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Common value: transferring development rights to make room for water

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ABSTRACT

In 2019 floods made up 49% of disasters and 43% of disaster related deaths globally. Flooding is also the costliest natural disaster, with yearly estimated losses of $36.3 billion. In order to counter these challenges, the flood risk management (FRM) narrative is evolving towards integration of blue/green infrastructure (BGI), using projects that harness nature and mimic natural processes. However, there is very little research into how BGI-related innovations will be mainstreamed, nor, particularly, how they will be funded. In order to reflect upon this situation, this paper analyses current academic literature and international best practice in BGI and Land Value Capture (LVC) instruments - to form a novel conceptual framework that is designed to act as a staging post for new research into BGI and its practical delivery. Specifically, this analysis focuses on the Transferable Development Rights (TDR) instrument, which has enabled some planning authorities to successfully push for their environmental agendas, including in flood prone areas. This gap in knowledge has multiple significance. Firstly, land management decisions related to BGI can have deep distributive-justice implications that need to be addressed. Secondly, there is an immediate need to pay for such FRM measures across the world. Thirdly, this financial imperative takes place against an international backdrop of reduced government funding in a time of deep structural change and Covid-19 pressure. Findings in this paper suggest that TDR has the potential to be a successful conduit for managing all three conditions. Yet, the success of TDR is closely linked to the specific legal, market and urban development contexts, which further research should explore within the framework of BGI implementation.

1. Introduction

In 2019 floods made up 49% of disasters and 43% of disaster related deaths globally (CRED, 2020). Flooding is also the costliest natural disaster, with yearly estimated losses of $36.3 billion (CRED, 2019; Dano et al., 2019). In order to counter these challenges, the flood risk management (FRM) narrative is evolving towards integration of blue/green infrastructure (BGI). BGI is defined as "strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services" (European Commission, 2013, p. 3). BGI are considered as sustainable and long-term solutions, complementary to traditional interventions that focus on physical/gray infrastructure. Regardless of its multiple benefits, the implementation of BGI has been surprisingly slow. Arguably this is due to higher requirements in land availability and maintenance costs (van Vuren et al., 2015), and most pertinently for this article, the complexity of unpicking and mediating the politics of land ownership, value and benefit. In contrast to other types of infrastructure (roads, rail, airports), research on how access to land for the implementation of BGI can be facilitated and funded is still in its early stages, with only a few studies exploring nature based solutions on private property (Merk et al., 2012; Hartmann et al., 2019a). In order to contribute to a more comprehensive approach to land management in the realm of FRM, this paper evaluates the potential of land value capture (LVC) methods to facilitate the implementation of BGI, focusing on transferable development rights (TDR).

LVC is based on the idea that the value of land is created by society and not linked to its landowner’s actions and should therefore, in part or entirely, be reaped by the public (Alterman, 2012; Smolka, 2013; Walters, 2016). TDR is one form of LVC that has been implemented by public authorities to achieve their zoning goals, including environmental/FRM ones, primarily through land conservation. Through TDR, development rights can be transferred from so-called ‘sending areas’, where development is not desirable, to ‘receiving areas’, in areas designated for...
development (Shahab et al., 2018). In doing so, TDR balances property and specifically TDR can be used in the context of BGI. This paper seeks to contribute to this gap in knowledge by addressing two main questions: To what extent LVC instruments can be employed to facilitate access to land and funding for BGI implementation? What is the potential for TDR to facilitate the implementation of BGI for FRM? These research questions reveal overlapping questions around practical solutions, methods of funding, how asset owners and communities will be affected and who benefits and who pays for the intervention.

In order to explore the linkages between FRM and equitable funding, the paper combines literature and research traditionally considered in isolation: that of climate change, justice, urbanisation, FRM, governmental funding and LVC. This novel reflection in literature is the methodological underpinning of the paper and forms the conceptual contribution to knowledge. Table 1 and Fig. 2 forms a conceptual framework for understanding how land value capture can be used to help deliver BGI. The utilisation of Critical Success Factors then helps to appraise TDR. However, findings presented in this paper are limited only on systemic literature review, and forms an analytical framework for future empirical research into the subject area.

