

Article

Holistic Business Model Conceptualisation—Capturing Sustainability Contributions Illustrated by Nature-Based Solutions

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Abstract: Businesses are under pressure to increasingly consider sustainability as an integral part of the enterprise and business model. Nature-based solutions (NBS) definitions reflect that sustainability can be improved by implementing NBS. These NBS require tailored business models. Therefore, this study aims to conceptualize a holistic business model canvas capturing the sustainability contributions of NBS. Methodically, the new Canvas is proposed based on an extensive literature review, and the application and testing are carried out on NBSs implemented in the proGReg project's three European Living Labs. As a result, by building on the Business Model Canvas (BMC) by Osterwalder and Pigneur as well as various modifications to capture the core concepts of sustainability and NBS, a new BMC for NBS is proposed—the nature-based sustainability Business Model Canvas (NB S BMC). It consists of 14 building blocks and offers a holistic overview of NBS business models considering the multi-faceted character of NBS. The case studies show that the NB S BMC can be applied to different contexts independently of their location and content orientation. Although this study development puts an emphasis on NBS, it can also be applied to capturing sustainable business models beyond the NBS domain.

Keywords: business model innovation; business model canvas; sustainability; performance; nature-based solutions; green entrepreneurship



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1. Introduction

Throughout the past years, the debate about concepts for more sustainable and cost-efficient land use management has shifted from ecosystem-based approaches to nature-based solutions (NBS) [1,2]. This debate covers different arenas, namely (a) blue and green infrastructure, (b) urban, peri-urban, and rural, and (c) ecological, social, and economic dimensions to tackle the pivotal societal challenges of climate change, loss of biodiversity and maintaining human health and well-being. The European Commission defines NBS as “solutions inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social, and economic benefits and help build resilience. Such solutions bring diverse nature and natural features and processes into cities, landscapes, and seascapes through locally adapted, resource-efficient, and systemic interventions. Nature-based solutions must, therefore, benefit biodiversity and support the delivery of a range of ecosystem services” [3]. The number of publications about NBS, on the one hand, and case-specific NBS implementations, on the other hand, has significantly grown throughout the past years. However, a growing debate exists about the concept's concrete contributions to ecological, social, and economic challenges [4].

Nevertheless, to the best of the authors' knowledge, there is no general and comprehensive concept which enables them to assess these contributions holistically. Therefore, developing a general evaluation concept to elaborate on the respective contributions of present and future NBS is crucial. To elaborate on the respective contributions of NBS, its

structures and activities need to be analysed in a holistic and clear manner. This could be achieved through business models, for whose concretization and analysis several methods have been deployed in the literature.

A prominent method is the Business Model Canvas (BMC) by Osterwalder and Pigneur [5]. The BMC focuses primarily on the economic objectives of private businesses, while NBS is often characterized by additional societal and environmental benefits, various stakeholder involvements, governance models and organizational structures, and diverse financing and funding models. Additionally, considering the multi-faceted character of NBS when capturing its business models could make a substantive contribution to future NBS studies. Therefore, this study aims to develop a holistic concept to capture and evaluate business models of sustainable NBS.

Generally, businesses are under pressure to increasingly consider sustainability as an integral part of the enterprise and business model [6]. This resulted in modifications of the traditional BMC by adjusting or adding the strategic management tool valuing sustainability dimensions prominently [6,7]. NBS is defined to be “cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience” [3]. This reflects that many sustainability dimensions can be improved by the implementation of NBS. These NBS require tailored business models to be described in an NBS-specific Business Model Canvas reflecting NBS definitions’ key elements.

The more holistic and often not primarily profit-oriented implementations of NBS require a thorough rethinking of the original BMC and its modifications. Therefore, a conceptualisation of a holistic business model canvas capturing the sustainability contributions of NBS is approached in this study. Methodically, the new Canvas is proposed based on an extensive literature review, and the application and testing are carried out on NBSs implemented in the proGReg project’s European Living Labs. For these three case studies, personal, on-site interviews were carried out with the key responsible persons for the NBS to go through all 14 building blocks. The interviews took place in winter 2022/23.

The new bundling nature-based sustainability Business Model Canvas (NB S BMC) enables the capture of business models of NBS and other sustainability-oriented green infrastructures comprehensively and holistically for the first time. The NB S BMC integrates BMC modifications from proGReg’s sister projects, Connecting Nature, Urban Nature Labs and Nature4Cities, as well as the Sustainable BMC from Gerlach [8] into the original BMC to make use of their synergies to capture NBS’ business models as holistically and multidimensional as possible. To make this new canvas concept usable for a wider audience, a detailed list of guiding questions is provided for each of the 14 building blocks. The proposed NB S BMC allows wide applicability from profit-oriented NBS enterprises over social enterprises to public NBS.

In the following chapters, the brief introduction of the proGReg project is followed by providing an overview of business model thinking. The methodology is explained in detail before presenting the strategic management template BMC from Osterwalder and Pigneur [5] and modifications to consider sustainability and NBS in analysing activities better. The BMC modifications, nonetheless, do not allow holistic overviews and the evaluation of NBS using a business model approach, so a new expanded template is developed. The newly designed NB S BMC is presented in detail, along with detailed guiding questions for the building blocks. Applying the concept to three case studies is tested and discussed as to why this new tool is needed and of additional value for stakeholders’ use.

2. Context and Previous Research

Several EU initiatives, especially the Biodiversity and Green Infrastructure strategies and the Thematic Strategy on Urban Environment, highlight the key role of urban areas in fulfilling the Sustainable Development Strategy of the EU. Thus, a series of EU-funded projects, like proGReg, focus on the planning, developing, and testing of NBS in cities and wider metropolitan areas. Expert groups of scientists and other stakeholders highlight the

required bridge between social and economic interests and the need for multi-stakeholder engagement to promote new green, sustainable and resilient economies, green jobs [2,9], and the assessment of ecosystem services' economic value [10,11]. A statement on the proGReg website also reflects this: "Nature-based solutions have huge potential to address technical, social and economic challenges and to make urban transformation work with and for citizens" [12].

2.1. ProGReg

The EU-funded Horizon 2020 project proGReg—productive Green Infrastructure for post-industrial urban regeneration—uses nature for urban regeneration with and for citizens [12]. Under the slogan "nature for renewal", proGReg plans, develops, implements, and simultaneously assesses eight different NBS in four Front Runner Cities. Dortmund (Germany), Turin (Italy), Zagreb (Croatia), and Ningbo (China) disclose Living Labs in which the NBS are spatially clustered. These eight NBS create productive green infrastructure following a co-creation process of local citizens, governments, businesses, NGOs, and higher education. The project aims to create a real impact by improving living conditions, reducing vulnerability to climate change, and providing economic benefits in and for post-industrial, deprived urban areas. Considering the project partners' expertise, capacities, and further resources, not all eight NBS are implemented by all four Front-Runner Cities, but several per city (see Table 1).

Table 1. List of implemented NBS in the four Front-Runner Cities.

NBS	Dortmund	Turin	Zagreb	Ningbo
NBS 1: Leisure use and energy production	x			
NBS 2: New regenerated soil		x		
NBS 3: Community-based urban farms and gardens	x	x	x	x
NBS 4: Aquaponics	x	x	x	
NBS 5: Capillary Green Infrastructure on walls and roofs		x	x	
NBS 6: Access to post-industrial sites and renatured river corridors	x	x	x	
NBS 7: Protocols and procedures for environmental compensation		x	x	x
NBS 8: Pollinator biodiversity	x	x		

"x" means that the NBS is implemented in the City.

