

# The inclusion of natural capital in spatial development

Need for improvisation in planning procedures



Eva-Lanxmeer neighborhood, Culemborg. Personal Picture.

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Wageningen Environmental Research offers a combination of practical, innovative and interdisciplinary scientific research across many disciplines related to the green world around us and the sustainable use of our living environment. Aspects of our environment on which Wageningen Environmental Research focuses include soil, water, the atmosphere, the landscape and biodiversity – on a global scale as well as regionally, from the Dutch polders to the Himalayas and from Amsterdam to the Arctic (retrieved from Wageningen Environmental Research website).

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# 1 Introduction: Problem description and research objective

## *Problem description*

Climate change and urbanization are affecting the structure and processes of biodiversity through temperatures increase and the creation of man-made barriers (Grimm et al., 2008; Haase et al., 2017; Kabisch et al., 2017). In the Netherlands, spatial planning plays an important role in biodiversity conservation and inclusion. The Dutch national strategy for spatial planning and the environment contains visions and goals for nature inclusion to be reached by 2050 (Government of the Netherlands, 2019). Examples are the inclusion and protection of natural capital in urban areas and the countryside, to promote sustainable growth (Government of the Netherlands, 2019; Vora & Vanema, 2008). Nature inclusion in urban development embeds the concept of nature-based solutions, through which it is possible to enhance the role of nature within planning and design tasks (Pauleit et al., 2011). Nature-based solutions represent a link between the use of nature in urban development and the related environmental and economic benefits. Numerous projects that incorporate nature-based solutions have already been implemented. Nonetheless, they are still in an experimentation phase and little is known about their long-term effects (Kabisch et al., 2017). The Dutch natural capital is protected by the Nature Conservation Act of 2017, based on the Habitats Directive (92/43/EEC) and the Birds Directive (79/409/EEC) stated by the European Union, which together form the delineation of Natura 2000 areas. Any spatial development that may harm these areas is not allowed (Beunen & van Assche, 2013; Ministry of agriculture, nature and food quality, n.d.).

Yet, outside protected areas, spatial planning does not always take nature into account. Urban development still represents a threat to natural capital, especially in a densely populated country like the Netherlands, where 75.000 houses need to be built every year (Iamexpat.nl, 2019). Municipalities are the responsible governmental bodies to evaluate construction permits and give permission. Everybody can apply for construction or other types of permissions, which can be granted by municipalities even if these harm or damage nature. An example is a request to cut trees or to change the course of water bodies to realize a new construction (Rijkswaterstaat, Ministry of Infrastructure and Water Management, n.d.). These factors do not support the inclusion of nature.

The recognition of environmental problems and the creation of environmental visions pushes governance paths towards a more nature-inclusive spatial planning in the Netherlands (van

Assche et al., 2013). Nonetheless, unsuitable spatial planning regulations and governance configuration can represent obstacles for nature inclusion (Beunen & van Assche, 2013). Dependencies within a governance path help to understand path configuration and direction (van Assche et al., 2013). With the presence of certain dependencies in spatial planning, nature inclusion could be ignored and may need improvisation in its processes. Project commissioners, developers, and architects need to find alternative solutions to protect and include natural capital in their plans. It is argued that improvisation leads to more effective spatial interventions (Inam, 2010; Rowan, 2004). It requires to embrace ambiguity and uncertainty rather than stuck on conventionality (Inam, 2010). Given this information, this study aims to generate knowledge about natural-capital inclusion in spatial planning.

### *Research objective and questions*

The main goal of this research is to find out how nature inclusive spatial developments in the Netherlands need improvisation compared to mainstream procedures. Based on this objective, The research question is formulated as follows:

*How nature inclusive spatial developments need improvisation, compared to mainstream spatial development?*

The research question is fragmented in two sub-research questions:

- I. *What are the mainstream procedures in Dutch housing development?*
- II. *What kinds of improvisation need nature-inclusive spatial developments?*

In the next chapter, I indicate the methodology used to answer the research question(s).

## 2 Methodology

This research describes mainstream spatial development and compares it with three nature-inclusive case studies to investigate elements of improvisation. The used methodology includes:

- I. A literature review (nature-based solutions and spatial planning regulation for natural-capital inclusion)
- II. A theoretical framework (governance paths and improvisation in spatial planning)
- III. Semi-structured interviews (to actors who participated in the development of three nature-inclusive neighborhoods).

Literature about nature-based solutions and spatial planning regulation on nature inclusion and protection was chosen because it provides an understanding of practices of natural capital inclusion in spatial planning. Most papers and documents were found through a deductive approach, by searching with keywords (i.e. *natural-capital inclusion, spatial planning regulation, dependencies, and improvisation*). Certain papers and documents were also chosen through snowballing, by looking at reference lists in papers and related links on websites. Dependencies in governance and improvisation in spatial planning were chosen as a theoretical framework to analyze the results gathered with the interviews to answer the research question(s). Lastly, semi-structured interviews were conducted to one expert on Dutch planning procedures, and people (six) involved in three nature-inclusive spatial developments. The interviewees have relevant expertise and background (spatial planning, design-architecture, ecology, nature conservation) and they were/are involved in the planning and design phases of such cases. The three cases were chosen due to their location (all of them are located in the Netherlands), for they nature-inclusive approaches stated in different publications and websites. The goal of the interviews is to investigate how natural capital inclusion in spatial planning deals with regulations in real cases, and if such an inclusion leads to improvisation. Then, it will be determined what kind(s) of improvisation(s) is/are related to nature-inclusive housing developments by focusing on what is improvised, who improvises, and how something is improvised during the development of the three cases.

### 3 Background information on the three case studies

The interviews were conducted to people involved in the development of three nature-inclusive neighborhoods. The chosen neighborhoods are *Kerckebosch* in Zeist (province of Utrecht), *Eva-Lanxmeer* in Culemborg (province of Gelderland), and the ecovillage *Ecodorp Boekel* located in Boekel (province of North-Brabant).

