

Article

Clustering Business Models of Heterogeneous Nature-Based Solutions Implementing Innovative Governance and Financing Concepts

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Abstract: Nature-based solutions (NBSs) are considered sustainable, cost-efficient, and resource-efficient land-use management approaches. When analysing NBS business models, two major challenges are commonly identified as slowing down broader NBS implementation: governance and financing barriers. This explorative study aims first to test the applicability of a NBS specific business model template and, second, to provide a clustered NBS business model pilot case study collection, which enables transferable solutions for overcoming the typical implementation challenges to be derived. Methodically, this is achieved by using the Nature-based Sustainability Business Model Canvas (NB S BMC for guided interviews. Twenty-three NBS case studies from proGIReg's four Front Runner Cities, namely Dortmund, Ningbo, Turin, and Zagreb, are examined. Pestoff's welfare triangle enables the NBS business models to be clustered. The main business model clusters are public provision, sales, and diversified. NBSs' governance models are very adaptable to individual NBS cases, of the independent type, and can include a huge diversity of involved stakeholders regarding their functions in the NBS implementation. Our findings highlight adaptable governance models across diverse stakeholder functions and confirm the NB S BMC as a robust framework for understanding NBS business models. These insights extend to land-use practices beyond NBSs, offering a template for innovative urban planning strategies.

Keywords: nature-based solutions; urban renewal; sustainable urbanisation; business model innovation; green entrepreneurship



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1. Introduction

Throughout the past few years, the debate for, first, more sustainable and resilient and, second, more cost- and resource-efficient land-use management has shifted from ecosystem-based approaches to the overarching level of nature-based solutions (NBSs) delivering ecosystem services [1–4]. This scholarly discussion covers a wide range of arenas: (1) not only green but also blue infrastructure; (2) urban, peri-urban, and rural contexts; (3) ecological, social, and economic dimensions to tackle pivotal societal challenges. Global warming, the loss of biodiversity and fertile soils, and harmful nutrient flows endanger, among others, nature as well as human health and well-being. NBSs are defined by the European Commission 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” [5].

The number of scientific NBS publications has significantly grown over the past few years, parallel to case-specific NBS implementations. Thereby, NBSs are often linked to sustainable urban development [6,7], corresponding to aspects such as life cycle thinking [8]

and green–blue infrastructure interventions [9,10]. However, a growing debate exists about the concept’s concrete and, ideally, measurable contributions to holistically meeting ecological, social, and economic challenges as well as societal ones [11–13]. At the same time, sustainable governance models and autonomous financing structures for NBSs are sought to enable their broader implementations [14,15]. Thus, a series of EU-funded projects focuses on the planning, physical implementation, developing, and testing of various NBSs in cities and wider metropolitan areas. Expert groups and further local stakeholder groups 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 [2,16], and the assessment of ecosystem services’ economic value [17,18].

The EU-funded Horizon 2020 project proGReg—productive green infrastructure for post-industrial urban regeneration—planned, developed, implemented, and simultaneously assessed eight different NBS types [19]. The implementations took place in living labs within proGReg’s four Front Runner Cities, namely Dortmund (Germany), Turin (Italy), Zagreb (Croatia), and Ningbo (China), between 2018 and 2023. Under the slogan “Nature for Renewal”, proGReg uses nature for urban regeneration with and for citizens. The eight NBS types in the four Front Runner Cities (FRC) created productive green infrastructure, following a co-creation process involving local citizens, governments, businesses, NGOs, and higher education. Therewith, the project aimed to create a real impact by improving living conditions, reducing vulnerability to climate change events, and providing economic benefits in and for post-industrial, deprived urban areas [20].

In addition to their individual thematic focuses, the eight NBS types implemented in the living labs address different challenges of urban regeneration and challenges of post-industrial sites in deprived urban areas [21]. The NBS type “Leisure activities and clean energy on former landfills (LE)” aims to make use of former landfill sites (garbage dumps, excavation dumps, etc.) for outdoor activities (biking, walking, viewpoints, and other sport and leisure-time activities) in combination with retreat areas for wildlife [22,23]. Additionally, the exposed position of landfills allows for renewably capturing energy, e.g., via solar panels. The soil in post-industrial areas is often contaminated with pollutants, sealed, or compressed. Therefore, carbon-neutral methods to restore soil and its fertility are developed in the NBS type “New regenerated soil (S)” by using deep excavation soils as a main resource for the creation of new, high-quality soil [24,25]. In addition to restoration, shared land uses such as “Community-based farms and gardens” (NBS type UA) enable turning un- or barely-used urban land into productive community gardens [26]. This creates a positive impact on locals, contributing to improved mental and physical health through exposure to nature, healthy sources of food, community building, participation, and a sense of belonging and responsibility [27–29]. As a land-use approach applicable without the use of natural soils, the NBS type “Aquaponics (AP)” promotes local food production in areas with irreversible soil destruction. Aquaponics is the combination of raising fish (aquaculture) in tanks and the soilless cultivation of plants (hydroponics) in a symbiotic environment, whereby the fish water provides the nutrients needed to feed the plants [30,31]. To extend the usable land for plants, the NBS type “Green walls and roofs (GI)” aims at the expansion of capillary green infrastructure. Green roofs and vertical gardens integrate the vertical dimension for NBS by improving buildings’ insulation, reducing stormwater run-off, capturing CO₂, filtering pollutants, and increasing habitats for biodiversity. This NBS type allows a reduction in energy consumption and an increase in urban resilience [32–34]. The target of the NBS type “Accessible green corridors (PI)” is to make post-industrial sites and renatured river corridors accessible for local residents [35,36]. The NBS type “Local environmental compensation processes (EC)” aims to consider green infrastructures, NBS, and participatory co-design and co-implementation processes inherently into urban planning procedures starting at the local level of municipalities [37–41]. Pollinators are essential for healthy and functioning ecosystems. The NBS type “Pollina-

tor biodiversity (B)” involves local citizens to create, monitor, and promote awareness of pollinator-friendly spaces [41–43].

To elaborate on the respective contributions of NBSs and to make the gained case study experiences transferable for mainstreaming NBS implementations, its structures and activities need to be analysed in a holistic and clear manner. This could be achieved through business models approached in a broad sense. Osterwalder defines business models as “a representation of how a company buys and sells goods and services and earns money” [44] (p. 14). While profit-oriented business models, e.g., the Business Model Canvas (BMC) by Osterwalder and Pigneur [45], focus primarily on the business layout and economic objectives of private businesses, NBSs oftentimes accentuate societal and environmental benefits and are characterised by various stakeholder involvements, governance models and organisational structures, and diverse financing and funding mechanisms [14,15].

An increasing number of projects, networks, and studies match business model thinking with new and innovative entrepreneurship [46], ecosystem services [47], life cycle thinking [48], sustainability [49–53], circularity concepts [54], and increasingly also the concept of NBSs [15]. Since the late 2010s, EU research and innovation projects have contributed significantly to the growing knowledge of NBS business models, although the strongest emphasis of projects lies on non-business-related assessments [14]. However, several studies (Bockarjova [55], Jacobs [56], and Croci [57]) evidence both monetary and non-monetary values of NBSs. With the emergence of NBS projects and applications in various European cities, business model tools tailored explicitly to NBSs have likewise emerged. All of these new tools and templates for capturing the BM of various NBS implementations have in common that they follow an explorative approach.

Two EU projects that prominently merge business model thinking and NBS activities—Connecting Nature (<https://connectingnature.eu/> (accessed on 10 June 2023)) [58] and Naturvation (<https://naturvation.eu/> (accessed on 10 June 2023)) [59]—contributed significantly to the emerging topic of NBS business models. The EU project Naturvation has developed a business model catalogue for urban NBSs, presenting eight business models based on their project-specific approach [60]. The Connecting Nature approach modifies the original BMC from Osterwalder and Pigneur [45] while retaining its core concept and structure [61]. Another EU project, Natur4Cities (<https://www.nature4cities.eu/> (accessed on 10 June 2023)) [62], developed and proposed another BMC modification tailored to NBSs. This new template, called the WHAT–WHO–HOW framework, puts a special emphasis on NBS cases’ governance, benefits, and beneficiaries [15]. The diamond model [63] was developed to capture business models of food production in urban landscapes. Like the Naturvation approach, value capture and value delivery build core elements of the model. The UNaLab team included parts on beneficiaries and financing models of NBSs in the original BMC [64].

