Tiny Forests by Akira Miyawaki – a possibility for Berlin?

Master's Thesis

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Berlin, 02.01.2023

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Abstract

This master's thesis investigates whether Tiny Forests planted according to the Miyawaki method can be a useful addition to the already existing urban green infrastructure of a European city like Berlin, Germany. The results of this study show that Tiny Forests can have advantages over other urban green infrastructure in Berlin due to their special characteristics, but it also becomes apparent that Akira Miyawaki's original reforestation concept needs to be adapted for the urban context. The spatial analysis of this study with the land types of fallow land without vegetation and areas with unsealing potential showed that after filtering only for these areas, that fall under the environmental justice core indicator of poor green supply, the amount of available land in Berlin is very small. Controversially, it is there that Tiny Forests would make the most sense for climatic reasons. Scattered throughout the city, these small patches of forest could also function as steppingstones for wildlife. The promotion of urban biodiversity and the social aspect that Tiny Forests have by involving citizens in the planting and maintenance process are considered the two most important benefits. Planting Tiny Forests in a participatory process, ideally with children, can help reconnect citizens with nature. Since the literature base on this topic is rather small with respect to Central European metropolitan areas, interpretative knowledge was also obtained from expert interviews for the purposes of this study. In some expert circles, there are reservations about the Miyawaki concept in urban environments and some of these reservations were also expressed in the interviews of this study. In general, three of the four interviewees were rather positive about the concept in Berlin, while one expressed his critical stance. Therefore, it is important to examine these caveats in more detail to ensure that all aspects are considered when implementing Tiny Forests in Berlin and to assess whether these urban forests can truly be a viable option. Moreover, the topic has gained popularity in recent years, and it remains exciting to see how the Tiny Forests that have already been planted will prove themselves in Europe and especially in urban areas. Thus, it remains to be seen to what extent and, if applicable, with what conceptual adaptations further Tiny Forests will be implemented in Berlin in the coming years and what future studies on the monitoring of these will find out.

Zusammenfassung

In dieser Masterarbeit wird untersucht, ob nach der Miyawaki-Methode gepflanzte Tiny Forests eine sinnvolle Ergänzung zu der bereits bestehenden urbanen grünen Infrastruktur einer europäischen Stadt wie Berlin, Deutschland, sein können. Die Ergebnisse dieser Studie zeigen, dass Tiny Forests aufgrund ihrer besonderen Eigenschaften Vorteile gegenüber anderer urbaner grüner Infrastruktur in Berlin haben können. Es wird jedoch auch deutlich, dass das ursprüngliche Aufforstungskonzept von Akira Miyawaki für den städtischen Kontext angepasst werden muss. Die Flächenanalyse dieser Studie mit den Flächentypen Brachflächen ohne Vegetation und Flächen mit Entsiegelungspotenzial hat gezeigt, dass nach der Filterung nur für diese Flächen, die unter den Umweltgerechtigkeits-Kernindikator der schlechten Grünversorgung fallen, die Menge der verfügbaren Flächen in Berlin sehr gering ist. Kontroverserweise, würden Tiny Forests gerade dort aus klimatischen Gründen am meisten Sinn machen. Über das Stadtgebiet verstreut, könnten diese kleinen Waldstücke zudem auch als Trittsteine für Wildtiere dienen. Die Förderung der biologischen Vielfalt in der Stadt und der soziale Aspekt, den Tiny Forests durch die Einbeziehung der Bürgerinnen und Bürger in den Pflanz- und Pflegeprozess haben, werden als die beiden wichtigsten Vorteile angesehen. Das Anlegen von Tiny Forests in einem partizipativen Prozess, idealerweise mit Kindern, kann dazu beitragen, die Bürgerinnen und Bürger wieder mit der Natur zu verbinden. Da die Literaturbasis zu diesem Thema in Bezug auf mitteleuropäische Ballungsräume eher gering ist, wurde für diese Studie auch interpretatives Wissen aus Interviews mit Expertinnen und Experten gewonnen. In einigen Fachkreisen gibt es Vorbehalte gegenüber dem Miyawaki-Konzept für städtische Gebiete, und einige dieser Vorbehalte wurden auch in den Interviews dieser Studie geäußert. Generell äußerten sich drei der vier Interviewten positiv über das Konzept in Berlin, während einer seine kritische Haltung zum Ausdruck brachte. Daher ist es wichtig, diese Vorbehalte genauer zu untersuchen, um sicherzustellen, dass alle Aspekte bei der Umsetzung von Tiny Forests in Berlin berücksichtigt werden. Nur so kann beurteilt werden, ob diese städtischen Wälder auch wirklich eine praktikable Option darstellen. Das Thema hat in den letzten Jahren an Popularität gewonnen. Es bleibt nun abzuwarten, wie sich die bereits etablierten Tiny Forests in Europa und insbesondere im urbanen Raum bewähren und inwieweit und gegebenenfalls mit welchen konzeptionellen

Anpassungen in den kommenden Jahren weitere Tiny Forests in Berlin umgesetzt und was zukünftige Studien zu deren Monitoring herausfinden werden.