In Kerckebosch Zeist, design and implementation focused on enhancing nature and social involvement (Craftvue, 2019). In 2019 the neighborhood was declared the most nature-inclusive development in the National Debate on Nature Inclusive Building (Craftvue, 2019). The design started around 2005 and the construction is still in development. Once finished, the new neighborhood will have 1100 inhabitants.

EVA-Lanxmeer consists of 250 houses and small businesses, realized by following the main principles of integration and participation (EVA-Lanxmeer: Results: Urban green-blue grids, n.d.). It was in 1994 the EVA foundation was created with the purpose to contribute to an environmentally conscious society (EVA-Lanxmeer, n.d.). That was the starting point of EVA-Lanxmeer development. The design phase started in 1997 and the construction of the original masterplan was concluded in 2008, but there are still little developments taking place in the area.

The third case is the Ecodorp Boekel located in Boekel. The idea of the development started from the willingness to promote the sustainable development goals (SDGs) through the creation of an ecovillage. It is the result of a bottom-up and co-creative process, which represents a living lab for a more sustainable future (SDG wijk Ecodorp Boekel, n.d.). In 2018 the municipality of Boekel agreed with the design and biodiversity plans and decided to permit the development of the ecovillage. The ecovillage will have 36 house units and will be home to about 50 people. The design was concluded in 2018, construction works started on the same year.

## 4 Literature review

### *A natural capital approach: nature-based solutions*

Nature-inclusive cities provide a great number of measurable benefits for humans and the environment, which are necessary for the survival of our species (Monti, 2020). Urban areas provide space where to apply policies that can protect and sustain natural capital (Grimm et al., 2008). Natural capital is defined as ‘the world's stocks of natural assets which include geology, soil, air, water, and all living things’ (World forum on natural capital, n.d.). Natural capital approaches are essential for the management, protection, and restoration of natural environments (Vora & Vanema, 2008). Furthermore, they support the transition towards sustainable development and circular economy (Loorbach & Oxenaar, 2018).

An example of natural capital approach in spatial planning are nature-based solutions, which provide multiple benefits to adapt and mitigate climate change, to protect biodiversity, and to improve quality of life (Ec.europa.eu, 2019; Emilsson & Sang, 2017; Haase et al., 2017). In particular, they represent actions to protect, manage and restore natural or modified ecosystems

(Nature-based Solutions, 2020). Droste et al. (2017) point out that nature-based solutions work as a shelter for natural capital in the urban context, by providing beneficial effects such as cooling down of temperatures, noise barriers, and carbon sequestration. Even if their benefits arouse interest in their investment, it is hard to arrange financial strategies for their realization. In urban areas, public actors are the ones that provide financial support for the implementation of nature-based solutions. Besides, there are necessary policy instruments to support the realization of nature-based solutions such as information (e.g. monitoring), cooperation (e.g. public-private partnership), and green spatial planning (Droste et al., 2017).

### *The inclusion of natural capital in Dutch spatial planning*

The Habitats Directive (92/43/EEC) and the Birds Directive (79/409/EEC) constitute together the basis of the ecological network of protected areas “Natura 2000” stated by the European Union. Member states, including the Netherlands, have to comply with those directives. According to Beunen & van Assche (2013), Dutch spatial planning became more legalistic after the designation of Natura 2000 areas with clear spatial delineations between natural and other areas. Before such a change, those delineations were parts of spatial planning itself. Delineations of sites were made considering their dynamic and based on an ecological perspective that enhanced the unit of ecosystems but also their processes and flows. With this simplification and without deliberation by the legal system, environmental adaptation in spatial planning lost some of its space (Beunen & van Assche, 2013). This may explain why outside those delineations natural capital inclusion is not considered when new spatial developments take place. This strict regulation leads to more conflicts in decision making and thus increases the opposition to nature-conservation rules by the actors involved (Beunen, 2006). Besides, the governance configuration in the Netherlands does not support natural capital inclusion in spatial planning; the Dutch central government is responsible for the national policies on major natural areas, whereas regional and local authorities (provinces and municipalities) set their own rules for nature inclusion and protection (Ministry of agriculture, nature and food quality, n.d.). Because of this governance pattern, many municipalities are free to exclude nature-inclusive policy for new developments.

## 5 Theoretical Framework: dependencies and improvisation in spatial planning

### *Governance paths and dependencies*

With its vision of a nature-inclusive country by 2050, Dutch governance is addressing environmental issues in its spatial planning policies.

The evolution of governance is related to the concept of a path formed by actors, institutions and expertise. As Dutch governance is multi-level governance (where the levels are national, regional and local), several paths exist and form. The evolution of one path can affect others and vice-versa. These paths are subject to dependencies that do not allow actors to freely change the paths' course (van Assche et al., 2013). Van Assche et al. (2013), distinguish path dependence, interdependence and goal dependence.

Path dependence refers to conservative views, restrictions of choice, locked - in mechanisms and traditional approaches, which impact the evolution of a path (Koch et al., 2008; van Assche et al., 2013). In the case of natural-capital inclusion in spatial development, path dependencies can be recognized in legislation and governance configurations that hamper the transition towards a nature-inclusive approach in spatial planning. These elements emerge and make choices more constrained by affecting outcomes of policy making (Koch et al., 2008). They guide governance in a certain direction through formal and informal rules (van Assche et al., 2013).

Interdependence refers to the relations between actors in governance processes, between actors and institutions and between institutions. Actors and institutions can complement or block each other's role but also develop their roles for a common good. In the case of natural capital inclusion in spatial development, interdependence refers to the relation among governments (local, regional and national) and all the other parties involved in the development (project commissioner, project developer, architects, etc.).

Goal dependence, considered the dependence on the future, refers to those visions or plans that change the configuration of actors and institutions. Plans and visions affect the present configuration of actors and/or institutions (van Assche et al., 2013). In the inclusion of natural capital in spatial development, examples of goal dependence are those environmental visions that affect spatial planning policies (e.g. the ones contained in the Dutch national strategy for spatial planning and the environment).