The remainder of this paper is structured in the following way. The next section briefly explains BGI within the wider context of FRM. Here the relationship between land (markets), flooding and BGI is discussed. This is in order to reveal the potential for the inherent value built up in land to help fund BGI. The paper then explores how this value can be fairly captured through methods of LVC, focusing on TDR programs. The paper concludes by reflecting back upon the underlying research question and setting out a research agenda for future study based on this Critical Success Factor analysis.

2. Flood risk management, blue/green infrastructure and land markets

2.1. Integrating BGI in FRM

There is now a consensus amongst researchers and practitioners that higher levees and grey protective infrastructure alone will not resolve the future flood protection needs of society. Perversely it might contribute to higher vulnerability towards disasters from unpredicted and extreme weather events (Brookes et al., 1983; Green et al., 2000; Hartmann, 2016). Recognizing the limitations of traditional FRM practices, the battle against water narrative has started shifting to an alternative conciliatory approach of using BGI to accommodate water (European Parliament and Council of the European Union, 2007; European Commission, 2013), as more efficient in handling complexity in an urban setting (Hansen and Pauleit, 2014).

The term green infrastructure, or blue and green infrastructure as it is often defined (Perini and Sabbion, 2016), was first coined in 1994 in Florida in a planning report that advocated for land conservation, (Florida Greenways Commission, 1994; Elliott et al., 2020). Nowadays, BGI have a broad appeal as they recreate a naturally oriented water cycle, while providing a variety of multiple benefits, including air pollution reduction, carbon sequestration and landscape benefits (Gill et al., 2007; Chon and Shafer, 2009; Getter et al., 2009; Hoyer et al., 2011; Lawson et al., 2014; Emmanuel and Loconsole, 2015; Matthews et al., 2015). In a recent study, Elliott et al. (2020) evaluated the degree of impact of 14 main BGI to the three main ecosystem services (ES) identified by the Common International Classification of Ecosystem Services (Haines-Young and Potschin, 2018): Cultural ES, Provisional ES and Regulating, Supporting and Maintenance ES (RSMES). BGI which resulted to have the highest positive impact in Water Quantity Mitigation, part of the RSMES, are highlighted in green in Fig. 1 below:

While varying in form, BGI that have the highest positive impact on Water Quantity Mitigation are the ones that offer some form of Natural Water Retention Measures (NWRM) (Hartmann et al., 2019b; Elliott et al., 2020; O’Donnell et al., 2020), which are more land intensive than other engineered solutions. This is because mimic pre-development hydrology involves planning of submergible land which is ultimately also reserved for its ecological, social and climate mitigation function. Evidently, access to land is one of the main factors hampering a wider mainstreaming of BGI internationally (Clean Water America Alliance, 2012; Hartmann et al., 2019a). Tackling the issue of land scarcity calls for an analysis of the impact of BGI on land markets, as a first step to exploring the extent to which LVC instruments can be employed for BGI facilitation.

2.2. Land markets and blue/green infrastructure

The link between BGI and land markets can be investigated by analysing the flood damage costs avoided (Grafakos et al., 2019) and the social, ecological and economic benefits brought about by BGI, which this paper will refer to as improved urban quality (D’Acci, 2019).