In addition to the social and environmental benefits, the project aims to integrate the tested NBS into—at least partly—self-sustaining business models. The diverse backgrounds and objectives of involved partners and the very diverse nature of the considered NBS ask for tailored organizational structures and business models. These business models go beyond traditional entrepreneurial business models, aiming primarily for profitability. Among others, they cover organizational structures of social enterprises, charitable organizations, inter-public cooperation, public-private partnership models and new green entrepreneurship. Thus, a new way of capturing the rationale of NBS business models is required and proposed in this paper. In preparation for this, the following chapter provides a concise overview of business model thinking.

2.2. Profit-Oriented Business Model Thinking

The first appearance of the term business model dates back as late as the 1960s, but the concept and ideas of business models have only risen more widely since the 1990s [13,14]. Yet, the wider business model thinking and use of business model tools is relatively young, with a peak shortly after the millennium web hype [15]. In a first straight-forward approach considering the two terms 'business' and 'model' individually, Osterwalder defines business models as "a representation of how a company buys and sells goods and services and earns money" [13] (p. 14).

Yet, there is more to discuss when using business model thinking. Business model thinking follows a holistic approach towards explaining how firms do business on a system

level. Organizational activities play an important role in the various conceptualizations of business models, which seek to explain how value is created and captured. The main idea behind this is to capture the core components of a business or organization to understand how it is functioning and who is offering what for whom. The identification of the ‘who’, ‘what’, and ‘how’ are essential when analysing business models [14], e.g., who are the target groups and customers, what are their needs, what is the company’s value proposition to the targeted customers, and how is the company configuring its business. “Business models describe, as a system, how the pieces of a business fit together” [15] (p. 6). Several definitions and interpretations exist on the meaning of business models. Two well-known and often cited definitions are, firstly, “business model describes the rationale of how an organization creates, delivers, and captures value” [5] (p. 14) and, secondly, “the business model explains how value is created for the customers and how value is captured for the company and its stakeholders” [14] (p. 31).

Examples of business models are detectable with a simple web search; they are, for instance, and among others, called premium, auction-based, niches, subscription, direct sale, peer-to-peer, multi-sided platform, leadership, personalized, bulk production, online-based, diversification, cost-reduction, hidden, etc. This list is only supposed to demonstrate the level of business models and the various approaches on how to name and classify them—in accordance with the varying analysers’ objectives when setting up the business model approach.

2.3. Holistic Business Model Thinking

While the business model thinking and tools are primarily designed for and used by profit-maximizing or at least profit-oriented businesses, an increasing number of projects, networks, and studies match business model thinking with entrepreneurship [16], ecosystem services [17], Life Cycle Thinking [18] sustainability [19–23], circularity concepts [24] and NBS [25]. The latter one on NBS is detailed further hereafter only.

Since the late 2010s, EU research and innovation projects have contributed significantly to the growing knowledge of NBS business models [26]. The COVID-19 pandemic has accelerated the implementation of NBS, presenting local governments with budget allocation challenges. Despite increasing project implementations demonstrating the multifunctionality and cross-sectoral benefits of NBS, public budgets for NBS investments often remain insufficient to facilitate their mainstream adoption [26]. Several studies, including those by Bockarjova [27], Jacobs [28] and Croci [29], evidence the monetary as well as non-monetary values of nature and NBS. However, a significant gap remains between articulating the value of nature and finding stakeholders willing to financially support the physical implementation, maintenance, and evolution of NBS [26]. Another critical aspect is the predominant focus on the investment phase alone. Generally speaking, (the majority of) NBS increase in value over time but require ongoing funding for operational or management costs, unlike grey infrastructure, which—fiscally speaking—depreciates over time. Generating financial income is, therefore, key to ensuring the sustainability, development, and expansion of NBS. Furthermore, it is crucial to consider a long-term horizon, which means that grey infrastructure must be demolished and rebuilt or at least to be reconstructed after its lifetime. Instead, green infrastructures, on the one hand, require ongoing maintenance, but, on the other hand, can exist and evolve over generations, e.g., food forests, often with increasing returns over time, here in the example of food forests, the fruit harvest.

The EU project Naturvation has developed a business model catalogue for urban NBS, presenting eight business models based on their project-specific approach [30]. According to Naturvation [31], implementing NBS depends on creating favourable policy conditions, securing financial resources and developing business models to ensure long-term sustainability. NBS often generate a complex array of public and private benefits, making it difficult to capture and realise their values in quantifiable terms. Their business model approach emphasizes four main building blocks: value proposition, value delivery, value capture,

and enabling conditions and risks. Based on Naturvation's experience, the catalogue proposes eight NBS business models: risk reduction, green densification, local stewardship, green health, urban offsetting, vacant space, education, and green heritage [30].

Further research also proposed tools and templates to capture NBS business models [25,32–34]. Depending on the projects' objectives and researchers' backgrounds, different elements are highlighted. All modifications concentrate on the simplification or addition of different, individual building blocks. Therefore, the need to conceptualise a holistic business model canvas capturing sustainability contributions based on these diverse earlier BMC modifications can be derived. In that regard, the modifications of the BMC with NBS-tailored building blocks are detailed below to substantiate the proposed holistic NBS BMC.

Nature-based enterprises (NBEs) have emerged as a concept that integrates the nature-based perspective of interventions with their activities' business dimension [35]. This includes new green and sustainability-targeted entrepreneurship and a start-up milieu. NBEs use nature as a core element of their product/service offering by directly using, growing, harvesting, or restoring natural resources sustainably or contributing to the planning, delivery, or management of sustainable NBS. NBEs cover a wide range of types, including (a) ecosystem creation, restoration and management; (b) green buildings, such as living green walls and roofs; (c) public and urban spaces, such as urban forestry and gardens; (d) water management and treatment, including wastewater management, (e) sustainable agriculture and food production, such as agroforestry, beekeeping and regenerative agriculture, (f) sustainable forestry and biomaterials, and (g) sustainable tourism, health and well-being, including agri-tourism, ecotourism and nature-based tourism. In addition, NBEs can indirectly use nature and its features and values by providing financial services related to carbon offsetting, natural capital accounting and investment for biodiversity and conservation. Indirect use of nature and its features and values can also be found in smart technologies, monitoring and assessment, education, research and innovation activities, and advisory services [35].

3. Materials and Methods

This study contributes to the before-identified need for the conceptualisation of a holistic business model canvas capturing the sustainability contributions of nature-based solutions. As introduced in the previous chapter, there are already existing modifications of the original BMC from Osterwalder and Pigneur [5], which capture these added contributions partly but not holistically. Therefore, a new BMC needs to be conceptualised that summarises the advantages of these modifications into one concise strategic management Canvas. In this regard, the methodological approach of this study is divided into four steps:

Firstly, a new strategic management Canvas for NBS is proposed. Methodically, this is conducted via an extensive literature review: After briefly introducing the original BMC (see Section 3.1) and its modifications (see Section 3.2), the nature-based sustainability Business Model Canvas (NBS BMC) is proposed (see Section 4.1) to fill the gaps of holistically describing business models of NBS and other sustainability-oriented green infrastructure. While other modifications often only concentrate on the simplification or addition of individual building blocks, this NBS BMC aims to cover the full picture of business models, including values, governance, the two main target groups of customers and beneficiaries, the NBS infrastructure, but also four distinct financial elements as well as the wider societal and environmental impacts of NBS.

Secondly, the first part of guiding questions for the NBS BMC building blocks, adapted from the original BMC from Osterwalder and Pigneur [5], are presented (see Section 4.2). Based on the literature, the questions are formulated for NBS in a broader sense, going beyond companies aiming for profit maximization.

