Uncertainty and multifunctionality: legal challenges and opportunities for "Green Infrastructure"

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Nature and its vital contributions to people, which together embody biodiversity and ecosystem functions and services, are deteriorating from the changes in land and sea use, overexploitation of animals, plants and other organisms, pollution and climate change. The anthropogenic changes in ecological systems have been so profound that scientists even warn that we have now entered a new geological period – "anthropocene". As we continue degrading our natural environment in order to gain ecological, economic and social benefits, the utilization of "nature-based solutions (NBS)" remains an underutilized option. "Green Infrastructure" (GI) concept and the implementation of GI emerges as a policy response to address and reverse the current rather counterproductive practice. The European Commission defines GI as a "strategically planned network of natural and semi-natural areas with other environmental features, designed and managed to deliver a wide range of ecosystem services ...". Yet, designing and implementing GI policy has proved challenging: e.g. how to safeguard sound and effective decision-making in managing complex systems with multiple stakeholders at various temporal/spatial scales, under conditions of uncertainty, with multiple conflicting interests? These and other questions in relation to GI design and implementation were discussed in April, 2020 during the "Woodnet" project (co-funded by the European Commission through Biodiversa) international interdisciplinary webinar "Uncertainty and Multifunctionality: Legal Challenges and Opportunities for GI" (administered by the Catholic University of Louvain (UCLouvain), Louvain-la-Neuve, Belgium). In the advent of a collective handbook and an international conference on the legal issues of GI design and implementation to be held in 2021, the present article contributes to the on-going discussions on uncertainty and multifunctionality and the associated legal challenges and opportunities in the context of GI design and implementation by discussing the relevant questions, raised during the recent webinar.

Keywords: Green Infrastructure, uncertainty, multifunctionality, connectivity conservation, precautionary principle, adaptive management, evidence-based approach, environmental law.

Неопределённость и мультифункциональность: правовые вызовы и перспективы «Зелёной инфрастурктуры»

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Природа и её жизненно важный вклад в развитие человечества истощаются из-за изменений в использовании земельных и морских ресурсов, чрезмерной эксплуатации животных, растений и других организмов, загрязнения окружающей среды и изменений климата. Антропогенные изменения в экологических системах настолько велики, что учёные предупреждают, мы входим в новый геологический период – «антропоцен». В то время как мы продолжаем истощать окружающую среду в экономических интересах и/или ради социального процветания, природные решения остаются мало использованными. Концепция «Зелёной инфраструктуры» и её имплементация приходят на выручку, как политическое и правовое решение, способное изменить эту губительную практику. Европейская Комиссия определяет, что «Зелёная инфраструктура» – это «стратегически спланированная сеть природных и полуприродных территорий с иными экологическими особенностями, разработанная и управляемая так, чтобы предоставлять широкий набор экологических услуг...». Однако в процессе разработки и имплементации права и политики в области «Зелёной инфраструктуры» возникает множество вопросов, на которые юристам ещё предстоит найти ответы. Например, такими вопросами являются: что такое неопределённость в правовом поле и с помощью каких юридических инструментов можно управлять неопределённостью? Эти и другие вопросы рассматривались в апреле 2020 г. в рамках международного междисциплинарного вебинара «Неопределённость и многофункциональность: правовые вопросы и перспективы «Зелёной инфраструктуры» (административное обслуживание вебинара осуществлено Католическим университетом Лювейна, Лювейн-ля-Нев, Бельгия, проект «Вуднет»). В преддверии проведения международной конференции по правовым вопросам в области «Зелёной инфраструктуры» в 2021 г. и в преддверии издания коллективной монографии, настоящая статья анализирует актуальные вопросы и предлагает типологию неопределённостей и три юридических инструмента, применение которых позволит управлять разными типами неопределённостей в правовом поле в области «Зелёной инфраструктуры».

Ключевые слова: зелёная инфраструктура, неопределённость, мультифункциональность, сохранение экологических связей, принцип предосторожности, адаптивное управление, экологическое право.

The idea of "utilizing the benefits of nature", inter alia, through linking natural areas and parks is not a new idea and the roots of "Green Infrastructure" (GI) can be traced back to the early 20th century (e.g. projects such as the "Boston Fenways" by F.L. Olmsted in the USA). Yet, the term "GI" is relatively new and flexible with no single definition. In general terms, GI is a network of green and blue areas (e.g. parks, green corridors, stepping stones, etc.), which can help societies address a variety of environmental, social and economic challenges in sustainable ways. GI is often contrasted to "grey infrastructure", i. e. human engineered infrastructures (e.g. a dam as a substitute for natural solutions to problems such as flood prevention), which provide for the same or even less durable services that nature can provide societies for free. GI is emerging as a solution to reverse the current rather counterproductive practice of utilizing expensive "grey infrastructures" and degrading our natural environment [1–3]. The challenge is, however, to design an enabling GI policy and implement it widely.