Damage Costs Avoided method can be evaluated by assessing either the potential damages that properties could incur if no BGI is implemented or the economic value that is spent in flood protection, i.e. insurance premiums for natural disasters. Although these values are very context bound, findings from several studies highlight the potential to invest in BGI through property damage costs avoided, i.e. $19 million avoided property damages by a wetland in river Charles, Massachusetts (Grafakos et al., 2019), $7.70 million per year avoided property damages from a greenway along the Meramec River in St. Louis County (Kousky and Walls, 2014), between $525,900 to $1,800,200 avoided damages in property due to conservation of Otter Creek wetlands and flood plains to Middlebury (Watson et al., 2016). Regardless of the evidence brought about by empirical research, avoided property damages might not always be reflected as property value increase after a BGI implementation. The reasons to consider vary from lack of risk awareness and perception by the general public (Lamond and Proverbs, 2006; Becker et al., 2014) or reliance on public compensation programs (Lamond and Proverbs, 2006). Hence, the likelihood of land markets responding positively to FRM measures through BGI are higher in localities where there is a high public awareness or where BGI implementation is accompanied with awareness campaigns (Zhang et al., 2018; Grafakos et al., 2019).

There is a growing body of literature that reinforces the positive correlation between the quality of urban environment on one hand, brought about by BGI through proximity to blue/green spaces, improved landscapes, open spaces, and on the other hand, property market (Zhang et al., 2012; McCord et al., 2014; Liu et al., 2015; Nurmii et al., 2016). The range of this impact varies depending on the locality, the type of BGI, the type of property and other contextual factors. D’Acci’s (2019) systematization of various international case studies exhibits an appreciation of 5%-117% of property values as a result of proximity to green areas and 4.9%–23.1% resulting from the property overseeing a park or green space. Although these findings should not be generalized, it is significant that more than 50 cases reviewed by D’Acci (2019) attest for a significant impact of blue/green and open/recreational spaces (elements which are usually present in BGI) in real estate market prices. Yet, not enough has been achieved in exploring mechanisms through which this potential economic value created by BGI implementation can be captured by public authorities to provide alternative ways of financing BGI.

3. Land value capture and flood risk management

The practice of LVC is very diverse and largely depends on the political and institutional positioning of a specific locality on the spectrum of this debate. Nevertheless, experience with LVC is present across the
globe, but also has a long-standing history dating back to antiquity, with property tax being a very popular financial instrument in Egypt, Persia, Babylon and later on in the Roman Empire. Yet, LVC is now a term used to refer to almost any instrument which captures some or all ‘unearned’ increment of land value, the narrative of which has significantly shifted over time. Land value capture can refer to capturing of unearned increments reflect economic development trends (direct value capture) or capturing of betterment, where the rise in value of land is the result of: a) improved development rights resulting from land use plans, and b) improvement of infrastructure and services (indirect value capture) (Alterman, 2012).

Table 1 below, systematizes the most popular LVC instruments, classified according to the design of instruments: Fiscal, Property Rights Management, Urban Transformation and Asset Management.

The systematization of LVC instruments in Table 1, provides the main basis for addressing the first research questions (RQ1), by narrowing down the list of instruments more adequate for facilitating land access and funding for BGI. First, some of the LVC instruments, such as Cooperative Land Banking, Community Land Trusts and Land Sharing, have a very specific scope, mostly related to affordable housing (Rabe, 2010; Lewis and Conaty, 2012; Jacobus, 2015). Although BGI can be integrated in such projects as well, the main focus of these instruments does not comprise BGI. Second, instruments grouped under “Asset management” are usually implemented in contexts where public authorities own substantial amounts of land or where they have the financial capacity to access land markets. Evidently, accessing land for BGI implementation in such contexts is easier, however this is not the case for the many countries where land tenure is dominated by private ownership or leasehold.