Thirdly, the proposed NBS BMC and the first part of guiding questions were implemented in three case studies. This application and testing of the NBS BMC were carried out in the three European Front-Runner Cities of the proGReg project, namely Dortmund,

Turin, and Zagreb. In each of the three cities, one NBS was selected based on the NBS development and stakeholder engagement. Personal, on-site interviews were carried out with the key responsible persons for each NBS to collect information for all 14 building blocks. For the building blocks of the original BMC, the derived guiding questions were used, and the other building blocks were interviewed explorative. Structuring content analysis operationalized via the NB S BMC template was used to analyse the interviews. The interviews took place in winter 2022/23. The results are presented in Section 4.3.

Fourthly, based on the explorative results of the case studies, guiding questions for the added building blocks in the NB S BMC were developed and finalized. This was done to provide a detailed list of guiding questions for all building blocks of the new NB S BMC, which makes this new strategic management canvas usable for a wider audience. The proposed guiding questions are presented in Section 4.4.

3.1. Business Model Canvas

To facilitate the understanding of business models without oversimplification, several tools have been developed. These tools present business models from a comprehensive perspective. A prominent tool in this regard is the BMC introduced by Osterwalder and Pigneur [5]. The BMC has gained widespread recognition as a strategic management framework that provides a condensed overview of the operational aspects of a company or organisation. Osterwalder, Pigneur and a group of 470 practitioners from 45 different countries published ‘Business Model Generation’, a comprehensive guide to the intricacies of the Business Model Canvas. The BMC serves not only for documenting existing business models but also for developing and visualising innovative business ideas. By providing a holistic view, the BMC facilitates the identification of key success factors, the detection of barriers, the comparison of competitors, and the generation of business ideas and innovations in its preparatory phase. The BMC consists of four primary components: customers, offer, infrastructure and financial viability, which allows for assessing the desirability, feasibility and viability of business ideas or developments. The BMC consists of nine basic building blocks (see Figure 1).

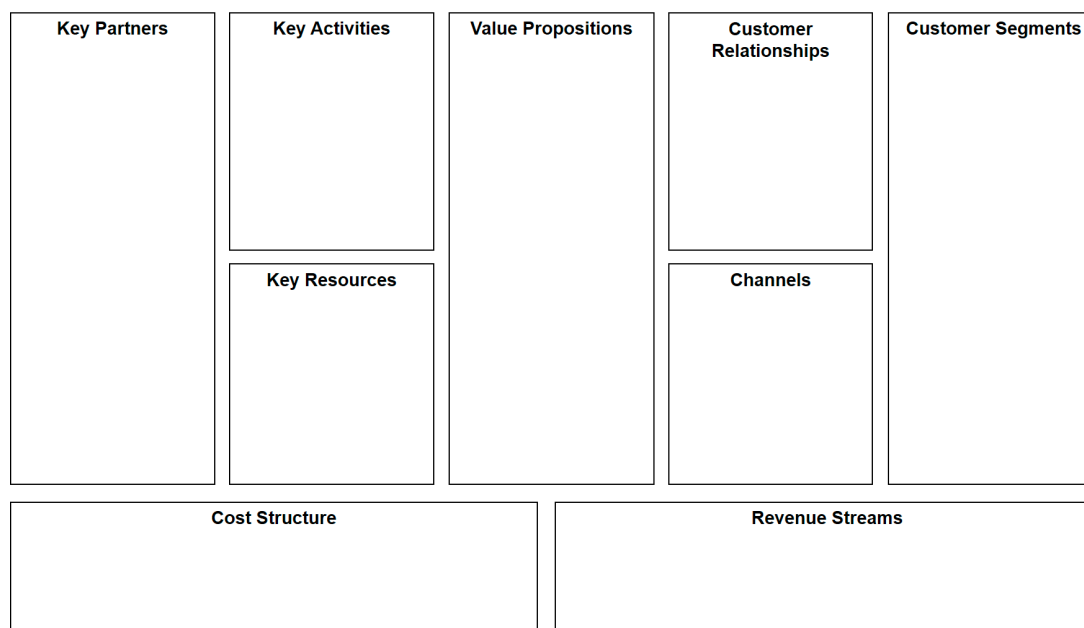


Figure 1. The original Business Model Canvas (BMC) from Osterwalder/Pigneur (2010) [5].

While the aspects addressing the customers (customer segments, customer relationships, channels) fill the right part of the Canvas, the offer is positioned centrally (value proposition), the infrastructure dimension to the left (key resources, key activities, key

partners), and the financial viability is derived from the two bottom building blocks cost structure and revenue streams. When being used for or by profit-oriented businesses, the BMC supports the derivation of strong statements on how value is created for the customers and captured for the company offering the values. Many sustainability-oriented initiatives and NBS implementations go beyond profit-orientation but, in contrast, focus on social or environmental objectives. This pushes the economic objectives to the back, while primarily, non-economic objectives prevail. Apart from financing created and offered values, which are not economically viable by themselves (including public money, grants, crowdfunding, sponsorships, etc.), these more holistic and not-for-profit implementations require a thorough rethinking of the BMC. This has already been done by several scholars (see below). The modifications include, among other aspects, the widening beyond customers to target groups or beneficiaries and the integration of intangible values, e.g., community building, biodiversity upgrade, inclusion or other social or environmental benefits. Furthermore, the management is often no longer in the hands of businesses but cities and other public entities, associations, communities, or individual citizens. To depict these alterations from business-as-usual businesses, modifications of the original BMC emerged.

3.2. Modifications of the BMC towards Sustainability and NBS

The original BMC developed by Osterwalder and Pigneur focuses primarily on businesses and associated aspects. To incorporate the sustainability dimension, one approach is to integrate it into the original BMC under the value proposition component. For example, Ferranti and Jaluzot [36] use this BMC to improve the impact of green infrastructure valuation tools. However, to better reflect holistic thinking and sustainability dimensions, various modifications and adaptations of the original BMC have been developed since the 2010s.

One such adaptation is the Triple-Layered Business Model Canvas, which dedicates individual layers to the three sustainability dimensions: economic, environmental, and social [37,38]. The economic layer maintains one-to-one with the original BMC. The environmental and social layers retain the same structure of nine blocks. Released after three years of research, design, development, and testing, it ensures not only horizontal but also vertical coherence within each, but more importantly, between the layers. In the social layer, the social value, governance, employees, end users, and local communities are among the building blocks to consider when using the triple-layered BMC. The environmental layer allows the users to concentrate on supply and outsourcing, production and materials, end-of-life, distribution, and use. Additionally, the two layers allow highlighting the benefits, socially and environmentally.

Another two adaptations highlight sustainability: The Sustainable Business Model Canvas by Cardeal [39] and the sustainable business model Canvas proposed by Gerlach [8]. This template aims to incentivise sustainable product and business model design by placing greater emphasis on all aspects relevant to holistic business model design, including economic, environmental, and socio-cultural aspects. In addition, Salwin [40] modified the original BMC to use it in the design and classification of product-service system design methods.

With the emergence of NBS projects and applications in various European cities, business model tools tailored explicitly to NBS have emerged likewise. All these new tools and templates to capture the BM of various NBS implementations have in common that they follow an explorative approach. The projects' Living Labs are used to develop and test the tools in an applied manner. Two EU projects that prominently integrate business models into NBS activities—Connecting Nature (<https://connectingnature.eu/> (accessed on 10 June 2023)) [41] and Naturvation (<https://naturvation.eu/> (accessed on 10 June 2023)) [42]—contributed significantly to the upcoming topic of NBS business models. The Connecting Nature approach modifies the original BMC while retaining its core concept and structure (see further below). As already introduced earlier on, Naturvation aggregates the business model debate for NBS to four main elements: value proposition, value delivery, value capture, as well as both enabling conditions and risks [30]. This allows

emphasizing these elements, but at the same time, loses information compared to other tools and templates.