Research aims and research questions

Uncertainty, (e.g. uncertain science, linguistic uncertainty, social uncertainty, etc.) behind GI is one among other obstacles to the elaboration of a robust framework on GI and its implementation. "Uncertainty" refers to situations and/or outcomes, for which we lack information that we'd like to have. Uncertainty is not only about what we do not know, but also about what we do not know well, and what can evolve without us knowing how or when. Assuming that GI design and implementation will always be based on less than complete knowledge and uncertain science, reducing both our ability to make accurate predictions, regarding responses of species and ecological processes or/and to other changes across GI areas, including climate change, as well as our ability to perform all steps from design to implementation of GI (e.g. how to enforce a protection if habitats are not mapped? Or how to enforce a protection if a term in legislation is difficult to interpret?), this article, aims to contribute to the discussion on the highly complex question: how to manage uncertainty in GI design and implementation?

In particular, the article contributes to the discussions on the legal challenges and opportunities associated with "multifunctionality" in the context of GI design and implementation. Initially, GIs were designed and implemented for a single purpose. For instance, this is the case with the core of the EU GI – the "Natura 2000" network, which was initially designed and implemented for the pure nature-conservation purpose. Yet, today, a multifunctional GI seeks to combine different ecological, social, and economic functions. Contemporary GI design and implementation practices show greater diversity in GI concepts and objectives pursued, including biodiversity conservation and other ecosystem services provision, (e.g. "Grow green" project in Spain, which aims, inter alia, to deliver improvements in social, environmental, and economic performances of several cities). Yet, as of now there is no agreement of what an "ecosystem service" is. In general terms, the concept

may be defined as "benefits that people obtain from ecosystems, or their direct and indirect contributions to human well-being" (e.g. the provisioning services, such as food and water, regulating services, such as flood and disease control, cultural services, such as spiritual, recreational and cultural benefits, etc.). The ambiguities associated with the definition of "ecosystem services" make it challenging to apply the concept in a normative way – e.g. when valuing or managing a wide range of ecosystem services. In the context of GI design and implementation the important questions are: What does "multifunctionality" mean? What may the consequences for the shift of the focus from a "single purpose" to "multifunctionality" be for GI design and implementation? And, moreover, how to frame the trade-offs between biodiversity conservation and other ecosystem services provision into GI policy and law (e.g. biodiversity conservation and other ecosystem services provision sometimes conflict)? These questions, *inter alia*, were considered during the Woodnet Biodiversa project [5] Webinar "Uncertainty and Multifunctionality: Legal Challenges and Opportunities for GI", which took place on the 28th of April, 2020 (online, administered by the Catholic University of Louvain, Louvain-la-Neuve, Belgium) [6].

What is GI?

Alix Vollet, a PhD candidate from the Rennes University in France, deliberates on the challenges associated with defining the term "GI": "What is GI?" Although the question might seem easy, in practice no single definition of GI has been widely recognized. Even though there are common features between many of the existing definitions (e.g. connectivity, multifunctionality, smart conservation, aim to either protect or develop such projects, etc.), defining GI remains a great source of uncertainty. In 2013 the European Commission (the executive branch of the European Union, responsible for proposing legislation, implementing decisions, upholding the EU treaties and managing the day-to-day business of the EU) suggested a working definition of GI as a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services ..." [4]. Yet, the definition is too broad and Member States (MSs) find that the definition is "challenging to capture".

In May 2019, a Commission staff working document was published as a Guidance on the strategic framework for further supporting the deployment of EU-level green and blue infrastructure. The document aims at clarifying the definition and, *inter alia*, provides a very important precision that "the EU GI concept is a services-oriented one" [7]. Insofar as biodiversity conservation and provision of ecosystem services are not always compatible goals, and even sometimes conflicting ones, this precision is not trivial, especially since GI first emerged in the EU Biodiversity Strategy for 2020. GI can therefore be built with funding and effort dedicated to biodiversity conservation whereas it might not be the best way to reach that goal: in this context, GI would act as an "ecological trap" [8]. Finally, this definition is one of the reasons behind the report that MSs have not yet implemented GI to the extent needed.