Therefore, the green part of the table highlights the group of LVC instruments that can be considered more adequate as BGI facilitators. The degree of adequacy of each instrument will be dependent on the context and the type of BGI, however findings from literature review highlight some main points of consideration:

- The nexus between land value creation and value capture (Peterson, 2008; Merk et al., 2012; Nelson et al., 2012; Smolka, 2013): The relevance with BGI is that, while some instruments are adequate to capture the value created in-site as a result of improved open spaces, landscape and overall urban quality delivered by a BGI, other instruments can be used off-site, to capture part of the value incremented by virtue of increased flood resilience, the two main effects that BGI exert on land markets (see Section 2.2).
- The context/purpose in which the instrument can be used: existing urban area, new urban development/redevelopment and for land conservation purposes (Peterson, 2008; Smolka, 2013; Needham, 2016; Pruetz, 2016). The same BGI can be facilitated through different LVC instruments depending on its context; for example a raingarden can be financed through fiscal LVC, such as betterment levies, if it is implemented in an existing urban area or it can be financed through a Land Redevelopment or Active land policy scheme, in a new urban area or urban redevelopment project.
- The type of solution presented by the instrument through government approach, market approach or community approach (Crabb and Coppens, 2019), depending on the stakeholder arrangement in the specific context (Fig. 2).

The conceptual framework highlights LVC instruments most suitable for the specific types of BGI that have higher impact on water quantity mitigation. Amongst these instruments this paper focuses on Transferable Development Rights for two main reasons: First, except from fiscal LVC instruments, TDR is the only instrument which allows for value to be captured and invested both in site and off-site, giving more flexibility in its application. Fiscal instruments which also offer this kind of flexibility have not been used for land conservation purposes so far. Which brings us to the second reason, the historic implementation of TDRs for land conservation/ environmental purposes, make this instrument attractive in terms of BGI facilitation. The numerous applications of TDR for conservation/environmental purposes, especially in the US, present great potential for further empirical research on how that experience can be adapted for BGI projects that rely on land conservation.

4. The potential for Transferable Development Rights as an instrument to make room for blue/green infrastructure

4.1. How does TDR work?

TDR builds on the idea that property rights exist as a separable bundle of rights which can be transferred from areas where development is not favoured, “sending areas”, to designated areas of planned development, “receiving areas” (Kaplowitz et al., 2008; Nelson et al., 2012). Landowners in “sending areas” and “receiving areas” participate in the programme voluntarily or compulsorily, and settle agreements either through direct negotiation, through the mediation of the local government or through a bank. Once this is carried out, a conservation easement is registered with the property deed in the sending area which permanently limits or freezes the development of land, in fulfilment to the predefined planning goals (Pruetz, 2016; Fang et al., 2019). Fig. 3 shows how “receiving areas” in a TDR program can contribute to land provision for BGI in “sending areas”.

TDR originated in USA as a tool for transferring unused air rights between adjacent lots under 1916 New York City zoning ordinance.
Table 1
Summary of LVC instruments applied internationally.