When analysing NBSs’ business models, two major challenges were identified that slow down the broader implementation of NBSs: governance and financing barriers. Both are linked to the particular characteristics of NBS types [14,65–68]. Therefore, suitable governance models and financing strategies are needed to overcome these challenges [15,67]. As the innovative nature of NBSs is often reflected in their novel governance and business models [68], these cases need to be analysed systematically. These new ways of collaborative and transdisciplinary governance along with complex financing structures are rooted in the diversity of created values and the multitude of stakeholders involved [14]. Many NBS implementations struggle to achieve financial self-sufficiency in the initial phase, but aim for long-term self-sufficiency [14]. Therefore, these transition processes need to be reflected in their governance and financing models. Next to the individual particularities of governance and financing aspects of NBSs, both are connected to specific business models, which influence the performance of NBS cases directly [4].

To overcome those major challenges for broader NBS implementations, further research on solutions is necessary. A promising way to support the expansion of new, innovative approaches, like NBSs, are pilot case studies [69]. Pilots can function as flag-

ships and demonstrate practically how to solve implementation challenges, e.g., regarding governance and financing. There has already been research conducted presenting NBS pilot case studies [14,15,60,61,63,64]. However, the understanding of business models specific to NBSs, especially regarding governance and financing, remains under- or even unexplored. To the best of the authors' knowledge, no scientific study has been carried out yet, which first captures NBS business models holistically and, second, clusters the NBS cases regarding the challenges in governance and financing identifying the individual NBS type. Therefore, the novel approach to develop a clustered pilot case study collection for NBS business models could make a substantive contribution to future NBS studies.

To capture NBS business models holistically, Stork et al. [70] proposed the nature-based sustainability business model canvas (NB S BMC) template. It consists of 14 building blocks and offers detailed guiding questions for each building block. Considering the multi-faceted character of NBSs, it offers a holistic overview of NBS business models, including two building blocks specifically addressing governance and financing (see below). This explorative study aims first to test the applicability of the proposed NB S BMC template, and second, to provide a clustered NBS business model pilot case study collection. Therewith, this study contributes to addressing the lack of solutions for overcoming the governance and financing challenges hindering NBSs' broader implementations. Thereby, the diversity of NBS implementations, both in terms of NBS types and their governance and financing models, is shown, and transferable solutions for typical implementation challenges are derived.

Methodically, this is achieved by using the NB S BMC from Stork et al. [70] for guided interviews. In total, 23 NBS implementations were examined in proGReg's four Front Runner Cities. The collected data were analysed using specific building blocks of the NB S BMC template. Pestoff's welfare triangle [71] enables the clustering of the NBS interventions into the business model cluster. In the following materials and methods section, the data collection process is described (see Section 2.1) before the NB S BMC from Stork et al. [70] is introduced (see Section 2.2) and the analysis approaches are explained, namely the Pestoff welfare triangle between the state, community, and market; financial approaches; and target group classification (see Section 2.3). In Section 3, the findings are presented according to the different analysis approaches. The results are discussed in Section 4 followed by the conclusion section (Section 5).

2. Materials and Methods

This study contributes to the above-identified need of solutions for overcoming the governance and financing challenges hindering NBSs' broader implementations. To fill this research gap, the nature-based sustainability business model canvas (NB S BMC) template from Stork et al. [70] was used for guided interviews. In total, 23 NBS implementations were examined. The collected data were analysed using specific building blocks of the NB S BMC template. Pestoff's welfare triangle [71] enables the clustering of the NBS interventions into the business model cluster. In the following, first, the data collection process is described (Section 2.1). Second, the NB S BMC template from Stork et al. [70] is introduced (Section 2.2), and third, the analysis approaches including Pestoff's welfare triangle are explained (Section 2.3).

2.1. Data Collection

In proGReg, eight different NBS types were co-designed, implemented, monitored, and assessed in the four Front Runner Cities of Dortmund (Germany), Turin (Italy), Zagreb (Croatia), and Ningbo (China). In each city, NBS implementations are geographically clustered in areas facing pivotal challenges with their post-industrial heritage. To collect the data comprehensively and comparably, structured interviews, guided by the NB S BMC template and the corresponding guiding questions from Stork et al. [70], were conducted, including both open-ended and targeted questions to elicit detailed insights (see Section 2.2). Case studies were selected based on diversity in governance structures, financing mecha-

nisms, and ecosystem service benefits. The selection focus was on NBSs' business models and not on their geographical localisation. Ten NBS implementations are located in Turin, six in Zagreb, five in Dortmund, and two in Ningbo (see Table 1). Per NBS type, between one and seven NBS cases were examined depending on the number of pilots implemented in the cities (see Tables 1 and 2). In total, 23 interviews were carried out with key contact persons of the NBS implementations (see the Supplementary Materials: Figures S1–S23). Since the stage of NBS development differed significantly from already running to the planning phase at the time of the interviews, the guiding questions asked for details on the current situation, but also predictions for the future. While the interviews took place on-site in Dortmund and Zagreb, the data collection in Turin and Ningbo was realised by personal online interviews. The interviewers were familiar with the local conditions in Turin due to earlier visits. In Ningbo, the NBS implementations are only known through photos. The interviews took place between October 2022 and March 2023.

Table 1. Interviews per NBS type and Front Runner City.

NBS Type	Dortmund	Turin	Zagreb	Ningbo
1: Leisure use and energy production (LE)	1			
2: New regenerated soil (S)		2		
3: Community-based urban farms and gardens (UA)	3	4; 5	6; 7; 8	9
4: Aquaponics (AP)	10	11	12	
5: Capillary GI on walls and roofs (GI)		13; 14; 15	12	
6: Access to post-industrial sites and renatured river corridors (PI)	16	17	18	
7: Protocols and procedures for environmental compensation (EC)		19	20	21
8: Pollinator biodiversity (B)	22	23		

Table 2. Numbers and names of the NBS implementation interviews.

Number	NBS Name
1	Sport devices urban park
2	New soil
3	Food forest
4	Urban farm
5	Raised-bed gardens
6	Therapeutic garden
7	Modernisation of existing garden
8	Info point
9	Urban lake planting
10	Aquaponics Dortmund
11	Aquaponics Turin
12	Aquaponics plus green wall and roof
13	Indoor green wall
14	Outdoor green wall
15	Green roof
16	Path for landfill access
17	Ecosystem path
18	Green corridor
19	Strategic tools
20	Urban planning guidelines
21	Water quality testing and management
22	Pollinator association
23	Butterfly gardens

The eight colours correspond to the eight NBS types introduced in Section 1. Accordingly, the colour indicates the NBS type category (NBS 1–8) and the interview number indicates the individual NBS implementation (Interview 1–23) (see Tables 1 and 2).

2.2. Nature-Based Sustainability Business Model Canvas

The nature-based sustainability business model canvas (NB S BMC) bundles together experiences from earlier works in the field of business models and NBS [70]. The NB S BMC consists of 14 building blocks (see Figure 1). It offers a holistic overview of NBS business models considering the multi-faceted character of NBSs.