Uncertainty: typology and possible legal responses

Dr Yelena M. Gordeeva, a post-doctoral researcher from the UCLouvain in Belgium deliberates on the "Types of Uncertainties and Possible Legal Responses". First, Dr Gordeeva discusses the knowledge needs in GI design and implementation (e.g. when the space is considered to be included into a GI meaning; when the ecosystem services are being valued; when connectivity conservation is being measured [9], etc.). Second, Dr Gordeeva suggests the typology of uncertainties in GI context, based on the typology by Gregory et al. [10]. Thus, in the context of GI design and implementation "Epistemic uncertainties" are particularly significant. These are uncertainties resulting from the lack of knowledge; these uncertainties reflect the limits of using scientific data to understand ecological processes and other parameters relevant for GI and its management (e.g. "Measurement Error", "Aleatory Uncertainties", "Parametric Uncertainties", etc.). "Linguistic Uncertainties" is the second major type of uncertainties, which can be encountered in the context of GI design and implementation. Uncertainties can be "Reducible" and "Irreducible". Uncertainties, depending on their type, may pose challenges and inspire resorting to the available legal tools for managing uncertainty in the process of GI design and implementation. Finally, the presentation suggested three possible alternatives for dealing with uncertainties in GI context, namely: the "Precautionary approach" [11, 12], the "Evidence-based approach" and the "Adap-

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tive management" [13]. Further research may include such questions as compatibility of the three approaches and the compatibility of the three approaches and legal principles (e.g. the principle of legal certainty).

US GI policy

Professor dr J.B. Ruhl from the Vanderbilt University, Nashville, Tennessee, USA, in his presentation "Beyond Stormwater: Moving US GI Policy to the Ecosystem Services Framework", illustrates that the approaches the US and EU have taken to urban GI have differed in important respects, but face many of the same challenges. The United States and European Union have both pursued policies to promote urban GI. Cities rely on GI outside their urban boundaries to provide important regulating ecosystem services such as groundwater recharge, sediment control, and water purification, as well as provision of and access to provisioning services (e.g., food) and cultural services (e.g., recreation). Cities also can promote GI within their urban boundaries to deliver a broad array of ecosystem services, including local services such as temperature regulation and air purification. In the US, the primary focus of urban GI policies has been on provision of GI to manage stormwater. By contrast, the EU's 2013 policy on GI embraced a more multifunctional vision of the ecosystem services GI can provide [13]. Consequently, research on urban GI has increased impressively in the EU, including at scales relevant to local policy making.

Professor dr J.B. Ruhl describes the background of urban GI, the US and EU policy emphases, and the questions and challenges that continue to require further research and deliberation. There is a need to continue to "downscale" biophysical and social science research to assist local decision makers. Regulating services such in particular present difficult challenges given their public good nature (lack of markets). Cities are dynamic systems requiring adaptive polices. And the goals, costs, and distribution of GI services and disservices must be established.

Adaptive management in Canadian natural resources law and policy: lessons for EU GI policy and implementation

"Adaptive Management in Canadian Natural Resources Law and Policy: Lessons for EU GI Policy and Implementation", a presentation by Associate Professor dr M. Olszynski (Calgary University, Canada) shares the Canadian experience with adaptive management [18] with a view towards identifying the opportunities and challenges for its incorporation in European Union (EU) GI policy and implementation. Much has been written in both Canada and the United States about adaptive management in the past two decades. Broadly understood as an iterative approach to environmental problems wherein management actions are designed as experiments with a view towards learning, adaptive management's implementation in Canada, as elsewhere, has been described predominantly as lacking in rigour – what leading U.S. scholars have termed "adaptive management lite". A recent review of the Canadian forestry and energy resource sectors confirms long-standing concerns: varying conceptions, including as a routine strategy that guarantees positive environmental outcomes; insufficient attention being paid to experimental design; and no or incomplete implementation. Adaptive management is also often misused to circumvent related regulatory requirements.

If adaptive management is to play a role in EU GI policy and implementation, serious consideration should first be given to the development of an adequate regulatory and policy framework. Examples of such frameworks have been proposed in both Canada and the United States and should provide a useful starting point for the discussion.

Forest ecosystems as a key element of EU GI: policy implementation and effectiveness

"Natura 2000 [16] and Forests in EU-28: Policy Implementation and Effectiveness", a presentation by an Associate Professor dr Metodi Sotirov (University of Freiburg, Germany), shows that forest ecosystems represent a key element of Natura 2000 network of protected areas based on the EU Habitats and Birds Directives and serving as one of the main instrument of GI in the EU [17, 18]. This is as 50% of Natura 2000 is designed in and/or depend on forest ecosystems. An integrated approach towards nature conservation and land use (e.g., forestry, agriculture) is expected to restore habitats and species and/or to keep them at a favourable conservation status.