When path dependencies hold actors and processes from reaching their goals, there might be the need to break them. Improvisation in spatial planning could represent a way to overcome path dependencies and facilitate goals' achievement.

### *Improvisation in spatial planning and design*

Improvisation is defined as a creative act that is done without previous thinking (Halpern *et al.*, 1994). This definition particularly refers to the context of comedy and acting (e.g. theatre and music). Inam (2010) argues that learning from (comedy) improvisation can support urban planners and designers to put in practice new ideas and ambition. They need to take risks for developing innovative solutions and sometimes they fail. Improvisation allows one to accept failure and learn from it. Furthermore, it supports a good collaboration between stakeholders' tasks, as spatial planning and design are increasingly interdependent fields that need abilities to co-work and communicate. Acting as improvisators, planners and designers see projects as on-going processes in which each other's idea can be explored, rather than an ended product (Inam, 2010).

Rowan (2004) distinguishes three modes of improvisation in urban planning and design, depending on how improvisation takes place. He identified improvisation by deviation, response, and insurgency (**Table 1**). The first kind refers to a deviation from the original plan which is spontaneous. The reason for such improvisation may vary from a refusal of the original plan to an appreciation of the used alternative. The second kind of improvisation refers to a response to something that was not included in the original plan. The third kind refers to an improvisation that goes against the original plan and implies resistance to the original plan and imposition of another (Rowan, 2004).

<b>Improvisation by deviation</b>	<b>Improvisation by response</b>	<b>Improvisation by insurgency</b>
Refusal of the original plan through the use of a prepared alternative	Reaction to a certain event not foreseen in the original plan	Resistance to the original plan through the imposition of another plan

**Table 1.** Three modes of improvisation in the planning and design phase of urban development (Rowan, 2004).

In this research, the expression 'original plan' refers to mainstream procedures of spatial development. Improvisation may be an action needed to change the mainstream and to include

natural capital. The framework showed in **Table 1** is used to investigate what kind of improvisations occur in nature-inclusive spatial development in the Netherlands. The three modes of improvisation are interconnected with each other and it may be hard to distinguish one from another (Rowan, 2004). However, by also focusing on what is improvised and who is/are the improvisator(s), such a distinction can result clear.

## 6 Results: spatial development among mainstream and nature inclusion

### *Mainstream spatial development in the Netherlands*

In the Netherlands, protected areas that have high natural values (as Natura 2000) are not considered for housing developments. That is not the case elsewhere. In unprotected areas, all the activities that regard ordinary building, demolishing, renovation, and that might harm natural capital, require a previous application for the so-called "all-in-one permit for physical aspects". This permit is part of the general provisions act "Wabo" that represents the basis for permits related to the physical environment (Netherlands enterprise agency, n.d.). The application is open to both public and private actors and the responsible authority is the local government (municipalities) where the application is made. Municipalities can decide to accept or refuse an application even when it is for spatial developments that are not nature-inclusive (Rijkswaterstaat, Ministry of Infrastructure and Water Management, n.d.). In many cases, the only purpose in starting a development remains to obtain the highest monetary revenue from land.

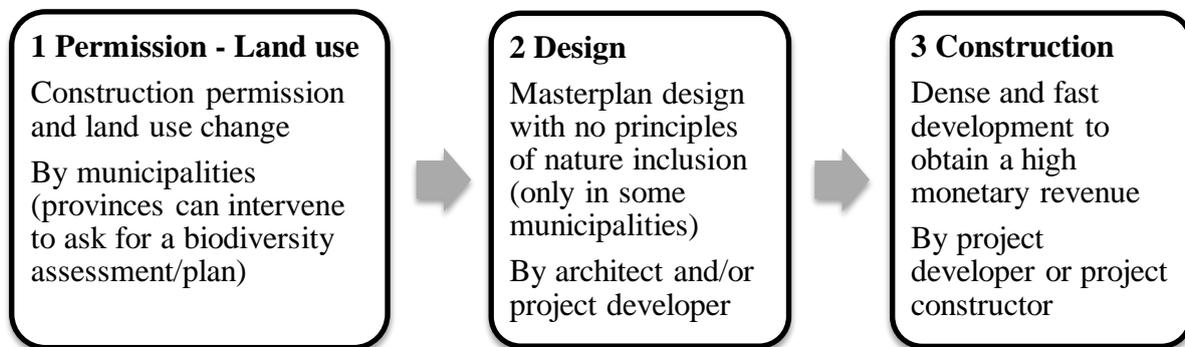
Even in the later stages, nature inclusion often remains unconsidered. When a new development starts there is either a change in the land use or it can remain the same. In the first case, municipalities are responsible for land-use changes. Such a process implies an analysis of the land where new constructions will occur. That analysis consists in checking if the soil (on the surface and underground) is suitable for the presence of new buildings.

Differently, when the land-use remains the same (because of previous/current building presence) municipalities have the decisional power to demolish, renew, or enlarge the existing neighborhood without need to check for existing natural values.

Either if municipalities have the ownership of the land or not (often they sell the land to private project developers), the usual development is done without nature-inclusion in the plan. Only

some municipalities introduced regulation for natural-capital inclusion, but as a choice. Furthermore, every municipality must build a certain number of houses per year, a fact which usually put apart natural capital. If that amount is not reachable because of different reasons (e.g. not enough space), the houses that remain to be built are developed on another land with a different land destination. When the construction starts, the process is not stoppable unless the regional authorities (provinces) consider the presence of natural values to protect.

These are features of mainstream spatial development, that explain why natural capital is put aside. Based on this information, the usual procedures of spatial development are schematized in the following phases. (**Figure 1**).



**Figure 1.** The main development phases of mainstream spatial development in the Netherlands.

The results obtained from the interviews about the three case studies will be organized by following these three phases, to have a comparison between mainstream housing development and nature-inclusive housing development.