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List of Abbreviations

ALKIS	Authoritative Real Estate Cadastre Information System
ANK	Action Program Natural Climate Protection
BBSR	Federal Office for Building and Regional Planning
BdB	Association of German Tree Nurseries
BfN	German Federal Agency for Nature Conservation
BMI	Federal Ministry of the Interior and for Home Affairs
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BMUV	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
BMWSB	Federal Ministry for Housing, Urban Development and Construction
CO2	Carbon dioxide
CRS	Coordinate reference system
ES	Ecosystem services
FAO	Food and Agriculture Organization of the United Nations
FIS	Interdisciplinary information system
GALK	Garden Office Managers Conference
GDPR	General Data Protection Regulation
IVN	Institute for Nature Education
MEA	Millennium Ecosystem Assessment
MIYA e.V.	Professional Association for the Promotion of the Miyawaki Method e.V.
NBS	Nature-based solutions
PNV	Potential natural vegetation
QCA	Qualitative content analysis
QGIS	Quantum Geographic Information System
QMS	Quick Map Services
SCA	Structured content analysis
SenSBW	Senate Department for Urban Development, Building and Housing
SenStadtUm	Senate Department for Urban Development and the Environment
SenUMVK	Senate Department for the Environment, Urban Mobility, Consumer Protection and Climate Action
StEP Klima	Urban Development Plan Climate
UGI	Urban green infrastructure
UHI	Urban heat island
URL	Uniform Resource Locator
WMS	Web Map Service
WUR	Wageningen University & Research

1 Introduction

“If I cannot do great things, I can do small things in a great way” –

Martin Luther King Jr.

According to Elmqvist et al. (2013), half of the population nowadays lives in cities and more and more people will move to cities in the future. Cities are becoming denser, leading to increased land use pressures and an increase in sealed surfaces. At the same time, global ecological crises, particularly in cities, threaten ecosystem functions that are beneficial to people (Grimm et al., 2008; Schröter et al., 2005). Reusswig et al. (2016, p.14) noted that “cities are significantly warmer than their surrounding countryside”. This phenomenon is called urban heat island (UHI) and occurs when three components come together: the dense development of cities, their reduced evaporation, and multiple barriers to the air exchange.

One adaptation strategy to the urban conditions is seen in the greening of the urban structure (Kabisch et al., 2016; Pauleit et al., 2019). For cities like Berlin to meet the national efforts of increasing their green share and to ensure the quality of life and resilience of urban lifestyles, they must radically transform (Seto et al., 2013). Further, the topic of urban green space was already highlighted by the German government in the National Strategy on Biological Diversity in 2007. The goal was to strongly increase the green share of cities and municipalities as well as the green in the immediate vicinity of residential areas by 2020 (BMUB, 2007). To create livable, functional, and community-oriented cities and regions, short distances between neighborhoods and high-quality, barrier-free green and open spaces are becoming increasingly important (BMI, 2021). In 2015, the Green Paper was published, which initiated the dialogue on the future importance of green and open spaces in cities and in 2017, it was followed by the White Paper, which contains concrete measures of the federal government to support municipalities in securing and enhancing green and open spaces (BMUB, 2017). In addition, the New Leipzig Charter underscores the federal government's urban development policy goals by creating urban structures that can respond appropriately to crises such as climate change or the current pandemic, and approaches such as dual internal development and integrated urban planning should

remain a stronger focus. Municipalities are called upon to expand and improve their urban green infrastructure (UGI) to meet the social, environmental, and economic challenges they face (Hackenberg et al., 2021).

This is where the reforestation concept *Tiny Forest* by plant biologist Akira Miyawaki comes in, because these forests require little space for their implementation and can be established in a very short time on degraded land and require little maintenance. Using the Miyawaki method, native tree and shrub species corresponding to the potential natural vegetation are planted in a small area starting at about 200 square meters (m^2) (MIYA e.V., 2022). In view of the competition for space in Berlin and the many sealed areas, such small urban forests can be planted to immensely improve the climate for the residents in the immediate vicinity, promote biodiversity and can also serve as steppingstones for wildlife (Kowarik et al., 2019; Schmidt et al., 2019). In general, Tiny Forests can make an active contribution to climate and environmental protection in growing cities. Biodiversity loss is said to be an even bigger threat to the existence of life on Earth than climate change, underlining the importance to preserve biodiversity in the environment (Rockström et al., 2009). According to Ottburg et al. (2018), the two main goals of Tiny Forests are the halt of biodiversity loss and the reconnection of urban citizens with nature. The concept therefore not only has an ecological component but also a social one as children, residents or interested citizens can actively participate in the process of planting, creating nature experience spaces from which everyone can benefit.