| Instruments | Rationale (Alterman, 2012) | Type | Brief definition of the instrument | Types of projects financed | In site/off-site | Context | Type of solution |
|-------------|-----------------------------|------|-----------------------------------|----------------------------|----------------|---------|------------------|
| B. Dyca et al. | Community Land Trusts | Lewis and Turnbull, 2011; National Institute of Urban AI, 2016; Blanco et al., 2017; Grashafer et al., 2019 | Indirect Fiscal | CLB separates the private ownership of buildings from land ownership, with all the land becoming owned by a cooperative controlled by its residents. | Infrastructure (mostly transport/road network) | InSite | Existing urban area | Government Based Solution |
| | Property tax | (Merk et al., 2012; Smolka, 2015; National Institute of Urban AI, 2016; Blanco et al., 2017; Salm, 2017; Thiel and Wenner, 2018; Dye and England, 2019) | Direct Fiscal | A tax imposed by local government on the ownership or occupation of property. | It is usually not earmarked (can be used for different expenditures) | Both | Existing urban area | Government Based Solution |
| | Developer exactions and Impact Fees | (Peterson, 2008; Smolka, 2015; Blanco et al., 2017) | Indirect Fiscal | Developers required to install at their own expense internal/external infrastructure | Infrastructure | Both | Existing urban area | Government Based Solution |
| | Tax increment Financing/ Business Retention Strategy | (Merk et al., 2012; Muldoon-Smith and Greenhalgh, 2015; National Institute of Urban AI, 2016; Blanco et al., 2017) | Indirect Fiscal | Using the future flow of property tax increases generated by a public intervention to finance its costs | Urban Upgrading/Transformation | Both | Existing urban area | Government Based Solution |
| | Transferable Development Rights / Sale of Development Rights | (Stinson, 1996; Kaplowitz et al., 2008; Nelson et al., 2012; Pruett, 2016; Shahab et al., 2018, 2019; Skuzinski and Linkous, 2018; Fang et al., 2019) | Direct Property rights management | TDR separates the development value from the property and allows its transferring to another property. | Historic and Environmental Preservation, Flood Risk Management | Both | Land conservation | Market based solution |
| | Cooperative Land Banking | (Lewis and Turnbull, 2011; National Institute of Urban AI, 2016; Turnbull, 2017) | Direct Property rights management | CLB separates the private ownership of buildings from land ownership, with all the land becoming owned by a cooperative controlled by its residents. | Infrastructure | Both | Existing urban area | Government Based Solution |
| | Community Land Trusts | (Davis and Jacobus, 2008; Davis, 2014; Thompson, 2015) | Direct Property rights management | A non-profit organization formed to hold title to land to preserve its long-term residual value for affordable housing and other community uses | Social Housing | | | |
| | Land Redjustment/ Land pooling | (Needham and Hong, 2007; Smolka, 2013; Blanco et al., 2017) | Macro Urban Transformation | Allows reconfiguration of lots in a given area in accord with a plan that increases their value and provides the land necessary for public uses | New developments in periphery Slum upgrading Post-disaster recovery | InSite | New urban development/Urban redevelopment | Community based solution |
| | Land Acquisition and Resale/Active Land policy | (Munoz, 2016; Wolff and Sparks, 2010; Needham, 2016; Valtonen et al., 2017) | Macro Urban Transformation | Capturing the value created from acquiring private land, investing in infrastructure and selling the remaining land at higher prices | Infrastructure | InSite | New urban development/Urban redevelopment | Community and Government based solution |
| | Land Sharing | (Rabe, 2005, 2009, 2010; Véczels, 2016) | Macro Urban Transformation | Urban redevelopment and slum upgrading model through sharing of land between profitable developments and social housing for informal dwellers. A special form of capital revenue, which can be used to help finance general capital expenditures (usually related to new infrastructure) | Social Housing | | | |
| | Public land Management/ Sales | (Peterson, 2008; Suzuki et al., 2015) | Macro Asset management | Revenues generated from leasing of public land with | Transport/Road infrastructure | | | |
| | Public land leasing | | Macro Asset management | | | | | |

(continued on next page)
Over time, its application has diversified to tackle a variety of issues related to sustainable planning and growth management, providing an alternative to the inefficacy of direct government interventions, such as development control through zoning (Shahab et al., 2018, 2019; Skuzinski and Linkous, 2018; Hou et al., 2020). In legal systems with secure private property rights, such as the US, land conservation can result in either substantial burdens on public budgets to buy the land or compensate landowners for stripping of the property from its development rights, or it can escalate to a political backlash, if land conservation is carried out without compensation (Skuzinski and Linkous, 2018; Fang et al., 2019). Hence TDR presents an appealing alternative tool for public authorities, although sometimes it is depicted as an instrument which enables them to achieve planning goals without paying compensation and deflecting lawsuits (Kaplinsky, 2018; Fang et al., 2019).