### *Nature-inclusive spatial development in the Netherlands*

#### *Kerckebosch Zeist*

The development of Kerckebosch started from the initiative of the municipality of Zeist and the housing corporation ‘woning corporatie’, owner of the old buildings previously located in the area. Before Kerckebosch Zeist, the area included big building blocks and a small forest, which divided the buildings from the rest of the town. The forest part belonged to the municipality, whereas the building blocks belonged to the social housing corporation. Around the year 2000, the municipality of Zeist and a housing corporation made a coalition under the name of WOM, to start the new development together. The land use remained the same for the areas where the old buildings were located and changed for the forest area, becoming with housing destination.

Since the beginning, the goal of the WOM was to realize a nature-inclusive neighborhood with 55% social housing and 45% private housing with also public buildings. The main idea of nature-inclusion was to integrate the new neighborhood with part of Utrecht Landschap, a protected natural area located in the province of Utrecht. A first masterplan was drawn around 2005 by a studio specialized in urban design. It gave a general impression of how the area should have looked, but it lacked details about how to incorporate nature in the plan. For this reason, in 2009 the development was assigned at another studio of urban design, also specialized in landscape architecture. Since then, nature inclusion started to become the main factor in the design development. The WOM, together with the new studio, was able to create a plan based on biodiversity increase in the area.

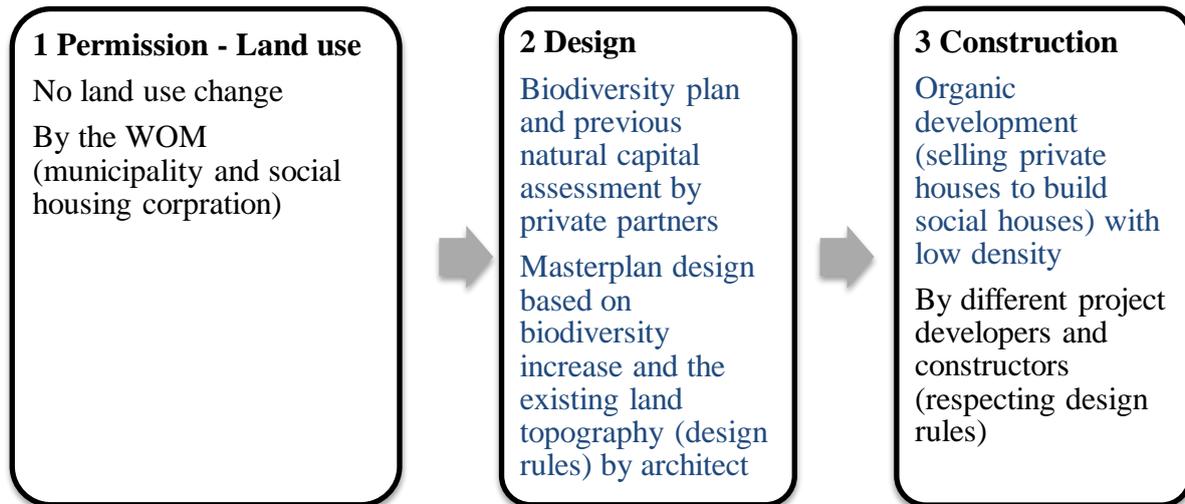
The first aspect of the biodiversity plan regards trees. As mentioned before, the old neighborhood incorporated a forest. A great number of trees needed to be cut to build houses and other buildings. In this case, the legislation says to plant one tree for any tree that is cut, without considering trees' age and type. To be aware of what was going to be cut and what needed to be preserved, the WOM decided to make a trees' analysis by focusing on type, life expectancy/condition, and dimension. To keep certain trees, that analysis brought to the decision of the WOM to not stick on regulation when it comes to distances between trees and buildings (> 5 m), and between trees and roads (> 3m). Furthermore, besides planting new trees to replace the cut ones, parts of trees were used for different functions (i.e. natural fences and barriers to avoid car parking). Not respecting the regulation about distances between trees and buildings caused some conflicts between inhabitants and project designer. Current inhabitants still have the power to ask that trees that do not respect the distances stated by the regulation have to be cut (in their property). In front of such a request, a municipality cannot refuse. In this situation, some inhabitants (even if they decided to live in a nature-inclusive neighborhood) prefer to feel safer in front of the risk that the trees could fall or receiving more daylight inside their houses instead of keeping a tree. This situation is a result of a lack of awareness about a tree value. As a response, the WOM decided to increase communication between inhabitants and landscape architects to increase such an awareness. Furthermore, together with Utrecht Landschap, the WOM decided to give a free one-year membership to every new inhabitant of Kerckebosch to visit Utrechts Landschap areas to increase inhabitants' sense of responsibility about the natural capital in the surroundings.

Another element of the biodiversity plan is the creation of heathlands within the neighborhood. In the part where the area borders with Utrecht Landschap, the delineation of the boundaries became less strict and more dynamic. This part of the area was chosen to have heathlands which are in direct contact with houses and inhabitants. They are under the ownership of Utrecht Landschap, which eventually gained more land with the development of Kerckebosch (**Figure 2**).



**Figure 2.** Masterplan of Kerckebosch. The blue line represents the new boundaries between Kerckebosch and Utrecht Landschap, and how they are dynamic rather than strict. The pink color areas (bottom-right) represent the heathlands integrated into the neighborhood. Source: <https://www.wurck.nl/projecten/kerckebosch-zeist/>

During the development, the biodiversity plan was translated into a "passport" of the neighborhood. After the masterplan and biodiversity plan were ready, different project developers bought different compartments of Kerckebosch from the WOM. All developers agreed to respect such a passport within any decision they want to make about design, by also keeping a dialogue with inhabitants. The financial strategy for the construction is based on an "organic development" based on selling private houses first, to make money for the development of social housing. It is important to mention that the whole development does not include an underground sewage system, as the rainwater is all infiltrated in the ground or collected for different uses. Construction materials are obtained locally as much as possible. Public spaces are built with 90% of material that comes either from Kerckebosch or from the concrete of the demolished buildings. The design was made by respecting the topography of the land, and the main strategy consists in the integration of the neighborhood with the protected area of Utrecht Landschap, by having more dynamics and less strict boundaries than before. The main project phases of the Kerckebosch Zeist are summarized in **Figure 3**.