As a result, Tiny Forests can provide the population with social participation, social gathering places, and an immediate experience of nature, in addition to health and quality of life (Almers et al., 2018; Hartig et al., 2014). Thus, they can be attractive to people (Bauer 2005; Rink and Emmrich 2005), provide recreational and health benefits (Hartig et al., 2014; Roe et al., 2013), and provide habitat for animals and plants (Apfelbeck et al., 2020).

1.1 State of Research

The approach by Miyawaki has so far been tested primarily in Japan, Southeast Asia, and South America and was initially created for non-urban areas as an afforestation method to create highly diverse ecosystems on degraded and fallow land (Miyawaki,

2004, 1998). The latter is land that is not used or maintained, on which diverse vegetation could often develop undisturbed (SenSBW, 2022a). Following his call, numerous initiatives and companies have emerged to carry the approach into the world. According to Miyawaki (2004, p. 83), the “restoration movement has spread from a local activity to a global movement”. One goal of the restoration of native forests is said for these forests to function as disaster-prevention in urban areas (Miyawaki, 2004, 1998). Miyawaki and Golley (1993) state that another goal is to quickly establish dense vegetation in relatively small areas to reduce environmental degradation such as erosion, noise, and air pollution, as well as to create greenery and restore habitat for organisms. However, these applications have always been made on sites characterized by high precipitation and there are hardly any published long-term studies or reliable findings, which is why it is worth examining the suitability and implementation for the urban context (Schirone et al., 2011). Various works are already available on the management and redevelopment of urban forests (Konijnendijk, 2005; Rink and Arndt, 2011), but they accentuate different strategies.

Tiny Forests can now be found all over the world and in the past few years the Tiny Forest concept has gained a foothold in Europe, with its first formal Tiny Forest planted in the Netherlands in 2015 by the Institute for Nature Education (IVN) (Ottburg et al., 2018). According to IVN (2022a), Indian engineer Shubhendu Sharma was inspired by Miyawaki´s method of restoring native forests, having been trained by him, and founded the consulting company Afforestt India to plant Miyawaki forests. Together with IVN, he registered the Tiny Forest trademark and patented it to ensure that small forests bearing the Tiny Forest name are consistent with the ideas of the Miyawaki concept and involve the local community and school children. In addition to the Netherlands, current implementing partners in Europe include Boomforest France and Goodplanet Belgium, as well as Earthwatch UK in the United Kingdom (IVN, 2022b). Some German cities have also recognized the potential of these small forests and are now applying the concept in urban areas. The first Tiny Forest in Germany was planted in a small community in Brandenburg in 2020 by MIYA e.V., the Professional Association for the Promotion of the Miyawaki Method, and was realized through a crowdfunding action. The association then began to apply the Tiny Forest concept to urban areas as well, and thus Tiny Forests have been planted in cities throughout Germany, one in Poland, and, starting in 2022, in Berlin (MIYA e.V., 2022).

1.1.1 Urban green infrastructure

The Food and Agriculture Organization of the United Nations (FAO) (2016) states that grey, blue, and green infrastructures can be considered the physical texture of a city and that the interaction between them is crucial. Considering climate change and the accompanying adaptation measures to climate change, the latter is becoming increasingly important with its multiple functions as well as the provision of ecosystem services (ES) and the promotion of biodiversity. The German Federal Agency for Nature Conservation (BfN) defines UGI as "a network of semi-natural and designed areas and elements in cities that are planned and maintained to collectively provide high quality in terms of usability, biodiversity, and aesthetics, and provide a wide range of ecosystem services" and it can include all types of “green and open spaces as well as water areas and individual elements such as trees in a city" (Hansen et al., 2018, p. 49, p. 51). The Millennium Ecosystem Assessment (MEA) study, initiated by the United Nations, shows that “many of the constituents or determinants of well-being” are either “directly or indirectly provided by ecosystem services" (MEA (Ed.), 2005, p. 82). Further, the benefits that people derive from ecosystems can be divided into four services: provisioning, regulating, cultural, and supporting. The latter are considered necessary for all other three ecosystem services (MEA (Ed.), 2005). According to Jay et al. (2016), urban forests can provide three of these four ES as part of the UGI because urban forests, unlike forests outside of cities, are not considered for timber production, which would count towards the provisioning ES. Air pollution, temperature regulation, carbon storage, water balance regulation such as buffering extreme weather events and water filtration as well as soil protection such as erosion control are mentioned as regulating ES. Recreation, health promotion, education, and environmental education are cited as cultural ES. Finally, supporting ES of urban forests include habitat for plants and animals.