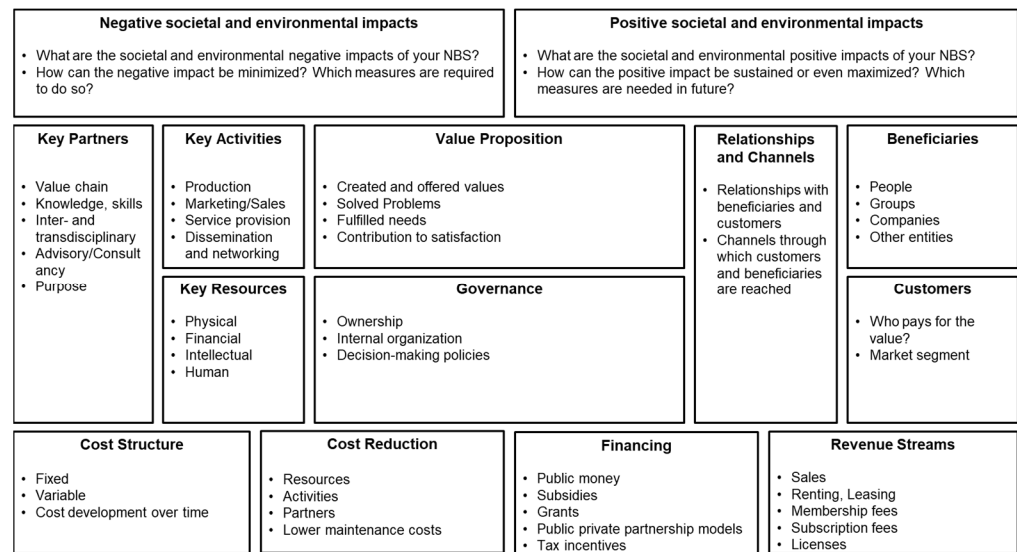


Figure 1. Nature-based sustainability business model canvas (NB S BMC) from Stork et al. [70].

The value proposition remains one of the focal points, presenting the core value created by the implemented NBSs being positioned centrally in the template. It covers tangible (goods and services) and intangible values. Governance is positioned below the value proposition. Unlike private businesses, the governance of NBSs is more diverse. Governance summarises ownership and internal organisational structures, such as hierarchy and decision-making policies regarding transparency, profit sharing, non-financial criteria, and consultation. The building block governance takes into account that a wide array of stakeholders take responsibility in the planning, implementation, and maintenance or evolution of NBSs. In addition to municipalities and other public entities (e.g., universities, research institutes), these are associations and community groups, but also businesses, including nature-based enterprises (NBE) and start-ups [70].

The two main target groups of NBS implementations, customers and beneficiaries, are positioned on the template's right edge along with their relationships and channels to their left side. Customers are individuals, groups, or entities that pay for the value offered (value proposition), while beneficiaries do not pay monetarily for the obtained values. NBSs are very diverse and thus provide values for different target groups, which is reflected here by these two building blocks. 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, although other financing models can also be exploited, e.g., crowd-funding campaigns, sponsorships, or donation models from private businesses supporting sustainability. With these building blocks, the NB S BMC template reflects the wider approach of NBSs, going beyond the profit orientation of primarily market-driven businesses without neglecting the economic potential of NBSs. The NBS infrastructure consists of key resources, activities,

and partners (left side), while the bottom left segment focuses on costs (cost structure) and measures of cost reduction. The latter can be achieved through reduced maintenance costs compared to alternative uses, as well as the use of volunteers. The top segment highlights the main positive (right) and potentially negative (left) social and environmental impacts on a more general level. To collect the information for all building blocks of the NB S BMC template, additional guiding questions were provided by Stork et al. [70].

2.3. Analysis Approach

Each NBS interview allowed us to fill an individual NB S BMC, resulting in 23 filled and usable sheets. Tailored analysis approaches were used to evaluate the results addressing the key research on the governance and financing of NBS. These analysis approaches cluster NBS implementations with similar business model characteristics, without standardising the different NBS types. In total, four analysis approaches were conducted and presented, resulting in distinct business model patterns. These are (1) Pestoff's welfare triangle, (2) financial benefits, (3) degree of profit orientation, and (4) target groups.

Pestoff's welfare triangle builds the main approach to clustering the NBSs [71]; it positions the NBS implementations between the state, market, and community (see Figure 2). For the positioning, the information on governance plays the pivotal role [72–75]. Therefore, NBS positioning in the triangle is based on the “governance” building block information of the NB S BMC.

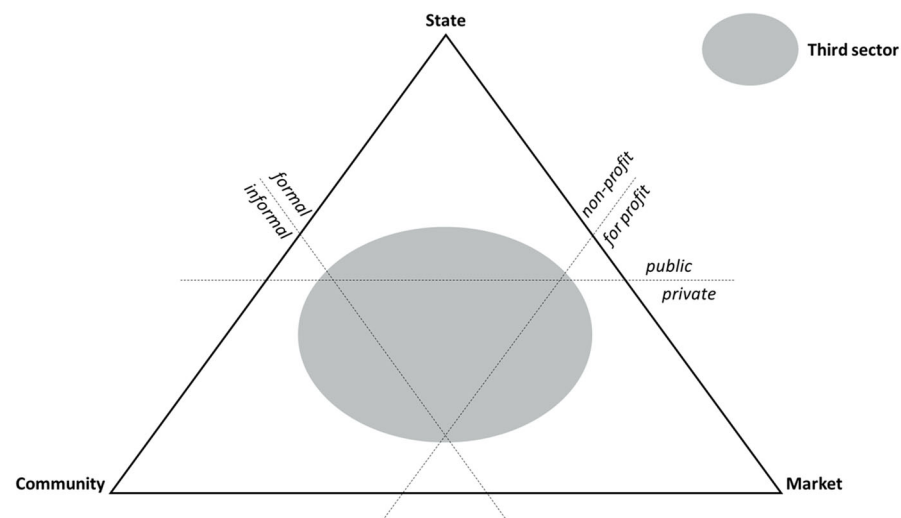


Figure 2. Pestoff's welfare triangle adapted from Pestoff [71].

The triangle serves as an enabler to highlight formal vs. informal, profit vs. non-profit, and public vs. private, generating a centrally positioned area defining the third sector. Associations, social enterprises, and public–private partnership models are typical examples of the third sector. The third sector, which plays an important role for several of the examined NBSs, bundles different stakeholders, goes beyond profit maximisation and pure capitalistic thinking, formalises community activities, and creates hybrid organisational structures. Thus, Pestoff's welfare triangle is considered a suitable and beneficial analytical tool for clustering the examined NBS cases (see Sections 3.1 and 3.2).

Complementary to clustering the examined NBS cases using Pestoff's welfare triangle to analyse NBSs' governance and business models, three further analysis approaches are used to identify NBSs' financing structures and strategies. Each of these three additional approaches uses information from appropriate building blocks of the NB S BMC template to position the pilots. First, the building blocks “revenue streams” and “cost reduction” are analysed to position the NBS cases with regard to financial benefits. The 23 NBS cases are ordered on a coordinate system. The x-axis defines the revenue streams from “no” to “high” and the y-axis defines the cost reduction from “no” to “direct” (see Section 3.3).

Second, the two building blocks “revenue streams” and “cost reduction” of the NB S BMC template facilitate statements on the degree of profit orientation. Each examined NBS implementation is ordered between the “no” and “strong” degrees of profit orientation (see Section 3.4). Third, positioning the examined NBS cases between the two target groups “customers” and “beneficiaries” shows the value orientation and target group priorities of the implemented NBSs. The relevant building blocks of the NB S BMC for this approach are positioned to the right side of the NB S BMC template. Customers pay for the offered values, especially goods and services, resulting in revenue streams. Beneficiaries gain value from the NBSs without paying directly for it. Beneficiaries demand other financial remuneration measures (financing), such as public funds or grants. The NBS cases are positioned on a coordinate system. The x-axis defines the customers from “no” to “many” and the y-axis the beneficiaries from “no” to “many” (see Section 3.5). These three analysis approaches in addition to Pestoff’s welfare triangle allow us to detect certain patterns and cluster-like NBS groups with similar results for the criteria analysed without standardising the different NBS types.

3. Results

In this results section, first, the individual NBS implementations are positioned between the state, market, and community according to their organisational governance (see Section 3.1). Second, the three business model clusters of public provision, diversified, and sales are analysed (see Section 3.2). Third, the examined NBS implementations are clustered according to their financial benefits (see Section 3.3), and fourth, they are ordered based on their degree of profit orientation (see Section 3.4). Finally, the examined NBS implementations are clustered according to their main target group orientation: customers and beneficiaries (see Section 3.5).