Nevertheless, in principle TDR programs are not designed to intensify development but rather redistribute it based on more sustainable development models (Chiodelli and Moroni, 2016), while shifting conservation costs from one group of landowners to another, consistent with ‘polluter pays principle’ (Kaplinsky, 2018; Shahab et al., 2019). In this sense, TDR is classified as an LVC instrument since it balances property blight/ wipe-outs in “sending areas” resulting from planning restrictions with windfalls in “receiving areas”, by capturing some of the value increase resulting from zoning regulations (Smolka, 2013; Germán and Bernstein, 2018; Theilacker et al., 2019). To what extent TDR succeeds in capturing the land value increase depends on a variety of factors that have to do with its design, the market conditions, stakeholders involved and the timeframe during which this instrument is analysed.

Sending areas can be located in close physical proximity to receiving areas, as is the case with some TDR programs in New York (Giordano, 1987; Nelson et al., 2012; City of New York - Department of City Planning, 2015), or they can be located away from receiving areas, which is

| Instruments | Rationale (Alterman, 2012) | Type Brief definition of the instrument | Types of projects financed | In site/off-site | Context | Type of solution |
|-------------|---------------------------|----------------------------------------|---------------------------|-----------------|--------|-----------------|
| (Anderson, 2012; Guelton and Le Rouzic, 2018) | market prices can be used to cover infrastructure investment needs | |

Source: Table elaborated by authors, 2020.
usually the case with TDR programs that contribute to conservation of farmland and environmentally sensitive land (Linkous and Chapin, 2014). In the first case, the quality of sending areas, especially in the case of BGI as described in Section 1.2 (D’Acci, 2019) can contribute to the market potential of the receiving area. Hence, it is important to bear in mind that, while the value captured through a TDR program is mainly resulting from zoning regulations, including bonus densities, it could also be a windfall created by the BGI implemented in the ‘sending areas’.

4.2. Facilitating Blue/green infrastructure through Transferable Development Rights

Some of the first examples of TDRs utilized for land conservation for BGI are from the 1970s, such as New York Special Park District next to Tudor City and New Jersey’s preservation of Pine Barrens, a forest area containing also an aquifer (Skuzinski and Linkous, 2018). Up to date, more than 320 cities around the world have implemented TDR programs, 283 of which in US, while the rest in 11 other countries such as Australia, Brazil, Canada, China, France, India, Italy, Japan, Mexico, Spain, and the Netherlands (Pruetz, 2016). More than half of these programs were designed to address environmental challenges and protect natural resources (Nelson et al., 2012).

Although the experience with TDR programs for flood risk management is limited, such cases attest for the untapped potential of this instrument. Some coastal TDR programs, initially designed to protect the ecosystems of environmentally sensitive areas, have expanded their objectives to target adaptation to sea level rise. For instance, 13 out of 20 counties in Florida that have implemented TDR programs are coastal counties (Linkous and Chapin, 2014). Additionally, some US counties have utilized TDR programs for BGI provision in urban areas. The High Line project in New York is one example of how a major BGI can be implemented through the facilitation of TDR, with receiving areas located next to the sending area (City of New York - Department of City Planning, 2015). The High Line consists of a public park built on top of an abandoned elevated train line, the implementation of which was rendered possible through a TDR program, which unlocked the development rights of the sending area, namely properties underneath and immediately to the west of the high line, by encouraging their transfer to the receiving area, mostly focused on nearby Avenues 10 and 11, as shown in Figure 4 (City of New York - Department of City Planning, 2015) (Fig. 4).

The fast-growing region of Adams County in Colorado has approved a TDR program seeking to preserve its floodplain and habitat surrounding the South Platte River (Pruetz, 2011). The six defined receiving areas are located in parts of the county deemed suitable for hosting bonus intensities of development according to the County’s Development Standards and Regulations. Similar TDR programs aiming at tackling flood risk through land conservation and BGI have also been piloted in other areas around US such as the Hudson River Park Trust in New York (Fenton, 2018), American Fork City TDR program in Utah, Johnson Creek Basin Plan District in Oregon, Fort Washington Office Park in Philadelphia (Pruetz, 2011). Indeed, the US Environment Protection Agency has recommended TDR as a tool to facilitate coastal retreat zones by designating them as ‘sending areas’ (Titus, 2011).