Even though the pressure as well as the demands on urban green and open spaces are continuously increasing, vegetation should mitigate and compensate for damaging effects in the urban ecosystem (Kowarik et al., 2017; Schröter et al., 2005), and the approach of giving value to nature, as in the ES approach, is increasingly becoming important in this context. Especially in growing cities, UGI is being used more intensively and in more diverse ways (Jahnke et al., 2018). Therefore, it is important to secure UGI in the long term so that the quality of them does not decline over time,

e.g., also due to a lack of maintenance after creation. For Berlin, the provision, care, and maintenance of green and open spaces is a municipal task and lies with the local authorities. However, the tight budgetary situation of the municipalities is, among other things, a major problem in ensuring the quality of green spaces in the city (Biercamp et al., 2018). The COVID-19 pandemic has also highlighted the special value of pedestrian green and open spaces, states the Federal Office for Building and Regional Planning (BBSR) (2020). Moreover, the value of UGI and its ES to the population needs to be further emphasized so that more resources are made available at the political level for its quality assurance.

1.1.2 The Miyawaki method

Since the 1970s, plant ecologist Akira Miyawaki advocated for the restoration and protection of natural forest ecosystems and has been developing a method to restore multilayer and semi-natural forests as quickly as possible, which was later applied worldwide as the Tiny Forest concept (Miyawaki, 2004). According to this approach, degraded areas can be transformed into complex forest communities in a timely manner through intensive soil preparation and dense planting (Manuel, 2020; Miyawaki and Golley, 1993; Schirone et al., 2011).

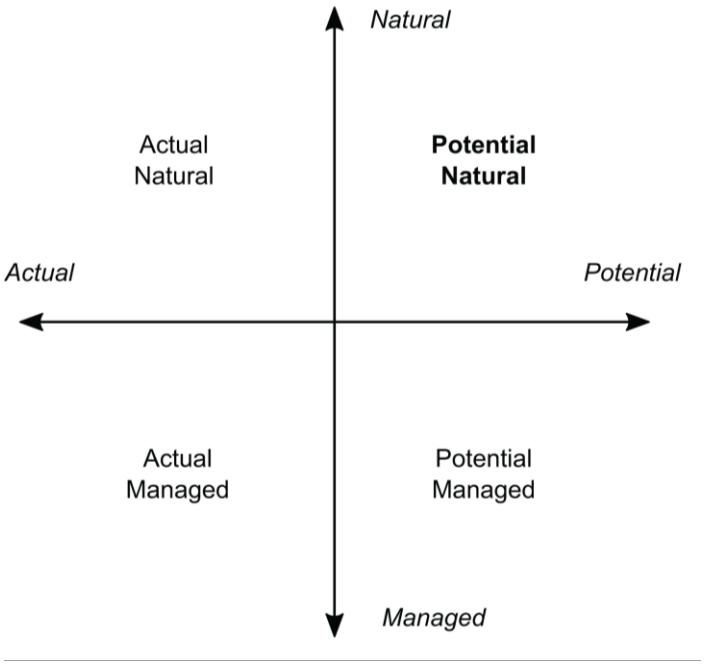

Figure 1: Difference between potential, actual, natural, and managed vegetation, taken from Hengl et al. (2018).

Miyawaki's approach draws heavily from German ecology and the concept of potential natural vegetation (PNV) by plant sociologist Reinhold Tüxen, a hypothetical nature as it might occur after a long period of time without disturbance (Tüxen, 1956). This means planting only native species whose diaspores are derived from remnants of an original flora. It can further be defined as vegetation that would be expected if humans would not intervene (Miyawaki, 2004, 1999, 1982). Figure 1 shows where the PNV can be placed in relation to the different types of vegetation by Hengl et al. (2018).

The approach promises that, in contrast to classical succession (Connell and Slatyer, 1977), a forest ecosystem with all climax species will emerge not after centuries but after only a few decades. Figure 2 below shows the comparison of the classical and new succession stages and how the latter are rather accelerated by using late-successional species on barren land (Miyawaki, 2004, 1999).