3.1. NBS between the State, Market, and Community

Based on Pestoff’s welfare triangle [71], the examined NBS implementations are positioned based on their organisational governance between the state (top), market (bottom right), and community (bottom left). The positioning of each NBS case in the triangle is based on the information of the “governance” building block of its corresponding NB S BMC template. Additionally, the triangle approach enables to visualise the transitions between formal and informal and non-profit and for profit as well as public and private activities. In addition to providing additional information on the 23 NBS case studies, these three supplementary parameters enable the precise positioning of individual NBSs (see Figure 3). Three beige-coloured dash-lined sectors are marked within the triangle: (1) public provision (top), (2) social enterprises (centrally positioned third sector), and (3) private business (bottom right). Most NBS pilots are positioned within the public or third-sector domains (see Figure 3). The public provision sector within the formal and non-profit area is dominating. However, three NBS pilots are aiming for profit (2, 11, and 12). Additionally, a few more pilots (4, 10, and 15) straddle the edge between for profit and non-profit, including public–private partnership (PPP) models.

Before detailing the three business model clusters, the positions of the NBS cases in Pestoff’s welfare triangle are presented according to the eight NBS types. The NBS implementation “Leisure use and energy production”, coloured red, is managed internally by the City of Dortmund (public provision) without external commitments (see Figure 3). The brown-coloured “new soil” NBS case from Turin is carried out by a private business for profit. Thus, it is situated in the bottom right corner of Pestoff’s welfare triangle. Some of the seven NBS implementations “Community-based urban farms and gardens”, coloured green, are introduced here for exemplifying its diversity: NBS 3 is a community-led food production project (permaculture orchard) in Dortmund; a church, a civil society, and an NGO are collaborating. Orti Generali (NBS 4) is a diversified social enterprise running a rent-a-garden concept and a kiosk; courses and education services create further significant income streams. The community-led pollinator-friendly garden boxes are run by a third-

sector collaboration (NBS 5). NBS 9 (Ningbo) belongs to the public sector and is not aiming for income, but provides public goods instead. The “Aquaponics” cases are coloured blue and positioned in the right “for profit” part of Pestoff’s welfare triangle (see Figure 3). In Dortmund’s NBS 10, a local NGO is working together with a public university to increase the technology readiness level of aquaponics on post-industrial sites and for establishing viable business models, e.g., a rental concept. NBS 11 has an explicit market and business focus on seeking profit. It is run by a private company. The company behind the mini urban farm (NBS 12), which is merging aquaponics with green walls and roofs, aims to sell produce but also systems. The three NBS cases of the type “Capillary GI on walls and roofs” are coloured black. NBS 13 focuses primarily on public provision activities. The outdoor green wall is realised by a social cooperative in cooperation with the city (NBS 14). The green roof NBS provides ecosystem services (NBS 15). “Access to post-industrial sites and renatured river corridors” NBS implementations are coloured grey and the “Protocols and procedures for environmental compensation” are coloured violet. NBS 22 and 23, coloured orange, belong to the type “Pollinator biodiversity” (see Figure 3). For the successful implementation of NBS 22 (pollinator biodiversity), a new citizen association was founded. The butterfly gardens are managed by an association together with the City and the University of Turin (NBS 23).

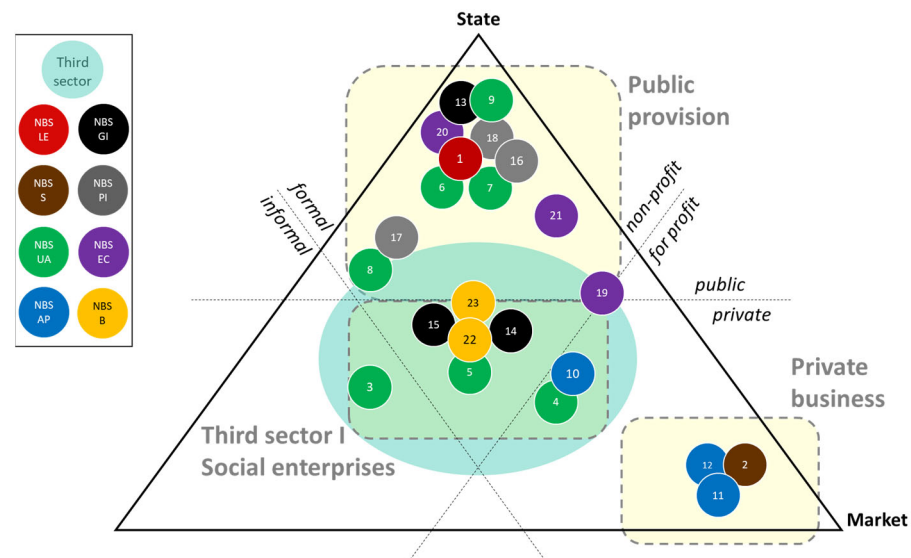


Figure 3. Positions of examined NBS implementations within Pestoff’s welfare triangle; numbers in circles represent the NBS implementation interviews.

3.2. NBS Business Model Clusters

By using Pestoff’s welfare triangle, it is possible to cluster types of business models. The main business model clusters are public provision (blue), sales (green), and diversified (red), which can be further detailed. This includes public–private partnership or sponsorship/donation models bridging public and private as well as diversified approaches relying on services or rental concepts (see Figure 4). The following sub-chapters briefly present the NBS business model clusters, starting with public provision.

3.2.1. Cluster Public Provision

The public provision NBS business model cluster’s sub-types are further detailed in the following sections.

City-Internal Public Provision

NBS implementations belonging to the city-internal public provision cluster are the sport exercise park in Dortmund (NBS 1) and Ningbo’s urban lake planting (NBS 9), as well

as the modernisation of an existing urban garden (NBS 7) and urban planning guidelines (NBS 20) in Zagreb (see Figure 4). Since only the cities are named under the business model's building block governance, they can be seen as common top-down approaches. However, varying degrees of co-design and community participation are realised.

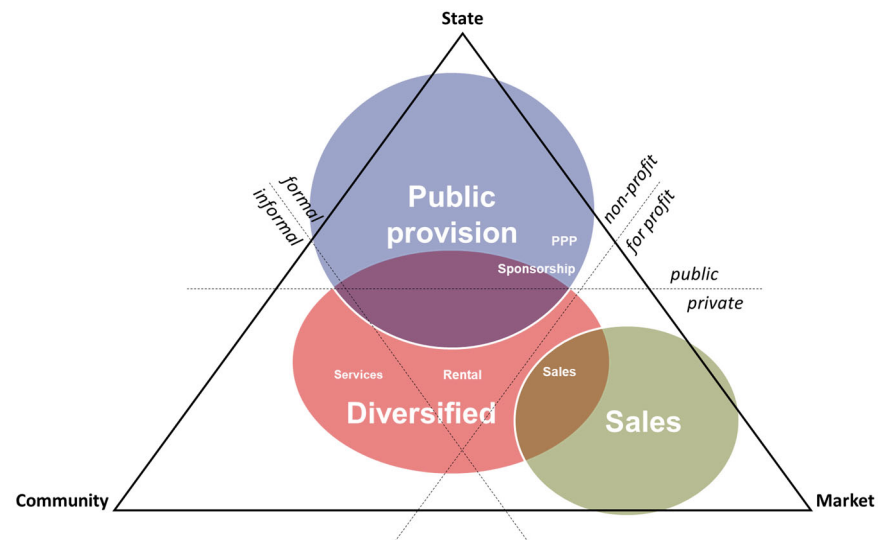


Figure 4. NBS business model clusters.

The sport exercise park in Dortmund (NBS 1) aims to serve as a magnet and anchor point for local people of all ages. While the implementation originates from proGireg funds, the municipality's green space department assures continuous maintenance after the project.