**Figure 3.** The main development phases of Kerckebosch Zeist.

### *EVA-Lanxmeer*

The idea of EVA-Lanxmeer comes from the EVA foundation, created in 1994 by architects, water experts, energy experts and other people with a different background.

The main goal of the foundation was to realize a pilot project that integrated ecological architecture, the relationship between man-nature and permaculture. The land was offered to the foundation in 1995 by the municipality of Culemborg when they became aware of the idea of the project. The permission given by the municipality was quite unusual since part of the land was with agricultural destination and the rest was a water abstraction zone. The regulation does not allow to build on such lands, but the municipality decided to make an exception. A first issue came up during the planning phase of the project because another housing development was taking place in the city. The problem was the excess of houses to be built within a municipality in one year. The other development led by a private project developer consisted of a very dense housing neighborhood that already exceeded the maximum allowance of houses. The process was not stoppable, not even by the municipality of Culemborg. However, because of their interest in the project, the province of Gelderland intervened deciding to grant permission to the foundation to proceed with the project. With this permission, the province allowed to build 50 houses per year.

To avoid potential damage to the structure and sub-structure of the land, the EVA foundation and municipality decided to carry out an ecological and archeological study of the land before the design and the development phases. This study, made with the support of an archeological advice office and ecological experts, brought to the discovery of old human settlements and a

residual water channel. Based on these discoveries, the masterplan of the neighborhood was designed by preserving the land where the settlements were found, re-creating the old water body and incorporate the existing landscape elements (e.g. natural levees). That study also identified the underground layers present in the area (e.g. impermeable clay layer which separate the water extraction area with other underground water flows) to decide where to build without disturbing the sub-soil systems. The inclusion and valorization of the existing landscape characteristics (e.g. the residual water) was a principle embedded in the design strategy (**Figure 4**).



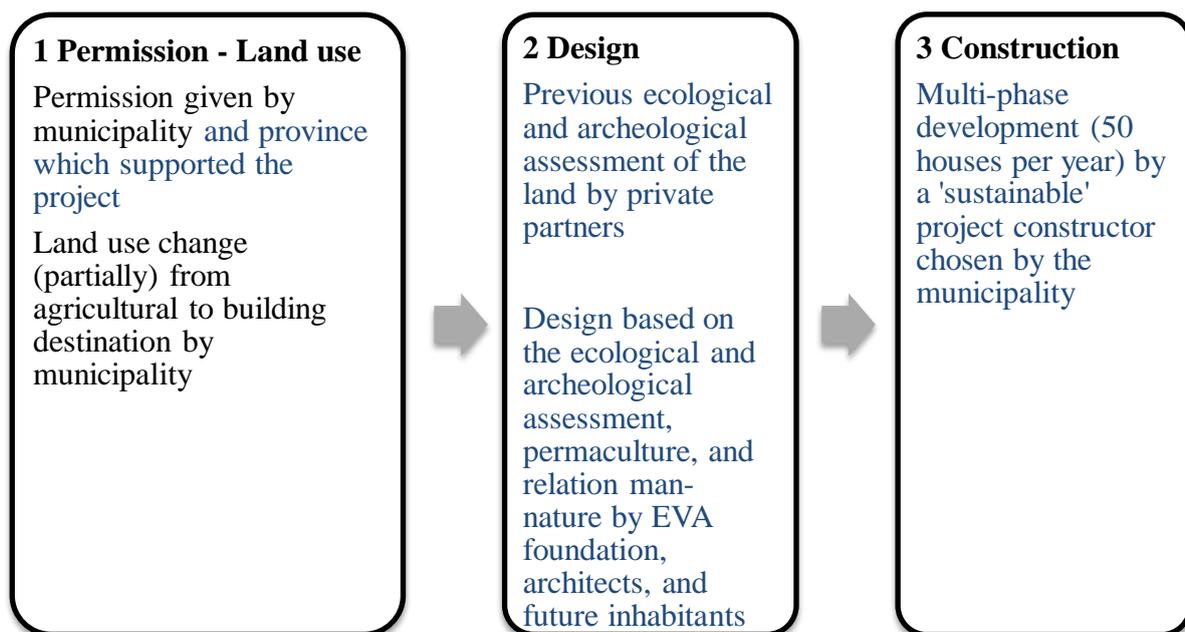
**Figure 4.** Masterplan of EVA-Lanxmeer. The blue arrow indicates the residual water channel incorporated in the design.  
Source: <http://www.eva-lanxmeer.nl/>

Since the beginning, the foundation EVA and the municipality agreed on excluding any project developer for the realization of the neighborhood. Different architects were commissioned by the foundation and municipality to design the buildings. Different parcels of land were assigned to different project constructors chosen by the future inhabitants (for the first houses) and successively by the foundation. Future inhabitants could also choose to make small changes in the design plans during the construction. However, part of the development does not stick to the original plan. Some houses were built on areas of the land where the original plan excluded the possibility to build, due to the type of subsoils or presence of valuable landscape elements. This was possible through negotiations with the inhabitants already living in the neighborhood and the municipality, but not without little conflicts. Some inhabitants were not enthusiastic

about the replacement of natural surroundings around their houses with more houses and about the increase of building density in the neighborhood.

Inhabitants formed different groups to manage the neighborhood from different aspects. An example is the BEL, a group whose role is to keep the neighborhood based on the original ideas (organic architecture, relation man-nature, and permaculture) through meetings to find new inspirations and take new decisions.

Multiple innovations enhance the relation man-nature in the neighborhood, for instance, the water systems. The rainwater is all infiltrated in the ground, the greywaters are purified in reed beds and re-used for multiple functions, whereas the black waters go in the sewage system of the municipality. Those are the only waters that go into the municipal sewage system. The residual water body is now the main water abstraction source for drinking water production in the neighborhood. The main project phases of the Eva-Lanxmeer are summarized in **Figure 5**.