Another EU project, Natur4Cities (<https://www.nature4cities.eu/> (accessed on 10 June 2023)) [43], developed and proposed another BMC modification tailored to NBS. This new template called the WHAT-WHO-HOW framework, puts a special emphasis on the NBS' governance, benefits, and beneficiaries [25]. The diamond model [34] was developed to capture business models of food production in urban landscapes. These urban food initiatives are a widely applied NBS in European cities. Like the Naturvation approach, value capture and value delivery build core elements of the model. It is designed in a way which is not restricted to commercial organisations but all governance models implementing urban food initiatives or other NBS.

4. Results and Discussion

4.1. Business Model Canvas: Synthesis for Nature-Based Solutions

Building on the original BMC [5] and the above-introduced modifications to capture the core concepts of sustainability and NBS, a new BMC for NBS is proposed—the nature-based sustainability Business Model Canvas (NB S BMC). This strategic management template bundles together experiences from earlier works in this field without over-complicating the easy-to-use original BMC tool. The NB S BMC consists of 14 building blocks instead of nine blocks compiled and ordered in the original BMC (see Figure 2). All building blocks of the original BMC remain in the newly proposed NB S BMC, which is coloured white in Figure 2. The only differentiation is the aggregation of the two components of customer relationships and channels into one building block. This reflects the clear economic dimension or even focus many NBS entail, e.g., nature-based enterprises (see before). This aim of developing at least partly self-sustaining business models is often under-represented in other modifications of the BMC in favour of non-business-oriented building blocks. For allowing appropriate consideration of NBS core principles, further building blocks are added and positioned accordingly. This offers a holistic overview of NBS business models considering the multi-faceted character of NBS.

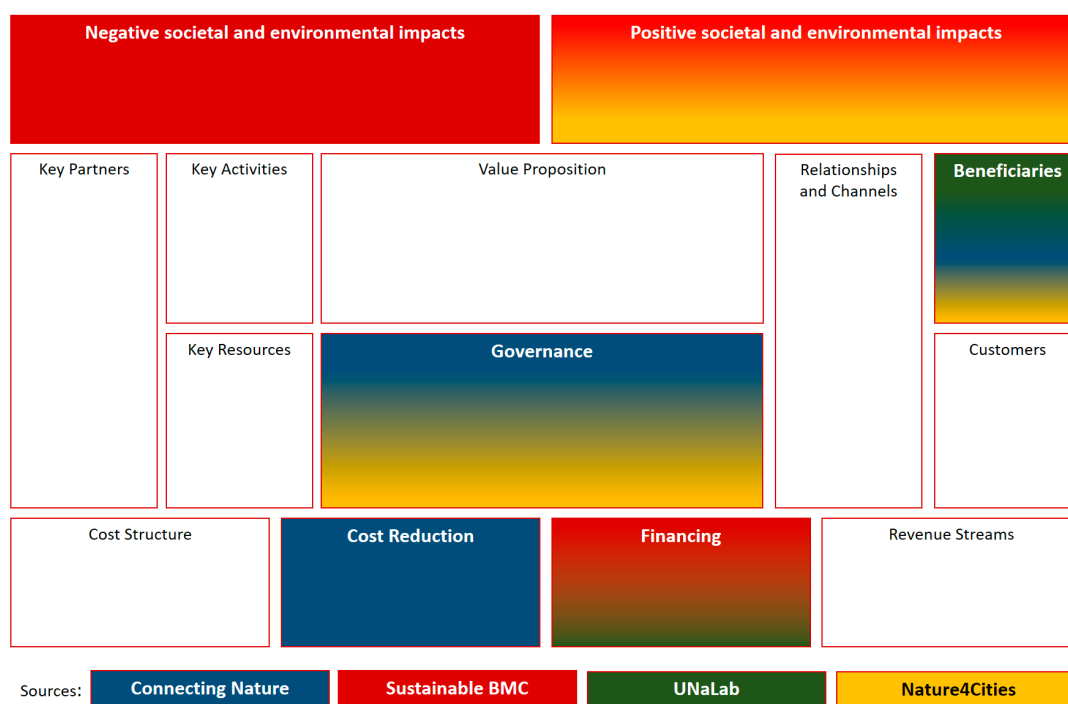


Figure 2. The NB S BMC highlights the integration of building blocks from the original BMC and other BMC modifications towards sustainability and NBS.

The focal point of the template remains the value proposition, which presents the core value created by the implemented NBS. These values can cover both tangible (goods and services) and intangible values. As already applied by Connecting Nature and Nature4Cities, NBS governance plays a key role. Thus, it is positioned centrally below the value proposition. Unlike private businesses, the governance of NBS is more diverse, including a set of stakeholder groups providing good reasons for implementing it as a separate and centrally positioned building block with the business model visualization. Governance summarizes the organizational structure and decision-making policies, including ownership, cooperatives, and private, not-for-profit organisations [44].

Furthermore, internal organizational structures, like hierarchy [45] and decision-making policies regarding transparency, profit sharing, non-financial criteria, and consultation [46], are relevant under governance. This addition of the building block governance respects that a wide array of stakeholders take responsibility in the planning, implementation, and maintenance or evolution of NBS—municipalities, but also other public entities (e.g., universities, research institutes, . . .), associations, community groups, but also businesses, including NBE and start-ups. These two building blocks define the offer (value proposition) and the organizational layout (governance) of NBS business models.

The two main target groups of NBS implementations, customers and beneficiaries, are positioned on the right-hand side of the Canvas, along with their relationships and channels between the value proposition/governance and customers/beneficiaries. Customers are individuals, groups or entities that pay for the value offered (value proposition), while beneficiaries do not pay monetarily for obtained NBS values. NBS are very diverse and thus provide values for different target groups, which is reflected here by these two building blocks. While some NBSs focus on customers, many NBSs provide value to (a large group of) beneficiaries. Accordingly, the lower part of the template distinguishes between two primary means of generating funds for the maintenance, development, and cost recovery of the NBS: revenue streams and financing. Revenue streams represent the money received from customers, while financing is required when the NBS provides value to beneficiaries without direct payment. Public funding is the main source of financing [26]. For instance, selling goods from a food forest or an aquaponics system contributes financial means as a revenue stream to the NBS, while public and other funds, including crowdfunding or sponsorship models, belong to financing. The central left side of the Canvas retains the structure of the original BMC. Key resources, activities and partners, which together describe the NBS infrastructure, are listed in three building blocks, while the bottom left segment focuses on costs (cost structure) and measures of cost reduction. As pointed out by Bockarjova [27], Egusquiza [25], and Mayor [26], the latter can be achieved through reduced maintenance costs compared to alternative uses, as well as the use of volunteers during NBS implementation and/or maintenance. The top segment of this NBS BMC highlights the main positive (right) and potentially negative (left) social and environmental impacts. They are derived from the sustainable BMC proposed by Gerlach [8].