Ningbo's planting along the shoreline of the urban Moon Lake, which intends to improve the water quality, can be seen as a showcase supporting replication and upscaling in other lake contexts (NBS 9). The water purifying and environmental upgrade of the lake targets improved environmental conditions, as well as local residents' options of recreation and tourism purposes around the lake. The planting is financially covered by state funds in the form of inter-governmental cooperation. However, further positive local economic effects are anticipated in the form of increased expenses in businesses around the lake (e.g., cafés, small shops). Increasing rents might develop in the neighbourhood of the Moon Lake. The costs for the five kilometres' shoreline planting covered by state money are first, the investment costs and, second, the running costs calculated at five to ten per cent of the investment costs per year. The planting was carried out by local companies, and supported by the University of Ningbo mainly for the planning and monitoring.

The modernisation of an existing urban garden in Zagreb's suburb of Sesvete allows better access to water for the gardeners along with a water quality upgrade (NBS 7). The city operates 14 gardens of this kind throughout the city. Following certain selection criteria, local residents receive two-year contracts for garden plots of 50 m² free of charge. The gardens are on city-owned land, allowing food self-supply and saving significant food purchase costs. Thus, selection criteria include income, where low income groups are prioritised. The gardens are maintained by a city subcontractor for landscaping, while the water purification system is implemented by an external company. All gardens have waiting lists, demonstrating high interest in and demand for urban and community gardening. Some plots are rented by local community groups and NGOs.

Another type of NBS carried out internally by the City of Zagreb is the development of guidelines for urban planning (NBS 20). This NBS goes beyond immediate physical implementation, but promotes a strategic paradigm shift towards a regulatory framework for urban planning. This shift fosters the transition from grey to green and from internal governance to co-design and participatory processes together with local stakeholders.

The beneficiaries are threefold: the local government and politicians within the City of Zagreb, but also beyond when the guidelines developed for Zagreb will be replicated in other cities and regions. Additionally, it fosters citizen empowerment in co-designed planning processes leading towards a greener, more inclusive and trustful city. Initially, the guidelines did not aim to create direct financial revenues, but might turn out to be a saleable service in the future. The City of Zagreb receives consultancy from two faculties of the University of Zagreb and the so-called “Renewal Program Team” consisting of City and University staff.

City-Led Public Provision

A set of NBS implementations is led by cities in cooperation with other public or private partners. Two examples of public cooperation are an indoor green wall in a Turin school for place-based learning (NBS 13) and the newly established inclusive therapeutic garden in Zagreb (NBS 6) (see Figure 4). Since for both NBSs three public entities collaborate, they can be labelled “public³ NBSs”.

In Turin, the city works together with the school and the university Politecnico di Torino. The academic partner led the co-design and co-creation for place-based learning (green lab), as well as research on the abatement of indoor contamination by green wall solutions (NBS 13). Furthermore, it is intentionally designed to be replicable, which leads to a wide range of beneficiaries (school pupils, families, teachers, school administration, scientists, other schools, and public institutions). The City of Turin also ensures longer-term maintenance to pay for a professional gardener after proGReg.

The second “public³ NBS” is the therapeutic garden in Zagreb (NBS 6) (see Figure 4). Led by the City of Zagreb in cooperation with public day-care centres and the city’s landscape holding, inclusive therapy is offered in the garden for children and adults with and without physical and/or mental disabilities. The day-care centres focus on inclusive therapy measures as well as dissemination activities, mainly via social media. The City of Zagreb carried out the co-design phase, released a tender for the design, and commissioned the construction. The proGReg funding was supplemented with additional funding by the City of Zagreb. The therapeutic garden serves as a good practice showcase in the wider surroundings, encouraging replication for the valuable therapy and inclusion offered by suitable garden settings.

Strategic tools to improve public green areas build the core value of NBS 19 in Turin (see Figure 4). In addition to the theoretical framework, this NBS relies on a donation and sponsorship model for physical nature upgrade implementations. Private companies are the main donators, but individuals and small communities also contribute small financial shares to the model, allowing the project to, for instance, plant trees in an urban environment. This NBS calls for a paradigm shift by bringing in private actors for social responsibility actions. The recognition of public green areas as “urban commons” builds the basis. To ensure the improvement of public green areas, software was bought with proGReg money allowing high-quality mapping and spatial analyses and monitoring of green areas.

Some NBS implementations within the proGReg project are realised by cities with the third sector (associations, NGOs) and active communities; namely the ecosystem path in Turin (NBS 17) and Zagreb’s community meeting place “info point” (NBS 8) (see Figure 4). Key for the Turin “ecosystem path” is the cooperation of the City of Turin with the charity association Fondazione Mirafiori and the University of Turin. The wider population living nearby directly benefits from the 800 m path. Connectivity and the quality of stay, but also pollinator-friendly islands and step stones, are building elements of the ecosystem path resulting in an open, welcoming environment for people and wildlife, especially pollinators. While the City of Turin led the implementation, Fondazione Mirafiori ensured continuous citizen involvement, also by bringing in further associations. Additionally, a modular implementation allows replicability in Turin and beyond, demonstrating its pilot character.

The City of Zagreb developed a meeting place—the so-called info point (NBS 8)—together with the NGO ZIPS (see Figure 4). It acts as a hub for the other NBS implemen-

tations and their communication and dissemination activities. Furthermore, it supports community building. Individuals, but also clubs, i.e., a chess club or a mountaineering group, take advantage of the newly created community space for meetings and events.

3.2.2. Diversified Cluster

Five NBS implementations belong to the third sector of Pestoff's welfare triangle (see Figure 4): pollinator-friendly wooden garden boxes (NBS 5), an outdoor green wall at a homeless shelter (NBS 14), and a green roof (NBS 15) situated in Turin, as well as the pollinator biodiversity implementations in Dortmund and Turin (NBS 22 and 23). Dortmund's food forest (NBS 3) is positioned more towards the community due to the informal cooperation of different stakeholders, while the garden Orti Generali in Turin (NBS 4) and Dortmund's aquaponics system (NBS 10) are positioned on the edge between non-profit and for-profit towards the market corner of the third sector. Both are run by third-sector actors (social enterprise, local association), though aiming for financial self-sufficiency.

In Dortmund, the non-profit association "Naturfelder Dortmund e.V." was founded to manage the implementation of flower meadows in urban environments (NBS 22) (see Figure 4). This association foundation, in which a wide range of actors participate as members, has a long-term perspective beyond the project lifetime. The core values are citizen involvement, education, and raising awareness, but also to contribute to a mind-set change in public administration on how to maintain public green areas. Overall, it can be highlighted that the implementation of flower meadows is a rather cheap and easy way to implement NBSs as long as landowners are willing to offer their land for these activities.

In Turin, NBS 23 is implemented in collaboration with several involved entities from research organisations, social associations, health institutions, and the City of Turin (see Figure 4). The butterfly gardens are run as a citizen science project including social, inclusive, and further educational activities for a wider group of people (kids, teachers, refugees, social housing residents, Alzheimer's patients, elderly people...). While the financing is currently coming from proGReg only, the responsible group is aiming for a partly self-sustaining business model in the future. To reach this, they intend to charge a price for educational or social activities, such as planting or the construction of butterfly gardens in wooden raised-bed garden boxes. Overall, the costs for implementation are also rather low in relation to other more technical NBSs. Key is the close collaboration of skilled personnel and experts from social and environmental backgrounds.

The wooden garden boxes NBS pilot (NBS 5) aims to revitalise abandoned or under-used urban areas in a green and inclusive manner; 16 boxes are used so as to allow food production in raised-bed gardens independently from the ground soil conditions. While food, especially basil and rocket, is cultivated in 4 of the 16 boxes, the remaining boxes support nearby honey production. For realising this "urban common", the local NGO coordinates activities, while partners belonging to the "Pact of Collaboration" are realising, implementing, and operating the wooden garden boxes' activities. The pact is comprised of a multi- and transdisciplinary team. Beneficiaries are a social restaurant receiving food produce (basil, rocket) for pizza, but also the inhabitants living nearby, especially elderly people and young families. Additionally, some goods (honey) and services (rent for kids' parties, donations for outdoor gym activities) are sold. These already existing smaller revenue streams are intended to be increased in line with the expiring proGReg financing.