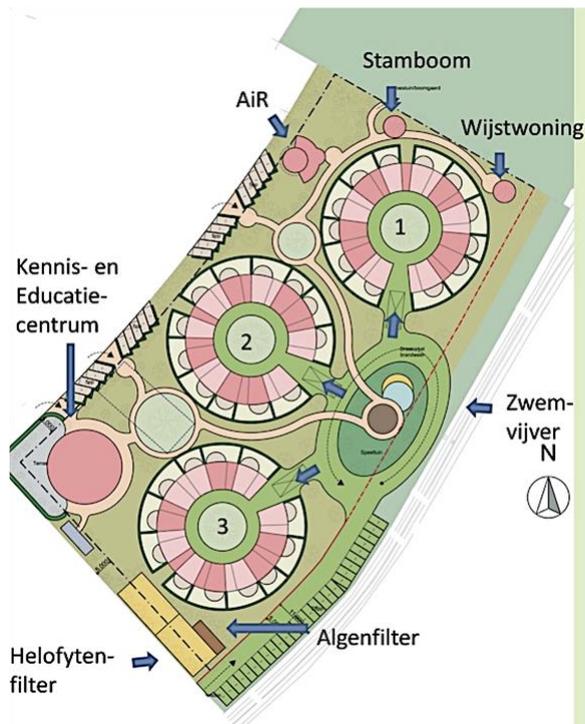
**Figure 5.** The main development phases of EVA-Lanxmeer.

### *The Ecodorp Boekel*

The foundation Ecodorp Boekel was created In 2013 by people coming from different countries and with different backgrounds who shared the will to live in a better environment and working on some of the sustainable development goals (SDGs). The same people who founded Ecodorp Boekel are also the future inhabitants of the neighborhood. The municipality used to be the owner of the land (with agricultural destination) when decided to give part of it for free to the

foundation Ecodorp Boekel in 2014 because of their interest in the idea. The foundation had five years to develop a biodiversity plan and a design plan for the realization of the eco-village. The biodiversity plan was financially supported by the national green fund. Nature's account on the land is close to zero, probably due to its previous agricultural destination. This is the first reason why the natural-capital account needs to increase. The plan for biodiversity is particularly based on the protection and increase of different species (two butterflies species, two birds species, two wild beasts species, two insect species, and two bats species). Regarding bats, the province of North Brabant has multiple voluntary groups that work for biodiversity protection, especially the protection of bats which is an endangered species. For this reason, the foundation Ecodorp Boekel, together with a voluntary group of biodiversity protection, decided to include spaces for bats where they can hibernate in the building design. This space is incorporated in the edges of the buildings' roof, on all the three buildings that will be developed. Bats, like every other species, will be monitored to understand more about their behavior. The plan for biodiversity will start once the construction will be ended, to avoid the stress of heavy machinery on the future natural capital.

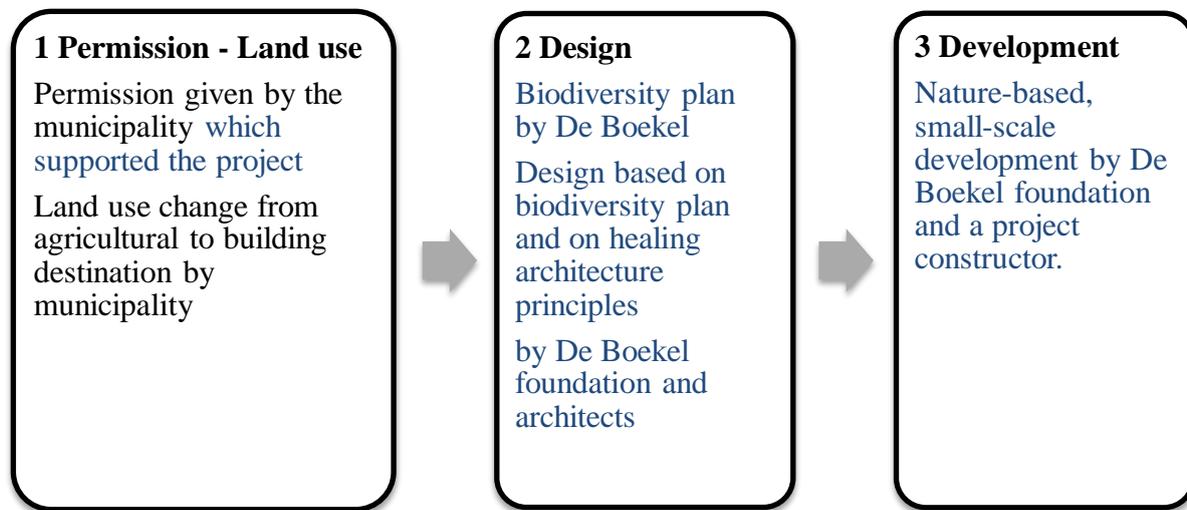
The design plan was developed by following principles of healing architecture. Healing architecture is a type of designing based on the shapes of natural elements and on environmental principles (e.g. nature-based building materials) to decrease resources' consumption. These principles are recognized in the shapes of the buildings, which are attached houses that form a circle with a common space in the center to enhance the sense of community (**Figure 6**). Moreover, the building materials are all bio-based and the masterplan includes also a center for research to support the UN work activities on the SDGs.