The building blocks of the NBS BMC beyond the original BMC originate from the before-introduced modifications of the BMC towards sustainability and NBS. Alterations are considering earlier works from proGReg's sister projects Connecting Nature [32] (blue colour in Figure 2), UNaLab [33] (green colour) and Nature4Cities [25] (yellow colour), as well as the Sustainable BMC from Gerlach [8] (red colour). The UNaLab team highlights seven building blocks; while the left half of the original BMC remains untouched, the right half is simplified and adjusted by focusing on beneficiaries and financing models. The NBS BMC reflects the wider approach of NBS, going beyond the profit orientation of primarily market-driven businesses without neglecting the economic potential of NBS. Many NBS create wider (in terms of beneficiaries) and often less quantifiable values. Since the values of NBS are—depending on the NBS type—not always saleable, the financing building block is important for these kinds of NBS. A typical way of financing NBS are public funds, although also other financing models can be exploited, e.g., crowd-funding campaigns, sponsorship or donation models from private businesses supporting sustainability. The

figure (see Figure 2) also shows that earlier modifications of the original BMC add or adjust only specific elements of the overall NBS picture. The sustainable BMC, for instance, highlights financing and the positive and negative impacts on society and the environment but misses adding the main target group beneficiaries and the pivotal governance of NBS. Contrarily, the Connecting Nature concept neglects the wider societal and environmental impacts resulting from plenty of NBS and financing but modifies the original BMC by adding beneficiaries, governance, and cost reduction as business model components to be considered. Nature4Cities highlights governance, beneficiaries, and benefits but ignores any adjustments on the financial side of NBS business models. Only when being holistically presented a comprehensive picture of NBS and their functionality can be obtained.

4.2. Guiding Questions for Interviews and Data Collection from the Original BMC

To collect information on NBS business models based on the proposed NBS BMC, the first part of guiding questions per building block adapted from the original BMC is worked out to allow comprehensive overviews of NBS and enable comparisons between different NBS implementations. This first list of guiding questions is also used for the data collection of proGReg case studies to test the proposed NBS BMC (see later). Based on the literature, the questions are formulated for NBS in a broader sense, going beyond companies aiming for profit maximization.

For better readability and usability, the list of guiding questions is split into smaller table blocks. In the following, only the guiding questions for the original BMC from Osterwalder and Pigneur [5] are presented, while after the case studies' presentation, the guiding questions of the further building blocks are presented following the study's methodological logic. The guiding questions for the nine building blocks of Osterwalder and Pigneur's BMC are grouped into sub-tables: value proposition and customer (relationships and channels) (see Table 2), infrastructure (key resources, key activities, and key partners) (see Table 3), and financial aspects in Table 4. The information won for each building block is synthesised with a few bullet points per building block to ensure an easy-to-capture depiction of NBS business models. The guiding questions of Tables 2–4 are derived from Osterwalder and Pigneur [5]. However, the questions are formulated for NBS in a broader sense, going beyond traditional companies.

The value proposition building block allows for highlighting the products, goods, and services, which can be of a quantitative and qualitative nature as well as tangible and intangible (see Table 2). The provision of a value for a specific (or more) target group(s) requires the need to solve a problem, e.g., local, sustainably produced food items from a food forest or higher quality of stay in a green, pollinator-friendly environment.

The co-design, implementation, and maintenance of NBS require suitable infrastructure, split into three building blocks within the Canvas describing the business model (see Table 3). The key resources embrace physical, financial, intellectual, and human resources. Besides the key resources and key activities, partners are crucial for the successful implementation and sustainability of the NBS. These partners include value chain partners, e.g., buying materials or skills from companies, for instance, companies selling suitable seeds for flower meadows. Furthermore, advisers or experts, e.g., on permaculture principles, benefit the NBS. In addition, it is helpful to connect the key partners with their role in the NBS, e.g., acquisition of resources, risk reduction, or optimization measures.

The financial building blocks are positioned at the bottom of the Canvas (see Figure 2). The following table focuses on the two financial building blocks of the original BMC: revenue streams and cost structure (see Table 4). Revenue streams can originate from sales and other means, like fees, rents, or licenses. The Canvas also allows positioning the most important revenue streams and/or financing models in decreasing order. The evolution of NBS requires financial means at different times—from the co-design pre-implementation phase, over the physical implementation of an NBS, to the maintenance/operation phase (post-implementation). Depending on the type of NBS, most costs occur at different phases. The highest costs are often required for the physical implementation, including materials,

while other NBS can have the highest costs during the planning phase or maintenance. For instance, the planning phase before implementation can cause significant or even the highest costs if the NBS requires formal approval, e.g., building permissions.

Table 2. Guiding questions value proposition, customers, relationships and channels.

Building Blocks	Guiding Questions
Value Proposition	Which values do you create and offer? Products and goods? Services? Are there any other quantitative and/or qualitative values? Tangible and intangible values? Which problems are you solving for the customers/beneficiaries? Which needs are you fulfilling for the customers/beneficiaries? How do you contribute to customers' and/or beneficiaries' satisfaction?
Customers	Do you have customers paying for the value (products/services)? If yes, who? What type of customers do you address? People, groups, companies, other entities. . .? When people, please incl. socio-demographic and socio-economic information: age, education, purchasing power. . . (estimations) Fluctuations? Who is most important for your NBS? What is the market segment you are looking for? (mass market, niche market. . .)
Relationships and Channels	How are your relationships with your customers/beneficiaries? Personal, automated, self-service, community-based/co-created. . .? Frequency of relationships? How do you reach your customers and/or beneficiaries? Through which channels? (www, social media, face-to-face, newspaper. . .) If applicable, channels for: Communication Distribution Sales After-sales

Table 3. Guiding questions infrastructure (key resources, key activities, and key partners).

Building Blocks	Guiding Questions
Key Resources	Which key resources are required to make your NBS work? Physical resources Financial resources Intellectual resources Human resources
Key Activities	Which key activities do you carry out to make your NBS work? Including: Production activities Marketing/Sales activities Service provision activities Dissemination and networking activities
Key Partners	Do you need partners? Who are your key partners? Value chain partners (materials, product components, infrastructure . . .) [buyer-supplier relationship] Partners for knowledge, skills (experts) Inter- and transdisciplinary partners Advisory/Consultancy partners In addition, for which purpose are they? Optimization, economies of scale, Risk reduction, Acquisition of specific resources

Table 4. Financial building blocks.

Building Blocks	Guiding Questions
Revenue Streams	If you have customers: How do you earn money? (one-time payments, recurring revenues) Sales, Usage fees, Membership fees, Subscription fees, Licenses, Renting, Leasing For which values and from which customers? How much is your financial revenue? Which revenues are most important?
Cost Structure	What are your main cost items? Fixed vs. variable costs: Fixed (salaries, rent, investment costs. . .) Variable (energy costs, fuel, seasonal worker. . .) How is the cost developing over time? Co-design/planning (prior implementation) Implementation (incl. construction) The maintenance and evolution phase

4.3. NBS Case Studies

The following case studies depict the developed NB S BMC of NBS implementations carried out under the proGReg project in the living labs of Zagreb, Turin, and Dortmund. The application of the NB S BMC is carried out with three NBS implemented in the proGReg project: the City-led therapeutic garden in Zagreb (see Section 4.3.1), the urban garden Orti Generali (social enterprise) in Turin (see Section 4.3.2), and the pollinator-friendly flower meadows in Dortmund including the establishment of an association for this purpose (see Section 4.3.3). To highlight the advantages of the NB S BMC over the original BMC, both are presented, compared, and discussed for the first NBS (therapeutic garden in Zagreb), while the further two NBS from Turin and Dortmund are presented with the new NB S BMC only. The NB S BMC highlights the additional information which cannot be presented in the original BMC in red to emphasize the added value of the proposed Canvas (see following figures).