However, the scientific and experts knowledge about Natura 2000 effectiveness shows that the majority of habitats/species are in unfavor-

able conservation status, and that effective management plans and measures are lacking. Yet, some best practices of Natura 2000 conservation in forests do exist. The effective forest habitats and species conservation under Natura 2000 depends on appropriate implementation across the EU-28 and has to consider also climate change, nitrogen emissions and forestry operations. Despite legal provisions about ecological connectivity, the Natura 2000 still needs to be further developed and managed as a connected, flexible network that can cope with climate and land use changes.

In order to make further progress, three key challenges need to be tackled. First, *ideological* and *information* challenges have to be addressed by improving communication between authorities and between them and stakeholders, and spelling out both win-win situations for and actively managing trade-offs between nature conservation and forest management practices. Second, *economic* interest-based challenges are to be tackled by encouraging co-funding from all administrative levels, and from nature conservation and agriculture/forestry sectors geared towards the effective provision and use of compensation payments to support conservation objectives, and sustainable forest use where appropriate and compatible with nature conservation. Last but not least, *institutional* challenges in Natura 2000 implementation in forests have to be tackled by improving the cross-sectoral policy integration and by strengthening coordination between the nature conservation and the forestry/land-use sectors.The positive effects of Natura 2000 in forests can be improved with appropriate application of Natura 2000 policy, integrated/adaptable site management and (re-)designation to allow species and habitats to remain despite changes, and creating safeguards towards meeting conservation objectives. This needs to go hand in hand with the involvement of forest managers/owners and nature conservationists in setting conservation objectives and assessing conservation status and understanding and managing the trade-offs between forest ecosystem goods and services and Natura 2000 management objectives.

GI in EU policy

"Working with Nature, rather than against it: GI in EU Policy", a presentation by Mrs Karin Zaunberger (Directorate General Environment, European Commission) discusses several concepts, which aspire to work with nature rather than against it. All are based on the principle that ecosystems in healthy condition deliver multiple benefits and services for human well-being and can thereby address economic, social and environmental goals simultaneously. Depending on their context, these activities are framed as Green Infrastructure (GI), Ecosystem-based Adaptation (EbA), Ecosystem-based Disaster Risk Reduction (EcoDRR), or Natural Water Retention Measures (NWRM). The term nature-based solutions (NbS) is used as an umbrella term.

Over the last decade EU has adopted several policy instruments and guidance documents relevant for GI. These include a dedicated Strategy on Green Infrastructure [4], and the follow-up documents such as the recent EU Guidance document on a strategic framework for further supporting the deployment of EU-level green and blue infrastructure [7], which encourages a more strategic and integrated approach to scaling-up investments in EU-level GI projects. The European Green Deal [19] covers a range of initiatives for which the deployment of GI is important: EU Biodiversity Strategy 2030 [20], Farm to Fork Strategy [21], Climate Law [22], etc.

Concluding remarks

To sum everything up, "GI" is a policy solution, which can help societies address a variety of environmental, social and economic challenges in sustainable ways. Yet, it is challenging, to design an enabling GI policy and implement it. Among other legal challenges and opportunities for GI design and implementation are the uncertainty behind GI and its multifunctionality. The article suggests the different types of uncertainties, which may be encountered in the process of GI design and implementation. Acknowledging that uncertainties exist – is the first step towards managing uncertainty in the context of GI design and implementation. The second step is – identifying the type of uncertainty. The present article suggests that the two major types of uncertainties in GI design and implementation context may be: "Epistemic Uncertainties" and "Linguistic Uncertainties". Identifying the types of uncertainties is important as it allows selecting an approach to manage it. The article suggests that the possible legal approaches to uncertainty management in the context of GI design and implementation may be: the precautionary principle, the adaptive management (e.g. Canadian experience), and the evidence-based approach.

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To conclude, the article contributes only to the beginning of providing answers to such complex questions as: what is GI? What are the types of uncertainties in the context of GI design and implementation and how to manage the uncertainties with the available legal tools? What is "multifunctionality" and what may the consequences be for the shift of the focus from a "single purpose" to "multifunctionality" in the context of GI design and implementation? And, moreover, how to frame the trade-offs between biodiversity conservation and ecosystem services provision into GI policy and law (e.g. biodiversity conservation and other ecosystem services provision sometimes conflict)? The research on the questions continues, including, *inter alia,* the agreement of the "Woodnet" webinar participants on the need to issue a collective handbook and to hold an international conference on the legal aspects of GI design and implementation in December, 2021 [24].

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