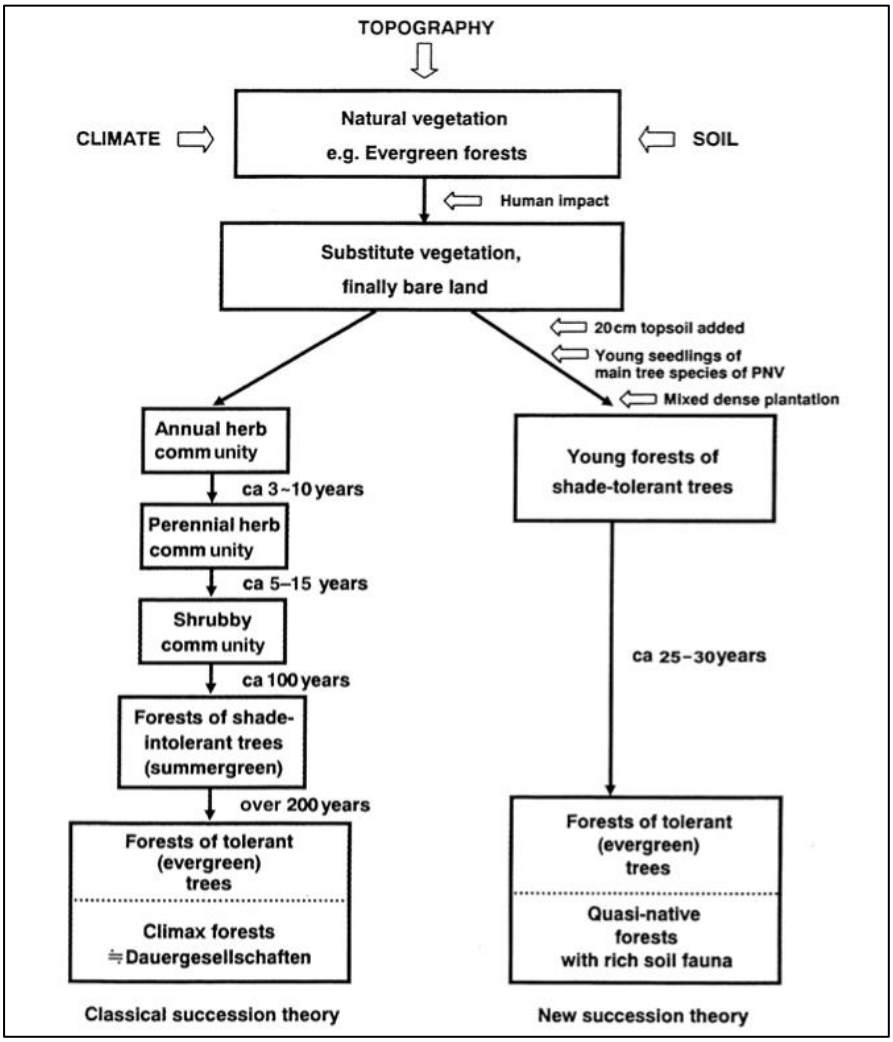

Figure 2: Comparison of the classical and new succession theory, taken from Miyawaki (2004).

MIYA e.V. (2022) define six steps when implementing a Tiny Forest, starting with an initial area search, the tree species selection, the soil analysis and soil preparation, the participatory planting action, and the maintenance. It should be noted that each Tiny Forest will have different characteristics because natural conditions vary from location to location, especially in the urban context. Once a site is identified, the trees and shrubs native to that site are determined according to the PNV by a field survey of local native forest stands or by using maps, for example such as that of Bohn and Welß (2003), who mapped forest communities for Germany. In this way, a plant community specifically adapted to the local conditions is assembled. Through a subsequent analysis of the soil, precise recommendations for action can be derived for soil regeneration. First, the desired planting site must be inspected for cables and pipelines. In addition, the soil type, soil density, and nutrients in the soil can be determined, followed by the water table and topsoil condition (Bruns et al., 2019). The next step is to determine the soil supplements for the respective site. However, Bruns et al. (2019, p. 12) note that one should rather fertilize too little than too much as the seedlings should receive “enough nutrients to get a good start in life, but no more than that” so that the Tiny Forest can build its own nutrient cycle over time. According to the original Miyawaki method, the soil is excavated to a depth of about one meter using an excavator. However, since this method was originally developed for non-urban areas, this depth is not always necessary in the city, as some soils may be better and a depth of half a meter may be sufficient as well. Either way, the soil is then enriched with locally available biomass such as straw, compost or even Terra Preta (see Figure 3). MIYA e.V. (2022) like to work with the latter because this humus substrate is loaded with organically and microbiologically activated charcoal that is said to be good for degraded soils and to improve its biological, chemical, and physical properties. It is also said to bind water and important nutrients well and has the potential to significantly increase the carbon storage and sequestration (Ariluoma et al., 2021). Moreover, due to its large pore volume, the plant carbon provides a permanent habitat for soil-building microorganisms and valuable fungi such as mycorrhiza. The goal of this step, then, is to build a well-aerated, nutrient-rich, and biologically active soil that can hold water well and in which plants can root well. As for the seedlings, Miyawaki (2004) notes that bare-rooted plants are difficult to transplant, so they should be grown in containers until they have developed their root systems, such as in nurseries (see 4).

Figure 3: Mixture of activated plant charcoal with mycorrhiza fungi incorporated into the soil when planting trees and shrubs for a Tiny Forest by MIYA e.V. in Berlin (by author, 2022).

Figure 4: Picture of a nursery tree with developed root system being planted (by author, 2022).