4.3.1. Therapeutic Garden in Zagreb

The therapeutic garden is managed by three public entities. Led by the City of Zagreb in cooperation with public daycare centres and the City's landscape holding, inclusive therapy is offered for children and grown-ups with and without physical and/or mental disabilities. The daycare centres take care of the inclusive therapy measures and dissemination activities, mainly via social media. The City of Zagreb ensured an open co-design approach, released a tender for the design, and commissioned the construction to the City's landscape holding. In addition to proGReg financing, the City of Zagreb contributes additional financial means. This therapeutic garden serves as a best practice showcase encouraging replication for valuable therapy and inclusion offers in urban gardens located on post-industrial sites.

The new NB S BMC filled for this therapeutic garden (see Figure 3) shows its advantages over the original BMC (see Figure 4) at different places on the Canvas. For the centrally positioned building blocks on the overall value and governance, target groups (to the right), and infrastructure (to the left), the added values of the new NB S BMC concern the governance and the beneficiaries' side. While the organization and management of the NBS is not able to be presented in the original BMC, the NB S BMC allows the description of these pivotal organisations—here public entities—behind the NBS realization (see Figure 3). Furthermore, the sole focus on customers in the original BMC leaves this right part of

Canvas blank (meaning no business model exists), while the extended NB S BMC allows the addition of beneficiaries as well as the relationships and channels with them (see Figure 3). The therapeutic garden exemplary shows how the NB S BMC widens the usability beyond business-oriented interventions, especially NBS planned, implemented, and maintained by a wide range of stakeholders for beneficiaries with various objectives going beyond profit making. Concerning the finances, the NB S BMC allows to differentiate between revenue streams originating from sales, fees, etc. and financing. This cannot be visualized in the original BMC offering, only the building block revenue streams. The NB S BMC establishes a logical link between target groups and financial sources: customers are mainly connected with revenue streams, while beneficiaries, who are not directly paying for a value, take advantage of other means of remuneration. This is often realised by public funds. The wider societal and environmental impacts are presented, substantiating why public funds are reasonable.

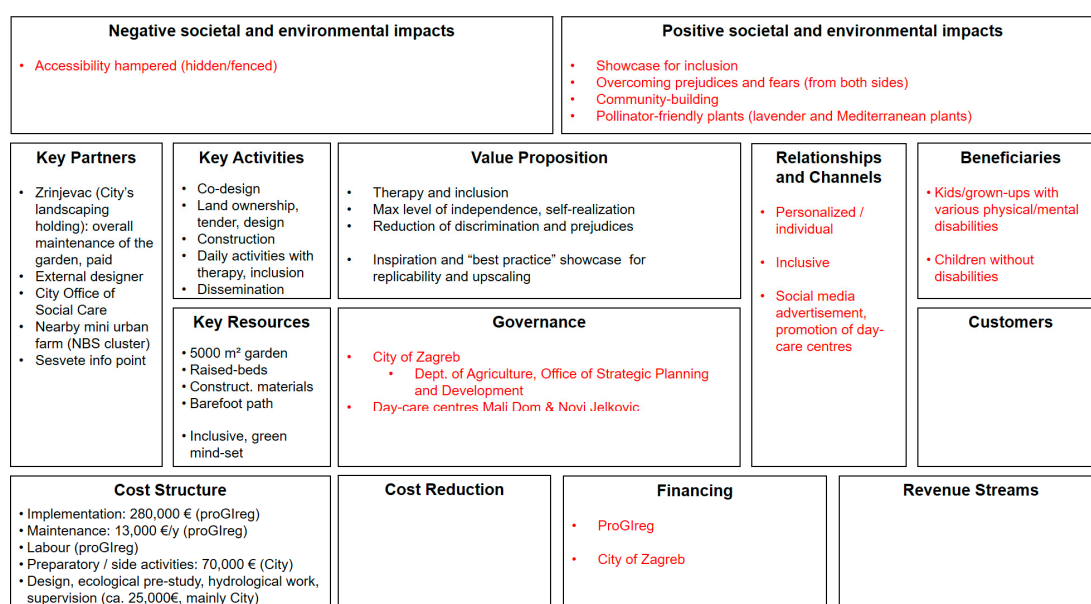


Figure 3. NB S BMC for the Therapeutic garden in Zagreb.

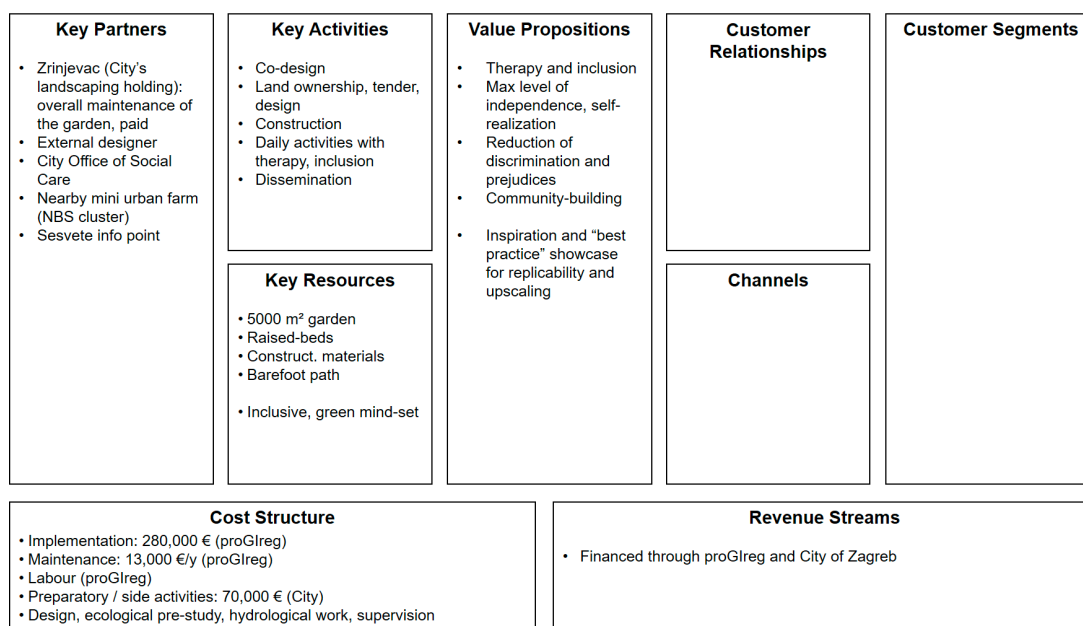


Figure 4. BMC for the Therapeutic Garden in Zagreb.

4.3.2. Urban Garden in Turin

The social enterprise ‘Orti Generali s.r.l. Impresa sociale’ runs an urban garden on a property owned by the City of Turin (see Figure 5). The concession for three hectares allows urban farming activities for several target groups. Local citizens, including disadvantaged people, benefit from education and dissemination activities initiating community building and social inclusion. Besides these beneficiaries, Orti Generali rents 160 gardening parcels to local citizens. The social enterprise offers next to a standard fee (50 m² for 25 €; 75 m² for 35 €; and 100 m² for 45 € per month), also reduced rents for people in social difficulties and for young people below 35 years. The yearly revenue for this income pillar accounts for approximately 45,000 €. Sales via the garden kiosk generate even higher revenues with around 75,000 €. Additional significant income streams are coming from fees for courses and educational activities.