**Figure 6.** Masterplan of De Boekel. It is possible to see the circular shapes of the buildings and other spaces within the neighborhood (with indications in Dutch). Source: [//www.ecodorpboekel.nl/](http://www.ecodorpboekel.nl/)

The construction of the neighborhood started thanks to the financial support given from the province of Brabant (money to invest and also a loan). Part of the expenses for the construction was given by the bank with a loan. From this financial support, De Boekel created a particular financing system aimed to support the development of other ecovillages. The future inhabitants will pay a monthly rent which will be used to pay back bank and province in the first years, afterward the money will be saved as a common fund to support the other ecovillages' development. People of De Boekel have complete decisional power the design development and biodiversity plan development. They also do voluntary work to help the project constructor. The development presents multiple nature-based solutions. For instance, the rainwater is all infiltrated in the ground since there is no connection to the municipal sewage systems, the grey waters will be cleaned in a constructed wetland. The black waters will go in a septic tank where the solid matter will be separated with the water which will also end in the constructed wetland. The houses will have solar panels that will heat a tank that contains basalt. Such a tank is heated by the solar panels and works as a heater for floors and tap water. This is a new kind of experimentation that is funded by the European Union. The electricity comes directly (without conversion) from photovoltaic cells.

The main project phases of the Ecodorp Boekel are summarized in **Figure 7**.



**Figure 7.** The main development phases of Ecodorp Boekel.

## 7 Results analysis: improvisation as a mean to overcome path dependencies

### *Dependencies in nature-inclusive spatial development*

The inclusion of natural capital in housing development presents dependencies among the different actors involved. In the cases of EVA-Lanxmeer and De Boekel, construction permission and land-use change were granted despite being against regulation.

In the case of EVA-Lanxmeer, the municipality of Culemborg decided to give land to the EVA foundation even if the destination was not suitable for housing development. Furthermore, the province of Gelderland allowed the project to start even if the number of houses to be built in Culemborg exceeded the maximum. Such exceptions were made because of the interest of municipality and province in the realization of EVA-Lanxmeer. The interest was not purely economic since both municipality and province supported the project financially. Instead, the interest was mainly related to the environmental features of the development. They believed that EVA-Lanxmeer would have become a model of the nature-inclusive neighborhood for other developments. The same counts for De Boekel, which was supported by the municipality and province of North-Brabant because of the environmentally friendly model it represents. The aim of supporting the SDG's goals through biodiversity increase and sustainable living

raised their interest in realizing the project. Differently, in the case of Kerckebosch regulation was 'broken' when the WOM decided to change the standard distances between trees and houses and trees and roads. Due to the recognition of trees' value, those distances were reduced to save as many trees as possible.

Considering the mainstream way of housing development and the cases of natural-capital inclusion, it is arguable that the presence (and absence) of certain regulation represents path dependencies. The tight interrelation between municipalities and foundations (in the cases of EVA-Lanxmeer and De Boekel), between municipality and housing corporation (in the case of Kerckebosch), and between municipality and architects (in all cases) represents an interdependence which is essential to change rules and reach established goals. Objectives such as biodiversity increase, a design that enhances the relationship between man and nature, the use of sustainable materials, and circularity in resource flows represent goal dependencies. The vision of the Dutch government to fully incorporate nature inclusion in spatial planning by 2050 influences the policy at the regional and local levels. However, that vision is still not present in the praxis of housing development, which becomes nature inclusive only when exceptions are made.

### *Improvisation in nature-inclusive spatial development*

In this section, I highlight situations of improvisation in nature-inclusive spatial development. The cases of Kerckebosch and De Boekel present a situation of improvisation by deviation, in which an alternative to the original plan was previously prepared.

In the case of Kerckebosch, deviation occurs in the development phase by choosing to create a passport for each compartment of the area to avoid that project developer would have the freedom to develop their parcels without taking nature into account. This strategy is a deviation from the standard way of selling parcels of land and allowing project developers to shape the land with total freedom. In the case of De Boekel, deviation occurred when the foundation decided to create an alternative financial mechanism to save money for the development of other eco-villages. By keeping the rental prices low and stable, the inhabitants do not have an interest in selling their house units and receiving the rent. In this way, the money from the rents are collected in a common fund, aimed to finance further ecovillages' development.

The cases of Kerckebosch and Eva-Lanxmeer both present a situation of improvisation by the response. In Kerckebosch, responsive improvisation occurred when some inhabitants started to

ask permission for cutting trees where they did not respect the distances from houses. As a remedy, the WOM decided to increase the dialogue with inhabitants of every parcel of the neighborhood to increase their awareness about trees' values and other natural values. In the case of EVA-Lanxmeer, a response occurred during the development of the masterplan design. The surface and sub-surface analysis of the land affected the design of the neighborhood. Some design sketches already developed had to change towards a design made in respect of the landscape and sub-surface. There was also a situation that presented opposition to the regulation to favorite natural capital inclusion. This kind of situation is classified as improvisation by insurgency, where standard regulation is considered as boundaries of an original plan. In Kerckebosch, the standard distances between trees and houses and trees and roads were ignored to preserve as many trees as possible, unless they were in an unhealthy state.

In EVA-Lanxmeer, improvisation by insurgency took place in the planning phase. The land was not suitable for a housing project (according to the regulation), and the number of houses to be built in the municipality was exceeding the maximum allowance (per year). However, the municipality of Culemborg and the province of Gelderland made an exception to support the idea of the development. In that way, municipality and province refused to respect standard rules and supported the idea of the development. Improvisation determines a change in each investigated case, by changing mainstream procedures towards more inclusion of nature. The situations of improvisation are schematized in **Table 2**.