All main and secondary tree species are then mixed and planted densely and in a random pattern, preferably at least 25 tree species in total, with about three plants per m² and with as many companion species as possible that will later form the canopy, understory, shrub, and herbaceous layer. There should be no plant species adjacent to the same species or from the same stratum. According to Bruns et al. (2019, p. 14) “a Tiny Forest isn’t just about plants; it also involves people and education” so “an attractive and functional design that fits well within its surroundings” is beneficial. They also point out that thought should be given to design requirements such as benches

or fences, and that it is important to lay out the Tiny Forest in a width of at least 4 meters without interruptions. Then, on the day of planting, people are encouraged to help plant the Tiny Forest, such as school children. Figure 5 shows a few of the tools needed for planting Tiny Forests together with groups. As mentioned earlier, the social component of involving citizens in the implementation of Tiny Forests is very important, in addition to the ecological aspect of the concept. Therefore, only non-toxic tree species are recommended, to develop a safe recreational area, in particular for children (Bruns et al., 2019). Further, to protect the soil from drying out, erosion, and unwanted growth after planting, the Tiny Forest area is mulched with organic material (see Figure 6, Figure 7, Figure 8 and Figure 9). Other benefits of mulching include the protection of the seedlings from low temperatures and the provision of nutrients after decomposition (Bruns et al., 2019).

Figure 5: Some of the equipment necessary for the joint planting action of a Tiny Forest with school or daycare center children used by MIYA e.V. in Berlin (by author, 2022).

Figure 6: Children helping to collect organic material for mulching a Tiny Forest created by MIYA e.V. in Berlin (by author, 2022).

Figure 7: Mulching of an entire Tiny Forest area, created by MIYA e.V. in Berlin (by author, 2022).

Figure 8: Mulched part, about 10 centimeters thick, of a Tiny Forest laid out by MIYA e.V. in Berlin (by author, 2022).

Figure 9: Collecting of bark mulch for laying out the paths of a Tiny Forest created by MIYA e.V. (by author, 2022).

Figure 10: Watering of planted trees and shrubs in a Tiny Forest created by MIYA e.V. (by author, 2022).

Figure 11: Wooden chestnut fence used by MIYA e.V. for a Tiny Forest in Berlin (by author, 2022).

Over the course of the first 2-3 years, the Tiny Forest will then require only minor maintenance, such as further mulching, watering (see Figure 10), removing perennials, or picking up debris. Apart from the latter task, the Tiny Forest does not need to be maintained and is said to sustain itself (Bruns et al., 2019; Miyawaki and Golley, 1993). The canopy is expected to fill in in about 3 years and a fence might also be beneficial for the demarcation of the area (see Figure 11).

1.1.3 Climate change, Tiny Forests & carbon storage potential

In addition to the massive change and overprinting of the material composition of the urban ecosystem, climate change and biodiversity loss pose a great challenge. By 2050, the average temperature in Berlin is expected to increase by 1°C and by the end

of the century by 3°C (Reusswig et al., 2016). This will lead to increasingly severe and long-lasting weather extremes. Water will thus be available for vegetation sometimes in abundance and sometimes not at all. Consequently, this will lead to further extensive negative changes in ecological relationships. Under the influence of the city-specific meso- and microclimate, thermal variances of up to 10°C can then arise in European cities, caused by the UHI (Baumüller, 2014). This makes it even more important to establish supporting vegetation concepts at different scales (Rastandeh and Jarchow, 2021). According to Beckers (2020, p. 2), UGI not only has "an important social balancing function in urban society", but additionally has an "important significance for the urban climate".

Approaches such as nature-based solutions (NBS) are gaining more and more attention these days. By 2026, the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and Consumer Protection (BMUV) will provide €4 billion for the Action Program Natural Climate Protection (ANK) to invest in NBS. These natural solutions can contribute, for example, in the form of UGI in the reduction of greenhouse gases or in climate change adaptation in the city (BMUV, 2022). One concrete measure of nature-based climate protection is to prevent the release of carbon sequestered in vegetation and soil (Naumann et al., 2014). Kabisch et al. (2016, p. 1) state that “green and blue urban areas have significant potential to decrease the vulnerability and enhance the resilience of cities in light of climatic change” and can be a cost-effective solution for performing many ecosystem functions by using nature as a model. Green-blue infrastructures can therefore be put to good use here and contribute to the development of biodiversity. Another concept within the NBS movement that uses nature as a model for solving urban problems is the principle of the Sponge City. The basic idea of a Sponge City is that of water storage, unsealing and decoupling, as well as infiltration and evaporation. A reference project for a climate-adapted, water-sensitive, and climate-neutral city is offered by the Sponge City principle in the Schumacher Quarter on the site of the former Tegel Airport in Berlin. Within the project, construction will be done in such a way that the effects of increasing weather events, such as heavy rain or periods of heat, are not felt as strongly at the neighborhood level. The residential buildings and open spaces are to be designed in such a way that rainwater can be retained, and the microclimate improved through evaporation and the associated cooling. In general, densification and sealing will be

avoided as far as possible, and the development of UGI will be emphasized (Tegel Projekt GmbH, 2022).