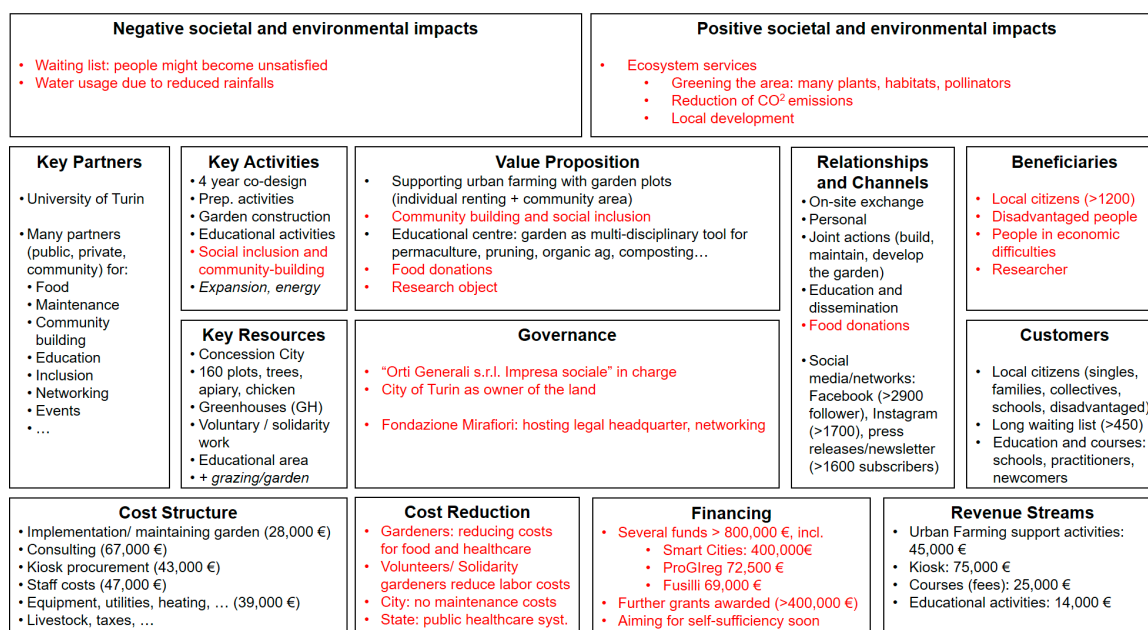


Figure 5. NB S BMC for the urban garden in Turin.

Thus, education for the wider public is offered without charge, while schools, practitioners, and newcomers pay for these activities. About one hectare is dedicated for educational purposes, including a greenhouse and didactic garden. Furthermore, food trees, chickens, a greenhouse, and an apiary complement the urban farm. For the future, another 2.5 hectares will be added via a new concession of the City of Turin. This aligns with a long waiting list of people interested in renting gardening parcels. The social enterprise aims to be financially self-sufficient within a short period. In addition to the several revenue streams, the social enterprise was very successful in applying for several public funds. Despite their financial aim (self-sufficiency), their food donations for people in economic difficulties and further non-profit-oriented values validate their strong social mission.

Several of the before-mentioned key elements of the urban garden can only be presented with the proposed NB S BMC (see Figure 5) since the social values are pivotal for the urban garden. These social values, including community building and social inclusion, food donations, and being an object of study (research), can only be integrated into the wider understanding of the NB S BMC. This concerns the value proposition as well as the building block beneficiaries. All the beneficiaries are neglected when using the original BMC. Furthermore, the successful application for public funds, including proGReg, as well as measures for cost reduction, can be highlighted by the usage of the NB S BMC. The cost reduction aspect concerns several actors; the gardens can reduce food and health care costs, while the social enterprise can reduce costs by voluntary work. Additionally, the city is

no longer maintaining the land, thus reducing costs. The land is even transferred from a source of costs (for maintenance) to an area where money is earned by implementing the urban garden NBS.

4.3.3. Pollinator-Friendly Flower Meadows in Dortmund

The non-profit association “Naturfelder Dortmund e.V.” was founded to manage and conduct the implementation of flower meadows in the urban environment of Dortmund. This association foundation, in which many actors participate as members, aims for a long-term perspective beyond the project’s lifetime. “Naturfelder Issum” (see key partners of Figure 6) served as a blueprint for the foundation in Dortmund. The core values established are citizen involvement, education, and awareness rising, but also to contribute to a mindset change in public administration on how to maintain public green areas in a more pollinator-friendly manner, e.g., in the form of flower meadows or lower mowing frequency during vegetation season. Compared to many other NBSs, the implementation of flower meadows is rather cheap and easy to implement NBS as long as landowners are willing to offer their land for these activities.

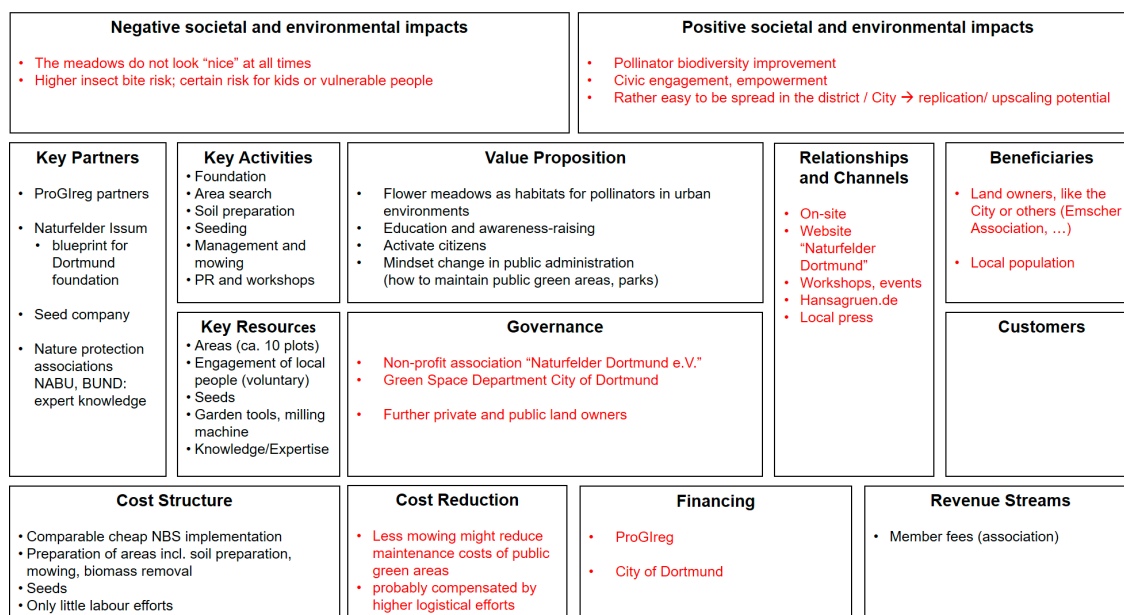


Figure 6. NB S BMC for the pollinator-friendly flower meadows in Dortmund.

Since the pollinator-friendly flower meadows implemented by the non-profit association are not aiming for any financial revenues beyond member fees, the right half of the Canvas can only be filled when applying the NB S BMC (see Figure 6). Furthermore, the association foundation and support by the City of Dortmund (Green Space Department) are summarized under governance. This would not be possible to be inserted into the original BMC layout.

4.4. Guiding Questions of the Added Building Blocks in the NB S BMC

In addition to the earlier presented guiding questions of the nine building blocks of the original BMC, the second part of guiding questions was developed based on the explorative results of the case studies. This was done to provide a detailed list of guiding questions for all building blocks of the new NB S BMC, which makes this new strategic management Canvas usable for a wider audience. The following table (see Table 5) summarizes the guiding questions for the six added building blocks: governance, beneficiaries, financing, cost reduction, and societal and environmental impacts (positive and negative).

Table 5. Guiding questions of the added building blocks in the NBS BMC.