Another implementation is the extensive green roof solution on top of an abandoned public building (NBS 15) (see Figure 4). Like the wooden garden boxes of NBS 5 in the same location, an NGO coordinates the extensive green roof implementation and maintenance. Together with the City of Turin, an association of beekeepers, and the University of Turin, they planned and implemented a 140 m² low-tech green roof, which aims to attract pollinators, but also to withhold water in case of heavy rainfall. The maintenance of the green roof solution is carried out by the association of beekeepers once

a year, highlighting the extensive character of the NBS. Although it is considered a rather small intervention, the costs are quite high.

Dortmund's food forest (NBS 3) is positioned the furthest towards the informal community sector (see Figure 4). The food forest is implemented by a rather loose coalition. It is located on the property of a church and with their approval and supervision. The church is strongly committed to the project goals and works closely together with the community (NGO) and education (university). During the co-design phase, the team was able to gather a group of interested local people taking care of the garden. These interested active people come from different backgrounds and institutions, especially church members, scouts' members, locals living in the vicinity, and members of the NGO. The team implemented a self-sustaining food forest following permaculture principles. Before implementation, the area was barely used, without taking advantage of the site's potential for quality of stay and urban wildlife habitats. The food forest planting allows a transition from unproductive to productive urban greenery, aiming to harvest a variety of food along with improved biodiversity. Additionally, social values can be provided via the food forest, including education and knowledge creation, but also social interactions and community-building as well as a sense of belonging, responsibility, and ownership. The food forest does not primarily look for customers paying for goods or services. However, certain revenue streams might be established with the project's end. Children learning in the newly established food forest are benefiting from the NBS pilot. It is used as a green, outdoor classroom. The increased biodiversity location is also used by a beekeeper placing beehives at the fringe of the food forest. This rather cheap NBS benefits from the early engagement of experts on permaculture principles and self-sustaining urban gardening concepts.

Two NBSs of the third sector cluster straddle the non-profit/for-profit divide (see Figure 4). These are the urban garden Orti Generali in Turin (NBS 4) and Dortmund's aquaponics system (NBS 10). Orti Generali benefits a large group of people with different values. A social enterprise runs an urban farm on the property of the City of Turin. The concession for three hectares allows urban farming activities for several target groups. Local citizens (>1200) and disadvantaged people benefit from education and dissemination activities, initiating community building and social inclusion. In addition to these main beneficiaries, they rent 160 gardening parcels to local citizens. The social enterprise offers a standard fee (50 m² for EUR 25; 75 m² for EUR 35; and 100 m² for EUR 45 per month), as well as reduced rents for people in social difficulties and young people aged below 35 years. The yearly revenue for this income pillar accounts for ca. EUR 45,000. Sales via the garden kiosk generate even higher revenues. Additional significant income streams come from fees for courses and educational activities. However, education for the wider public is offered without any charge, while schools, practitioners, and newcomers are paying for these activities. About one hectare of the garden is reserved for educational purposes including a greenhouse and didactic garden. Furthermore, food trees, chicken, a green-house, and an apiary complement the urban farm. In the future, another 2.5 hectares will be added to the farm via a new concession. This is line with a long waiting list of people interested in renting gardening parcels. The social enterprise aims to be financially self-sufficient on short notice. They were very successful in applying for public funds; the proGReg money can be interpreted as leverage money for further funds and grants. Despite this financial aim (self-sufficiency), their food donations for people in economic difficulties validate their strong social mission.

Dortmund's aquaponics system (NBS 10) contributes to research and development on aquaponics, especially towards technological innovation, energy optimisation, and business models. The planning and implementation team consists of a university, an NGO, and a private business specialised in aquaponics (considered a key partner due to their expert role). With the launch of vegetable production in so-called deep water culture systems, the team is aiming to obtain customers, especially local people and gastronomy. With regard to the vegetables and fish, the revenues will be exploited by a renting concept, but also via direct sales of produce. In addition, services, such as courses and guided tours,

contribute to the site's revenue. In order to set up a viable business model, the significant planning and implementation costs have to be considered. However, the stronger research focus lies on the optimisation during operation, especially via energy optimisation. Thus, two identical greenhouses were built for research purposes. Both greenhouses are not equipped with any additional heating, but water tanks for heat storage extend the growing season. Furthermore, no artificial lighting of the vegetables is considered for cost-reduction purposes. A longer-term perspective for the two greenhouses and aquaponics is the International Garden Exhibition (IGA) 2027, which will take place—among other places in the Ruhr Metropolitan Area—in this area.

3.2.3. Sales Cluster

Three NBS pilots are implemented and run by private businesses with a clear profit orientation (Figure 4, bottom right). The two NBSs from Turin are the new soil NBS (NBS 2) and the aquaponics system (NBS 11), whereas the mini urban farm merging green walls and roofs with indoor aquaponics (NBS 12) in Zagreb builds the third sales-oriented business model.

Turin's new soil NBS (NBS 2) upgrades deep excavation soil and material for the development of sellable new soil (see Figure 4). The company realised a new soil composition especially for public green areas. Financially, the new soil NBS is lucrative, since the company is paid for taking the deep excavation material. They do not have costs for this one main resource; on the contrary, it is even an income for them. The main customers are private landscaping companies realising public green areas, both for new green areas and also for upgrading existing public green areas. Additionally, private people and households buy small portions of the new soil for their private gardens. Different qualities of new soil can be produced: for landfills only, low-quality soil is produced, while for parks the quality standards are higher, also resulting in a higher price. The quality for food gardens must be the highest, avoiding any harmful effects.

The aquaponics system "Mitte Garten" (NBS 11) in Turin's living lab complements a company's larger system (see Figure 4). The aquaponics production brings together vegetable production—basil, lettuce, and recently also tomatoes—and fish breeding, in this case carp. The key customers are restaurants via direct sale. The basil production is most profitable thus far. Additionally, "Mitte Garten" offers visits and courses for rehabilitation centres and schools. Since the system in Mirafiori Sud is integrated into an already existing greenhouse, the costs could be reduced. A further measure to reduce costs is the combination of vegetables and fish in one tank (fish eat the plant roots). It is an important showcase for innovative and new methods of growing food in cities and in post-industrial areas.

In Zagreb, the NBSs on aquaponics and green roofs and walls are merged together in a so-called mini urban farm (NBS 12) (see Figure 4). The company follows research and development purposes mainly in order to optimise (and customise) their business. It mainly relies on indoor farming produce. Additionally, the company developed a small niche market in selling their systems to other businesses, for instance innovative peri-urban farmers around Zagreb. They aim to extend this market segment further. By merging indoor aquaponics with outdoor green walls and roofs, the costs can be reduced, for instance, due to insulation advantages. Additionally, solar panels make the system partly independent from the public grid and volatile energy prices. In addition to their customers (business-to-consumers and business-to-business), the NBS benefits researchers and projects for research and development. Furthermore, students use the NBS implementation for practice-based learning units in the university's curricula.

3.3. Financial Benefits

The positioning of NBS pilots into Pestoff's welfare triangle between the state, market, and community rely on the governance building block of the NBS BMC template. The building blocks "cost reduction" and "revenue streams" allow the clustering of the NBS

cases according to their financial benefits. Since several implemented NBS cases are not aiming for any profit, a significant number create no or only low revenue streams and no or only indirect cost reduction measures (see Figure 5). At the same time, it becomes obvious that the revenue-oriented NBS implementations also look for ways and options to reduce costs at different stages of the NBS development, planning and co-design, implementation, and maintenance. A range of different NBS types and main stakeholder groups exploit cost-reduction measures. Thus, the economic dimension is not only of relevance for the market-oriented private sector, but likewise also for the centrally positioned third-sector NBS pilots as well as public entities implementing NBSs.