More and more cities are developing climate adaptation concepts. Berlin also has a city climate development plan called StEP Klima, which is one of the six essential parts of the Berlin 2030 Urban Development Plan, in which UGI such as green facades and green roofs are also recognized as important measures, along with parks and urban trees (SenStadtUm, 2016). In densely built-up areas, building greenery such as vertical green or green roofs can be a viable solution to fulfill many functions at this point such as air purification and climate regulation because they require less space. These two forms of greening buildings are said to be the most effective when they are distributed over a large area throughout the city and, at best, are applied in particularly affected urban areas (BBSR (Hrsg.), 2022). This aspect of distribution can also be applied to the establishment of small urban forests like Tiny Forests in Berlin as many of these Miyawaki forests have a greater impact than just one or a few. If implemented throughout the city, well-designed and well-managed Tiny Forests could help address urban challenges and act as green corridors for wildlife, connecting larger green spaces (Lepczyk et al., 2017). Haerter (2021) adds that the impact of these small forest patches depends more on their overall quantity and quality than on their size and that design plays a big role when it comes to the acceptance of the neighborhood. In addition, Tiny Forests are expected to reliably reduce the magnitude of future weather extremes (Howe et al., 2017), noise emissions (Ow and Ghosh, 2017), and pollutant loads (Kumar et al., 2019; Nowak et al., 2018) and sequester carbon dioxide (CO2) (Ariluoma et al., 2021). According to Haerter (2021, p. 18), “small green space can have a micro contribution to the UHI” and the totality of all green spaces, as well as appropriate design, will determine whether an urban area can receive benefits such as ES. She also notes that more research is needed to prove the positive mitigation of climate extremes by Tiny Forests. Spatial analyses may also gain importance in research to evaluate the greening situation of cities (Kabisch and Haase, 2014).

With the help of photosynthesis, plants can sequester CO2 and therefore store carbon in plant biomass and soil (Fares et al., 2017; natureOffice GmbH, 2018). Only the woody biomass formed by a tree is used to calculate long-term sequestered CO2 (Rock 2017). It consists of the above ground biomass such as crown and trunk and the

below ground biomass such as the roots. Lerink et al. (2020) from the Wageningen University & Research (WUR) have established a protocol for the inventory of Tiny Forests and the subsequent calculation of their annual carbon storage that can be applied to other sites as well. Knowing the carbon storage potential of an urban forest like that of a Tiny Forest could further underpin their benefits. In the following, this aspect will only be briefly discussed, as the methodological focus of this study is mainly on the area analysis and the interviews with experts. First, a transect inventory with two intersecting transects of one meter width and one meter length can be used to collect data in quadrants that is needed to determine the standing wood volume and CO2 sequestration as can be seen below in Figure 12 and Figure 13.

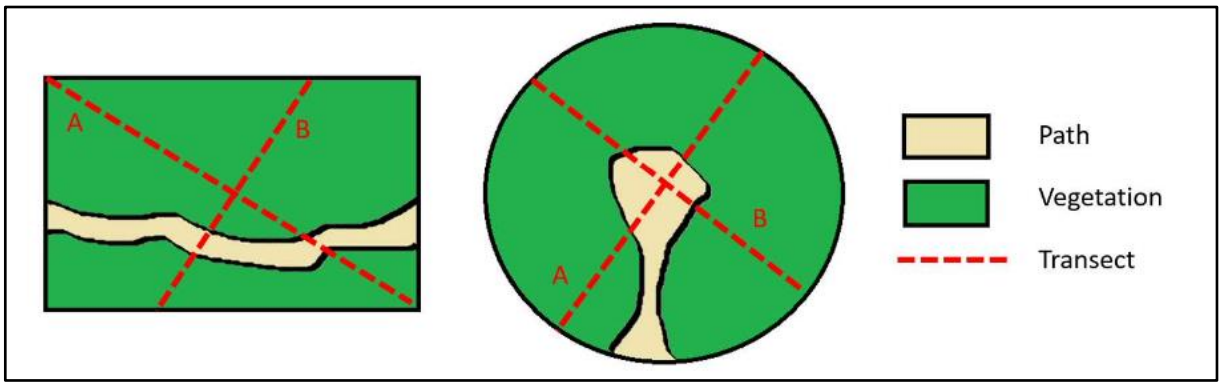

Figure 12: Transects A and B for two differently designed Tiny Forests, taken from Lerink et al. (2020).