Building Blocks	Guiding Questions
Governance	How is the ownership (of the land, the NBS itself...)? How are you structured organizationally? How are you organized internally? How is your organizational hierarchy? How is your decision-making conducted? Transparency? Consultations? (internal) Profit sharing? Non-financial criteria?
Beneficiaries	Who are the beneficiaries of your NBS values? What type of beneficiaries do you address? People, groups, companies, other entities...? When people, please incl. socio-demographic and socio-economic information: age, education, purchasing power... (estimations) Fluctuations? Which beneficiaries are most important for your NBS?
Financing	Do you receive financing or financial support for your NBS and associated values? public money, subsidies, grants, Public Private Partnership models, EU or other funding, Tax incentives
Cost Reduction	Are you able to reduce costs? (your NBS compared to the earlier land use) Possibilities to reduce costs include: Resources (volunteers, low-tech...) Activities (self-sustaining principles, lower maintenance costs, e.g., permaculture, reduced mowing regime...) Partners Lower maintenance/follow-up costs
Positive societal and environmental impact	What are the societal and environmental positive impacts of your NBS? Do you receive financial remuneration for the societal and/or environmental positive impact? How can the positive impact be sustained or even maximized? Which measures are needed in future?
Negative societal and environmental impact	What are the societal and environmental negative impacts of your NBS? Do you have to compensate for the societal and/or environmental positive impact (financially)? How can the negative impact be minimized? Which measures are required to do so?

The governance building block summarizes the ownership and organization aspects mainly. This includes the hierarchy and transparency along with decision-making processes. The new NBS BMC includes both main target groups, customers and beneficiaries. NBS must have beneficiaries. However, some NBS implementations aim for revenues by selling goods or services to customers (see above). The questions on the beneficiaries aim for a better understanding of the characteristics of the people taking advantage of an NBS. Furthermore, the NBS managers must establish successful and lasting relationships with beneficiaries (and customers).

NBS is also creating a wider impact on society and the environment. These impacts can be positive, but it also must be considered that NBS implementations might have negative impacts as well. In this case, it is important to detect measures for minimizing or even deleting these negative impacts. Contrarily, the positive impacts should be sustained. This is reflecting also in the guiding questions on the impact side. Furthermore, it is a declared concept behind NBS to reduce costs over time. Food forests or permaculture orchards also reduced the maintenance intensity of public green, e.g., from frequently mowed lawns to more nature-oriented green.

4.5. Synthesising Discussion

The development of the herewith-proposed NB S BMC builds the first of four steps. It relies on the original BMC from Osterwalder and Pigneur [5] and its modifications towards sustainability and NBS. The original BMC targets profit-oriented businesses, while the introduced modifications from several EU projects and beyond address certain elements of the wider NBS debate. However, all modifications lack holistic development for what reason? Fourteen building blocks are constructed via an explorative approach within the proGReg Living Labs of Dortmund, Turin, and Zagreb (see Figure 2).

The added values of the NB S BMC lie especially in adding governance and financial building blocks as well as two distinct building blocks for two very different target groups: customers and beneficiaries. Finally, the wider impact on society and the environment is building the header of the Canvas. Thus, the absence of negative impacts when implementing NBS is not taken for granted. As demonstrated by the case studies, negative impacts can occur, although they are outweighed by positive impacts. In detail, concerning the finances, the NB S BMC allows to differentiate between revenue streams from sales, fees, etc. and financing. This cannot be visualized in the original basic BMC offering, only the building block of revenue streams. Financing models play a pivotal role [26], for what reason an individual building block is advantageous for describing the overall business model of NBS comprehensibly.

Furthermore, the NB S BMC establishes a logical link between the two target groups, customers and beneficiaries, and sources of financing: customers are directly connected with revenue streams, while beneficiaries, who are not directly paying for a value, take advantage of other means of remuneration, the financing building block. This is often realised by public funds. Additionally, the wider societal and environmental impacts are presented to justify the reasonability of public funds. Many NBSs lack financial self-sufficiency and viability (at least in the initial phases), so financing is important and cannot be omitted. Importantly, all the beneficiaries are neglected when using the original BMC, and the successful application for public funds, including proGReg, and measures for cost reduction can only be highlighted by the usage of the NB S BMC. While BMC modifications targeting NBS consider beneficiaries prominently, these tools partly neglect the customer target groups in return. This pushes NBS away from entrepreneurial thinking. However, measures to show viable business models and entrepreneurial NBS (e.g., NBE) are of utmost importance for the wider application or mainstreaming of NBS in Europe.

Even though earlier developed modifications of the original BMC can cover parts of these advantages, none of these modifications is mature enough to capture the NBS' business models in a comprehensive manner. This is because other modifications oftentimes only concentrate on the simplification or addition of individual building blocks, while the NB S BMC aims to cover the full picture of business models. The sustainable BMC, for instance, highlights financing and the positive and negative impacts on society and the environment but misses to add the main target group beneficiaries and the governance part of NBS. Contrarily, the Connecting Nature concept neglects the wider societal and environmental impacts and the financing but modifies the original BMC by adding beneficiaries, governance, and the cost reduction aspect to the BMC. Only when being holistically presented a comprehensive picture of NBS and their functionality can be obtained.

As a limitation, it must be mentioned that the developed NB S BMC was still applied to a relatively small number of cases in this paper. To underline its application benefits for businesses and politicians, it could be applied more widely in future studies. Therefore, further research is required to test the applicability of this NB S BMC template for a wider set of NBS implementations. This applies to the general NB S BMC template and the guiding questions. The case studies show its feasibility already for a range of NBS types, namely settings of a social enterprise, a fully public City-led intervention, and a community-initiated association. Although these NBS settings are already diverse, a wider application of the NB S BMC allows to test further NBS and other green infrastructure measures in terms of governance structures, different target groups, and financial means.

Finally, the NB S BMC considers the sustainability role of key partners and suppliers only to a limited extent.

5. Conclusions

This study aimed to develop a holistic concept to capture and evaluate business models of future NBS for the first time. Methodically, the new Canvas is proposed based on an extensive literature review, and the application and testing are carried out on NBSs implemented in the proGReg project's European Living Labs. For these case studies, personal, on-site interviews were carried out with the key responsible persons for the NBS to go through all 14 building blocks. The interviews took place in winter 2022/23.

The new bundling nature-based sustainability Business Model Canvas (NB S BMC) enables the capture of business models of NBS and other sustainability-oriented green infrastructures comprehensively and holistically for the first time. The NB S BMC integrates BMC modifications from proGReg's sister projects, Connecting Nature, Urban Nature Labs and Nature4Cities, as well as the Sustainable BMC from Gerlach [8] into the original BMC to make use of their synergies to capture NBS' business models as holistically and multidimensional as possible. To make this new canvas concept usable for a wider audience, a detailed list of guiding questions is provided for each of the 14 building blocks.

The results of this study show that a comprehensive picture of NBS and their functionality can only be obtained when being holistically presented, considering not just economic but also societal and ecological aspects and benefits. The NB S BMC widens the usability beyond business-oriented interventions, especially NBS, which are planned, implemented, and maintained by a wide range of stakeholders with various objectives beyond profit-making. Therefore, the proposed NB S BMC allows wide applicability from profit-oriented NBS enterprises over social enterprises to public NBS.

The practical implications of the developed NB S BMC are that it provides a general tool to capture and evaluate different NBS in the future on a generally valid and comparable basis. Through this, NBS can also be better classified by types and benefits at the same time. Additionally, innovative NBS approaches, e.g., financing concepts, can get broader recognition and a higher adoption rate. In addition to that, the NB S BMC makes an original contribution to the advancement of knowledge in the field of business models beyond the traditional profit-oriented economy. The case studies presented show that the NB S BMC can be applied to various types of NBSs and diverse implementation locations, indicating broad transferability. Although this canvas development puts an emphasis on NBS, it can also be applied to capturing sustainable business models beyond the NBS domain.

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