a pressing issue, and yet the two are not sufficiently envisaged together, debated in the same fora, or combined in a given development strategy for win-win outcomes in both domains. In this paper I iterate the thesis mooted by Uddin (2006) and Dunn

(2010) that there are clear links between them. Consequently, investments in UGI are likely to have clear benefits in reducing or mitigating urban poverty, especially of the most poor. This needs to be added to the calls and motivations for increased budgets for urban greening. Indeed, it is a critical time for this relationship to be acknowledged and acted upon because both UGI and poverty are under threat from multiple and overlapping dynamics, such as climate change, covid-19 and erosion of UGI in many Global South cities as they expand and develop.

Unfortunately, it is not as simple as just advocating for more UGI, because in many towns and cities there is insufficient UGI to meet many of the other functions it performs. In these contexts, there is need for a transformation of mindsets and frameworks of planners and decision-makers, towards the mainstreaming of UGI and nature-based solutions in all planning and management domains, not just relegated to the parks department. In other settings there is extensive UGI in public spaces, but it is inequitably distributed (Nesbitt et al., 2019; Venter et al., 2020), meaning that the benefits are not accessible to all, and often those in most need have the least availability or access to UGI. This inequity has implications beyond just recreation and health aspects highlighted in the literature (e.g., Jennings et al., 2016, 2017), but includes material wellbeing and poverty as highlighted here. The issue of inequitable distributions of quantity and quality of UGI intersects with notions of “Rights to the City” (Harvey, 2003; Friendly, 2013; Purcell, 2014) and the social values ascribed by different stakeholders to UGI. It also concerns the range of choices and freedoms around the uses to which UGI can be put and the consequent benefit flows. This reinforces that investment in UGI can also be considered as an investment in poverty alleviation *via* employment and other direct and indirect links and should be considered in poverty alleviation discourses, policies and programmes, and vice versa. Indeed, Birtchnell et al. (2019) urge for a reframing of urban greening discourses and framings in the Global South, to better resonate with the realities of poverty and informality that characterise most Global South towns and cities.

Any integration of poverty issues into UGI plans and programmes, and *vice versa*, must also be sensitive to the reality that UGI can also generate ecosystem disservices (Lyytimäki and Sipilä, 2009; Von Döhren and Haase, 2015). This is particularly pertinent because the poor are often disproportionately exposed to ecosystem disservices such as floods, wind damage, mudslides and exposure to harmful diseases and animals when collecting water or provisioning goods. Coupled with a lower asset base and response capacity means that the effects of some ecosystem disservices can be particularly devastating (Douglas, 2018; Davoren and Shackleton, 2021). Thus, the nature and location of the UGI needs to be carefully planned and managed to reduce rather than exacerbate poverty levels.

Although the case has been made in this paper about the clear and intuitive direct links between UGI and poverty alleviation, the evidence is still very limited, and much of it has not been framed within a poverty alleviation lens. Additionally, the evidence comes from only a handful of countries, currently mostly South Africa and the USA. Consequently, there is a clear need for more research and advocacy into the relationship

and from a wider diversity of contexts to augment and advance arguments for UGI, especially in poor communities and countries, which can underpin significant improvements in livelihoods and wellbeing. To this end I would suggest the need for more context specific studies, i.e., grounded, qualitative, quantitative and interdisciplinary research that also involves non-research stakeholders into the relationship between UGI and poverty alleviation. In the Global South there is more widespread multifunctional poverty including basic needs, coupled with an often higher vulnerability to shocks due to lower household asset bases and weaker institutional safety-nets. Thus, the potential poverty alleviation potential *via* UGI is likely to span the full range of direct and indirect pathways as indicated in **Figure 1**. However, the wider and more pervasive poverty in the Global South demands that researching and securing the direct pathways is likely to address this more pressing need. In the Global North, where basic needs are met to a far greater extent, and where there are more widespread institutional safety-nets for the poor, the research and advocacy focus should be more, albeit not exclusively, on the indirect links whilst being explicit on the poverty alleviation dimensions or potential.

Given that opportunities for poverty alleviation through UGI are context specific, one must be cautious about generalising research needs and questions. However, I see some pressing questions that can transcend or explicitly address context specificities. The first is to consider what types of UGI best benefit the poor in specific contexts? This is necessary to inform city planners and parks agencies around the types of spaces and, species and products that will best support the urban poor in their needs for food, income, and space. The second question relates to how to ensure the equitable distribution of UGI so that the urban poor have proximate and ready access and can use

the UGI for purposes that best suit them. Third, what barriers hinder use of UGI for direct poverty alleviation? Such barriers might include design or formal regulatory barriers, as well as informal barriers to access some UGI or the norms of what is “allowed” (or not) in specific spaces. For example, some city authorities disallow picking of fruits or trading of goods in public parks. Other parks might charge access fees which limit the ability of poorer citizens to access them. In whose interests were such regulations developed and why, and what might be the result of relaxing them? Fourth, how can city authorities better design and manage UGI towards greater poverty alleviation? This requires integrating a poverty alleviation lens when planning for UGI, as well as involving the urban poor to understand what best suits their needs. However, material poverty often overlaps with perceived powerlessness and lack of voice. Thus, innovative, sensitive and respectful approaches will be required to hear the voices of the poor and engender their participation. Fifth, as empirical studies and evidence accumulates, would be a meta-analysis, or comparative case examples, of how does it vary between and within countries and contexts?

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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