4.3. Critical success factors

There is a growing body of literature presenting evaluations on the success degrees of TDR programs (Pruetz and Pruetz, 2007; Kaplowitz et al., 2008; Pruetz and Standridge, 2009; Shih and Chang, 2015; Fang et al., 2019), which mostly assess the fulfilment of predefined objectives of the program, usually by referring to the number of transactions and surface area of land conserved. Some authors have been sceptical on whether conformance-based evaluation approach is the best policy evaluation method, putting forward limitations of this approach in terms of side-effect and transaction costs evaluation (Mickwitz, 2012; Shahab et al., 2018). Hence this paper has covered an array of studies that both evaluate the success degree of TDR programs through a conformance-based approach and studies that reflect on side-effects, seeking to identify Critical Success Factors (CSF) of TDR programs. CSF concept refers to key factors necessary to reach specific goals (Oyebanji et al., 2017). Recurring themes/factors that come across literature as CSF for TDR programs include:

- **High Demand for bonus development.** The motivation to participate in the program should derive from extra benefit created for developers
quality of urban environments are becoming increasingly important factors, especially when it comes to residential areas, and they positively impact the real estate market, although the extent of this effect is very context related.

Second, the implementation of Blue/green Infrastructure projects remains stubbornly slow, granted their socio-economic and ecological added value, mostly due to increased land requirements that such infrastructure poses in comparison to grey infrastructure, as well as higher maintenance costs. By merging literature that is typically considered separately, such as literature on land markets on one hand and flood resilience on the other, this article highlights the potential that LVC instruments provide for access to land and funding, as well as the vast experience in using such instruments to finance road networks, transport or other types of infrastructure. To what extent LVC instruments can be employed to facilitate access to land and funding for BGI implementation? This research seeks to initiate this conversation by systematizing the body of knowledge on LVC instruments (Table 1), identifying the most adequate LVC instruments and highlighting the main factors to consider when evaluating the extent to which a LVC instrument can facilitate BGI implementation. The variety and degree of success of LVC instruments is diverse, and as such, it is important to carefully consider each instrument in the realm of a given context.

Transferable Development Rights, an LVC instrument with an emphasis on land conservation, can be an attractive instrument in terms of cross-subsidizing property windfalls, of the properties benefiting from zoning regulations, bonus densities or proximity to BGI and property blights of the landowners in properties where development shall be frozen to provide BGI. TDR requires attractive land markets to subsidize land conservation and perpetually freeze development for BGI provision. The positive impact that BGI has on land markets of the beneficial areas presents an incentive for such areas to be designated as receiving areas. Findings from an array of studies have informed a synthesized list of Critical Success Factors for TDR programs, which help address the second research question of this paper. Receiving areas can be designated to host additional development rights, should the carrying capacity of the area allow to do so. However, it is important to estimate the amount of additional development rights and their value and to balance them with the development rights to be transferred from the sending area. Nevertheless, Transferable Development Rights programs operate within specific legal contexts, in which the right to develop is part of the bundle of rights of property and is separable and transferrable. Without such legal embedding and without approaching development rights as a social construct, granted from the society to the individual landowner, the implementation of TDR for any purpose would be difficult, if possible, at all. Therefore, while TDR has the potential to be implemented for land provision scoping to mainstream BGI, further research should explore the legal, institutional implications that this entails as well as constantly contribute to identify CSF of TDR programs in the realm of BGI implementation.

CRediT authorship contribution statement

Besmira Dyca: Conceptualization, Methodology, Investigation, Resources, Writing - original draft, Writing - review & editing, Visualization. Kevin Muldoon-Smith: Methodology, Writing - review & editing, Supervision. Paul Greenhalgh: Methodology, Supervision.

Declaration of Competing Interest

The authors report no declarations of interest.

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