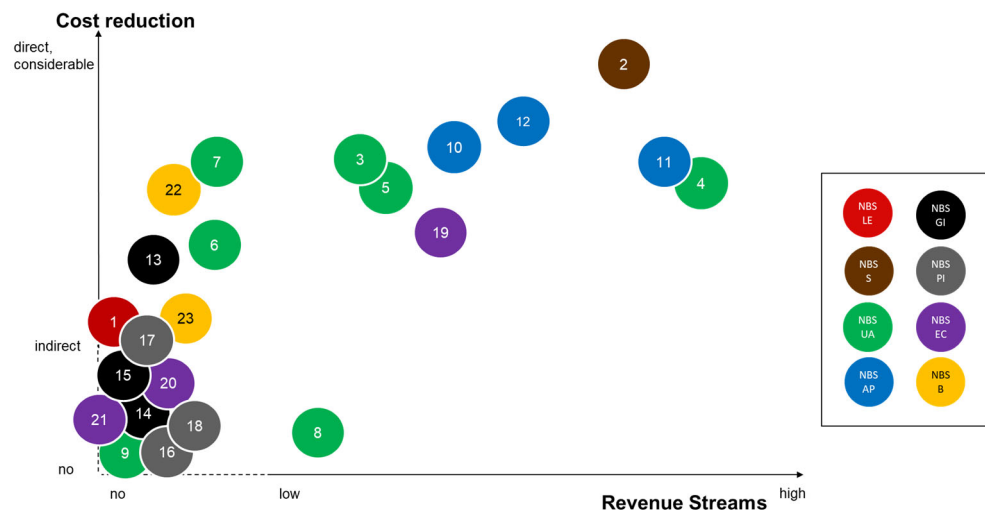


Figure 5. Financial benefits of the examined NBS implementations; numbers in circles represent the NBS implementation interviews.

3.4. Degree of Profit Orientation

The degree of profit orientation allows the structuring of NBSs regarding their economic focus (see Figure 6). Three NBS pilots in Turin, namely new soil (NBS 2), aquaponics (NBS 11), and the urban garden “Orti Generali” (NBS 4), show the strongest degree of profit orientation. The two businesses running NBS 2 and NBS 11 aim at the economic viability of the NBSs. The social enterprise managing “Orti Generali” (NBS 4) aims at financial self-sufficiency within the next three to four years. Several income streams build a robust foundation but demand suitable management and coordination. All NBSs with a certain profit orientation aim for an even higher degree of profit orientation in the future.

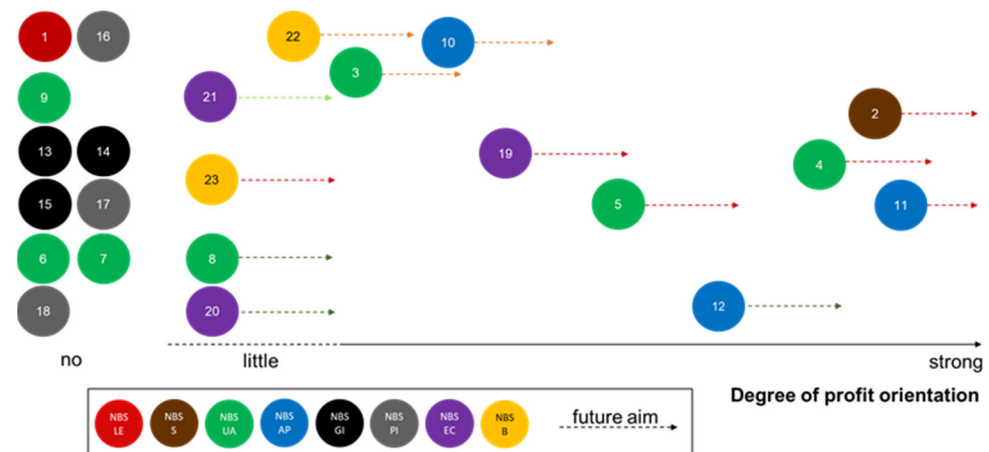


Figure 6. Degree of profit orientation of the examined NBS implementations; numbers in circles represent the NBS implementation interviews.

However, several NBS implementations are not oriented towards economic viability and profit making. These NBSs belong either to the public provision business model cluster (both city-internal and city-led) or the diversified business model cluster. Examples include the sport exercise park (NBS 1) and Deussenberg path (NBS 16) in Dortmund, planting activities along the Moon Lake in Ningbo (NBS 9), the modernisation of an existing urban garden (NBS 7) and the therapeutic garden (NBS 6) in Zagreb, and the outdoor green wall (NBS 14) and extensive green roof (NBS 15) in Turin.

Some NBSs are positioned between no (the very left of Figure 6) and a strong (very right) degree of profit orientation. This diverse group includes NBS implementations that start with small sales/offers, such as the food forest in Dortmund (NBS 3), but also public–private coalitions, such as the donation/sponsorship model in Turin (NBS 19) and the public–private partnership approach of NBS 21 in Ningbo.

3.5. Main Target Groups

The used NBS BMC template intentionally differentiates between the two main target groups, namely beneficiaries and customers. Most NBS pilots serve a significant number of beneficiaries (see Figure 7). The majority of implemented NBSs are open to the public, without any access barriers. Others have limited access, but only one—the extensive green roof on an abandoned building in Turin (NBS 15)—provides no direct access. Its primary objective is achieving environmental benefits. Additionally, education and knowledge creation take place in close proximity to the roof without demanding the physical access of beneficiaries. Some NBSs also have customers, some even many. Orti Generali is a promising example (NBS 4) of how to combine customers with beneficiaries. Local citizens (>1200) and disadvantaged people benefit from education and dissemination activities initiating community building and social inclusion. Customers are the people or small groups who are renting a gardening parcel, kiosk shoppers, and people attending and paying for courses and educational activities.

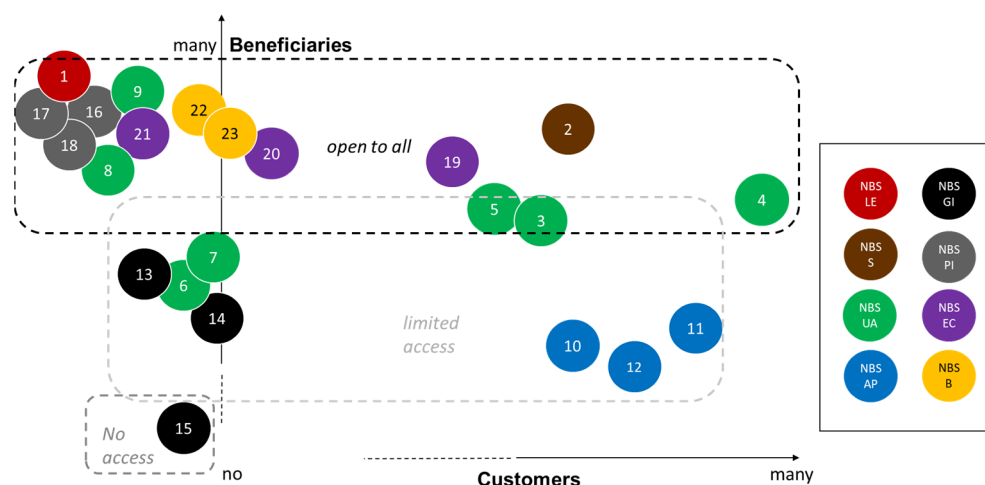


Figure 7. Main target groups of the examined NBS implementations; numbers in circles represent the NBS implementation interviews.

It is obvious that outdoor implementations are easier to access, especially when being implemented on land open to the public. Some pilots are designed for unlimited access or use, e.g., the sport exercise facilities in a park in Dortmund (NBS 1), an urban park upgraded with new soil (NBS 2), green corridors and connectivity (NBS type PI), flower meadows and other pollinator-friendly implementations increasing biodiversity (NBS type B), and many of the urban farming and gardening implementations of the NBS type UA. Indirectly, the planning guidelines (NBS type EC) benefit a large number of people by incorporating the participation of the public into planning processes following the idea of co-design. Contrarily, some pilots have no or only limited access. This is especially true for

building-integrated implementations, like an indoor green wall within a school building or an extensive green roof on top of an abandoned building.