Case study	What is improvised?	Who improvises?	How is it improvised?	Mode of improvisation
<i>Kerckebosch</i>	<p>Preservation of trees which needed to be cut (according to regulation)</p> <p>Dialogue with inhabitants for nature preservation in response to conflict</p> <p>Passport for every parcel of land to be sold to preserve and increase biodiversity</p>	<p>WOM - architects</p> <p>WOM - architects</p> <p>WOM – architects</p>	<p>Changing standard distances between trees and houses, and between trees and roads</p> <p>Informing inhabitants about natural capital values (e.g. trees)</p> <p>Creation of standards to preserve and increase biodiversity to not leave complete freedom to project developers</p>	<p>Improvisation by insurgency</p> <p>Improvisation by response</p> <p>Improvisation by deviation</p>
<i>EVA- Lanxmeer</i>	<p>Granting permission and land (not suitable for housing)</p> <p>Masterplan design</p>	<p>Municipality - Province</p> <p>EVA foundation</p>	<p>Building on agricultural land - exceeding the maximum number of houses per year</p> <p>Respecting land features after an archeological and ecological analysis</p>	<p>Improvisation by insurgency</p> <p>Improvisation by response</p>
<i>Ecovillage Boekel</i>	<p>Financial mechanism</p>	<p>De Boekel foundation</p>	<p>Creating a fund to sustain expenses and to support ecovillages with inhabitants' rent</p>	<p>Improvisation by deviation</p>

**Table 2.** Factors of improvisation in the planning and design phases of the three housing developments.

## 8 Conclusion

My findings show that mainstream procedures of housing development in the Netherlands are strongly affected by financial and regulative aspects, which leave nature-inclusion aside. The main purpose of housing development is to obtain financial revenue. That is the goal of project developers who have enough freedom to shape their land with high building density to sell more housing units. As a result, nature-inclusion is put apart in spatial developments, unless they affect a network of protected areas (e.g. Natura 2000 areas). When nature represents an obstacle for spatial development (e.g. presence of trees), no policy protects natural elements. In the case of trees, they can just be cut and planted somewhere else. Furthermore, no regulation protect animal species which live, breed and nest in unprotected areas, unless there is the willingness to do so (as for bats in the case of Ecodorp Boekel). In other cases, the presence of regulation affects the inclusion of natural capital housing development. Nature-inclusive developments are stopped because there are already other developments taking place in the same municipality (as in the case of EVA Lanxmeer) which overpass the threshold of houses that can be built.

All these aspects are identified as path dependencies that hamper the transition of spatial developments towards more nature-inclusion. The three investigated cases showed such dependencies in their processes, but also the way how to overcome them. Tasks that support nature-inclusion (e.g. creation of biodiversity plans) rely on the interdependence between public authorities (e.g. municipality and province) and the initiators of such developments. Within their interrelation, public authorities and project initiators are the actors that improvise to include natural capital in the spatial plans. In that way, new developments can partly comply with those nature-inclusive goals of spatial planning and environment (goal dependence).

In the investigated cases, improvisation occurred in all forms that were distinguished from the literature (by deviation, response, and insurgency). It occurred by preparing alternative kinds of plans to support biodiversity increase (deviation), by adapting masterplan design to the existing land values (response) and by breaking rules to preserve natural values (insurgency).

## 9 Discussion

The results show multiple aspects that need to be discussed. Firstly, in all investigated cases the success of nature-inclusion depends on the relationship between project initiators (i.e. EVA and Ecodorp Boekel) and public authorities. This relation is a key interdependence in nature-inclusive spatial developments. None of the three cases would have been realized without the support of municipalities and provinces. Some municipalities in the Netherlands promote nature-inclusive development in different ways (e.g. granting land and permission, giving financial support, etc.). Nonetheless, no regulation supports nature-inclusion or impedes project developers to harm natural capital. The only present regulation is the strict division between what needs to be protected and what does not. These path dependencies in natural-capital inclusion go against goal dependencies represented by visions and goals, which are not still inserted in the current procedures at the local level. This confirms that, also in the case of nature inclusion in spatial development, a governance path is shaped by all kinds of dependencies, which interact with each other and form the path's pattern in space/time scale (van Assche et al., 2013).

Secondly, the financial mechanisms of the investigated cases play an important role. Besides receiving support from public authorities (as in the cases of EVA-Lanxmeer and De Boekel), there are also improvised self-financing mechanisms applied in the cases of Kerckebosch and De Boekel. The 'organic development' of Kerckebosch sustained the expenses necessary for social housing. The common fund organized by De Boekel permits to pay back the loan given by the province of North-Brabant and inspires other nature-inclusive developments. These innovative financial strategies supported the case studies' feasibility.

Thirdly, the case of Kerckebosch presents an interesting feature linked to the strict division between protected and unprotected areas. The borders between the area and Utrecht Landschap became more dynamic with the new spatial developments. Utrecht Landschap and Kerckebosch seem to be spatially integrated, without net separations. This feature represents an advantage for the biodiversity and confirms that clear delineations between what is protected and what is not, do not always represent an advantage from an environmental perspective (Beunen & van Assche, 2013).

Lastly, the results also show that improvisation in nature-inclusive spatial developments changes according to the approach (top-down or bottom-up). In the case of Kerckebosch (top-down approach), situations of improvisation are more frequent than in the cases of Eva-

Lanxmeer and De Boekel. In those two cases, both developments can be defined as cases of improvisation by deviation as wholes. Initiators of both cases refused the mainstream way of spatial development from the start, with a prior alternative plan. This may suggest that improvisation is more needed in nature-inclusive spatial development when the project praxis is close to mainstream. Moreover, it means that there might be cases of improvisation within a situation that is already improvised. This situation confirms that there is not always a clear distinction between modes of improvisation (Rowan, 2004).

The methodology used in this study can be improved by increasing the number of cases to investigate with related interviews, to obtain more empirical evidence and more internal validity. Furthermore, there are multiple aspects linked to this study that could be deepened.

The design aspect seems to be useful to identify situations of improvisation in nature-inclusive spatial developments. All investigated cases presented innovation in their design. Permaculture (as in the case of EVA-Lanxmeer) and healing architecture (as in the case of De Boekel) embed design principles that enhance the inclusion of nature. Another aspect that can be further researched is the social one. For instance, public participation and co-creation are two factors that play an important role in nature-inclusive spatial developments. All investigated cases included numerous participatory processes and two of them (EVA-Lanxmeer and De Boekel) started with a bottom-up initiative with a certain degree of power owned by (future) inhabitants. Due to time and language limitations, those improvements did not apply to this research.

It is important to mention that the three investigated neighborhoods were developed at different times, along which regulations and environmental goals have changed. Nevertheless, they present similarities in the way how they improvise to deal with regulation.

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