4. Discussion

The results section presents the business models of NBSs with a special focus on governance and financing characteristics. Twenty-three individual NBS pilots belonging to eight NBS types were examined and analysed from different vantage points, namely governance, target groups, and financing. In the following, the results are discussed and interpreted in a synthesising manner with regard to the methodology used, the empirical findings, and transferability to support replication and upscaling. In terms of methodology, the used NBS BMC template from Stork et al. [70] affirms its wide applicability from profit-oriented NBS enterprises through social enterprises to public NBS interventions led by cities or other public entities. This modest but holistic tool functions as a valid method to collect and structure data on NBS business models for further analysis steps. Pestoff's welfare triangle serves as a suitable tool to position NBS governance structures between the state, market, and community and allows us to cluster the NBS cases without standardising the individual NBS type. Therewith, it enables us to compile business model clusters consisting of NBS cases with similar governance and financing models. Additionally, the emphasis on finances is implemented in the NBS BMC template by four distinct building blocks: (1) revenue streams, (2) financing, (3) cost structure, and (4) cost reduction. This detailing allows us to draw clear conclusions on the financial components of NBS implementations. Furthermore, it allows stakeholders in the field of NBSs to integrate financial aspects right from the beginning of the co-design and planning processes, which aim to valorise the potential of NBS implementations not only in post-industrial urban areas, but also broader applications beyond.

In terms of the analyses' findings, the clustered pilot case study collection (23 NBS cases) allows different stakeholders with varying objectives, backgrounds, and motivations to select NBS business models of their interest. This relates not only to the NBS type itself, e.g., an aquaponics system vs. a food forest, but especially also in terms of governance and financing models. The collection shows the diversity of NBS implementations regarding the four aspects: types, governance models, financing strategies, and target groups, and their various combinations of manifestations. Although this explorative study used the data of 23 NBS cases, these findings already show that the governance and financing models tend to be type-independent. The division into two main target groups addressed by NBS implementations raises the need for further research. Within this respective sample, this classification tends to be type-dependent.

Several transferable solutions to overcome governance and financing challenges can be derived from the clustered pilot case study collection. NBSs' governance models are very adaptable to the individual NBS cases, are type-independent, and can include a large diversity of involved stakeholders in order to contribute their functions in the NBS implementation. This is in line with UNaLab's [64] study. They were able to conclude that NBSs' business models are context-dependent and therefore should be individually tailored. Recommendable financing strategies are donation and sponsorship models (e.g., NBS 19), collaborations with research (e.g., NBS 19), the remuneration of beneficiaries through public partners, recurring revenue streams such as renting (e.g., NBS 4, 10), and sales as one-off payments for goods (e.g., NBS 11 and 12). For financial benefits, both revenue streams and cost-reduction measures play a pivotal role. In order to generate long-term sustainability, cost-reduction measures are necessary for all NBS implementations independent from their revenue streams. To reduce costs, the use of already existing sources for resources is recommended, e.g., NBS 13 saves energy through locating the green wall under a roof window so that no additional artificial lighting is required. Another example is the new soil NBS 2, which is using the soil from deep excavation sites—often considered as waste—as a key resource of their distinctive business model. The responsible company is even paid for turning this “waste” into a key resource and success factor. Although none of the examined

NBS cases have achieved self-sufficiency thus far, some NBS cases (2, 11, 4) aim for it. These three cases are all positioned in the sales cluster at the bottom right of Pestoff's welfare triangle. Combining different NBS types is a recommendable way to generate multiple synergies (e.g., NBS 12). However, this can raise governance complexity and the need for sophisticated NBS management. This is one example for the dependence of the governance model on the financing strategy, which was also one main conclusion from Egusquiza et al. [15].

Regarding declining public budgets, alternative approaches for compensating this lack of finance are required for some NBSs of the public and diversified business model clusters. The results show that it therefore could be suitable to integrate entrepreneurial thinking from early on in the implementation process of NBSs. Entrepreneurial thinking goes beyond exploiting promising revenue streams, also utilising financing strategies and measures to reduce costs, especially in the maintenance and evolution phase of NBS implementations. The cooperation of various stakeholder groups is deemed a suitable and sustainable way towards the mainstreaming of NBS implementations. Through combining public, private, and third-sector stakeholders, new, synergetic alliances can be developed in order to create more flexible and innovative milieus, sustainable long-term perspectives, and reduced dependencies upon temporary public financing. This is in line with the conclusions of Mayor et al. [14], who recommend facilitating the engagement of public, private, and community stakeholders.

Concerning land-use management, the analysed NBS cases show diverse solutions for revitalising and renewing post-industrial sites in deprived neighbourhoods into nature-driven and future-oriented land uses. They cover soilless production systems (in this project especially aquaponics) and an upgrade of a former landfill site (NBS 1), but also the shift from unproductive to productive green infrastructures such as urban gardens and farms. Additionally, the urban planning guidelines of NBS Type 7 emphasise the need for serious participatory processes and co-design activities, as well as the transition to a green paradigm in urban planning.

As limitations of this study, (1) the number of examined NBS cases, (2) the connection of all cases to the proGReg project, and (3) the soft scaling used when analysing the data have to be mentioned. Therefore, there is a further need to examine additional NBS cases from outside the proGReg project and to develop fixed quantitative criteria for the clustering, also by using the findings from this empirical explorative work. Finally, this study's reliance on the NBS BMC framework might leave other relevant aspects aside, despite being comprehensive with regard to the overall business model layout. However, it may also constrain the exploration of emergent themes not encapsulated within the structure of the business model canvas adapted to NBSs.

5. Conclusions

This explorative study aimed first to test the applicability of the proposed NBS BMC template from Stork et al. [70] and, second, to provide a clustered NBS business model pilot case study collection, which enabled the derivation of transferable solutions for overcoming the typical NBS implementation challenges: governance and financing. Methodically, this was achieved by using the NBS BMC template from Stork et al. [70] for guided interviews. In total, 23 NBS implementations were examined in proGReg's four Front Runner Cities. The collected data were analysed using specific building blocks of the NBS BMC template. Pestoff's welfare triangle [71] enables the clustering of the NBS interventions into business model clusters.

The main business model clusters are public provision, sales, and diversified, which can be further detailed. This includes public-private partnerships or sponsorship/donation models bridging public and private spheres, as well as diversified approaches relying on services or rental concepts. NBSs' governance models are very adaptable to the individual NBS cases, are type-independent, and can include a large diversity of involved stakeholders in order to their functions in the NBS implementation. The used NBS BMC template affirms

its wide applicability and functions as a valid and holistic method to collect and structure data on NBS business models.

The clustered pilot case study collection (23 NBS cases) allows different stakeholders with varying objectives, backgrounds, and motivations to select NBS business models of their interest. It offers broad usability by covering diverse NBS implementations in terms of four aspects, namely type, governance model, financing strategy, and target group, as well as various combinations of manifestations of these four aspects. Therewith, the practical implications of the pilot case study collection are that it delivers transferable solutions for NBSs' implementation challenges, which offer a broad applicability for already implemented and planned NBSs. Therefore, individual, innovative pilot solutions receive broader recognition and a higher adoption rate. Although this clustered pilot case study collection and the derived solutions for overcoming governance and financing challenges of NBS implementations focus explicitly on NBSs, the recommendations can also be applied to innovative approaches beyond the NBS domain, e.g., innovative urban planning strategies. Accompanying the contribution of this study to supporting the broader implementations of NBSs, the analysed NBS pilots show diverse solutions for revitalising and renewing post-industrial sites in deprived neighbourhoods into nature-driven and future-oriented land uses.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/land12122116/s1>, Figures S1–S23: NB S BMC templates 1–23.

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