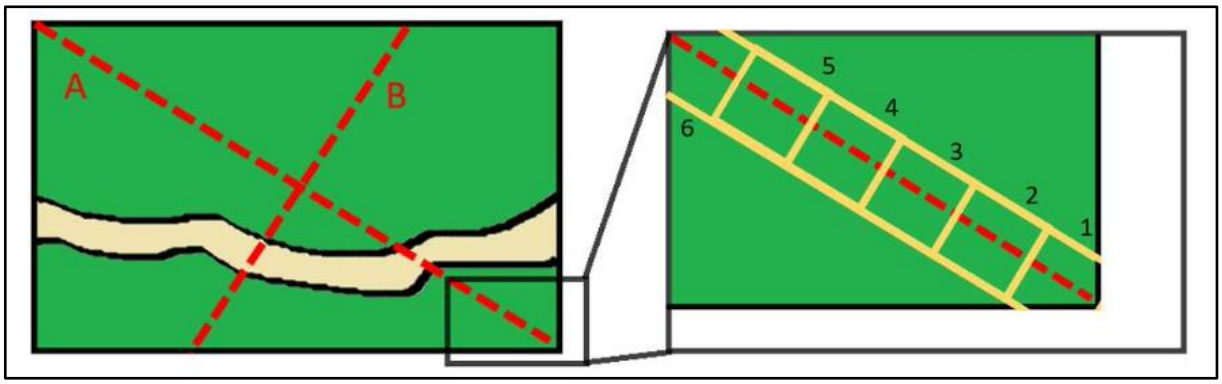

Figure 13: Example of a transect in a Tiny Forest and the position of its quadrants with one meter width and one meter length, taken from Lerink et al. (2020).

The required equations and their following sequence can be found below:

$$V\ Standing\ stemwood = basal\ area * dominant\ height * stand\ formfactor * area\ Tiny\ Forest$$

$$Above\ and\ below\ ground\ woody\ biomass = stem\ wood\ volume * expansion\ factor$$

$$Mass\ CO2 - equivalent = \frac{(biomass * carbon\ content)}{\frac{CO2}{C}}$$

$$Average\ yearly\ CO2 - sequestration = \frac{mass\ CO2 - equivalent}{age\ Tiny\ Forest}$$

In summary, if the inventory method is repeated, the first step is to measure the diameter of the trees at breast height of 1.30 meters and to document the respective tree species. Smaller trees below this height are not considered in the inventory. The basal area in square meters per hectare (m²/ha) is of interest and can be determined from the diameter of each tree, the area of the transects, and the area of the Tiny Forest in ha. The dominant height in meters can be determined by averaging the height of the trees with the largest diameter. For the stand form factor, an estimate is made based on the most common tree species in each Tiny Forest. An expansion factor is needed to determine the total mass of woody biomass above and below the ground by multiplying by the stem wood volume determined in the previous calculation. The next step is to use the carbon content of the biomass to calculate the total sequestered mass of carbon. The authors used an average carbon content of 48% in hardwood biomass, since most Tiny Forests are estimated to be composed primarily of hardwood trees and this is the value they found in the literature for it. Next, the mass of carbon must be converted to the CO2 equivalent by multiplying the molecular mass of CO2 divided by the mass of a carbon atom by a value of 3.67. To clarify, CO2 equivalent is a unit of measurement that aims to make the effect of all greenhouse gases on the climate comparable. This unit is necessary because the various greenhouse gases contribute to the greenhouse effect to different degrees and remain in the earth's atmosphere for different lengths of time. To determine the CO2 sequestration in the biomass as an annual average, the mass of CO2 equivalent sequestered is divided by the age of the respective Tiny Forest (Rock, 2017).

According to Ottburg et al. (2022), a young Tiny Forest aged 1-5 of about 200 m² binds about 127.5 kilogram (kg) CO2 equivalent per year. Further, even 50 years after planting, it is assumed that Tiny Forests of that size can bind up to 250 kg CO2 per year (Boosten et al., 2022; Ottburg et al., 2022). In one of their studies, the woody biomass of eleven Tiny Forests was measured to calculate their annual CO2 sequestration. The researchers found out that between the individual Tiny Forests there were big differences in terms of tree species selection, soil characteristics, and plant density. Moreover, it was discovered that older Tiny Forests have a higher CO2 sequestration than newly established ones (Ottburg et al., 2022). The Urban Forests company has also made calculations for a 100 m² Miyawaki forest and concluded that a Tiny Forest of this size will sequester about 50 kg of additional CO2 equivalent each year after stabilization (Manuel, 2020). However, the exact amount or extent to which Tiny Forests can influence the climate of their surroundings or the climate of an entire city depends on many factors. Same goes for their potential for carbon storage and sequestration, which depends on the wood mass, density, age, and geographical location (Ottburg et al., 2022). To get a complete picture of the carbon storage capacity, the initial soil preparation must also be considered, especially if the existing soil was not used for the most part, but was replaced or heavily amended with external material, as may sometimes be necessary in urban areas. In general, urban trees only compensate for a fraction of the total urban CO2 emissions. Same goes for their carbon sequestration compared to forests, woodlands, and peatlands (Breuste, 2019). However, in terms of carbon sequestration, it was found that compact vegetation can potentially sequester more carbon than individual trees, which argues in favor of Tiny Forests and their dense planting (Fares et al., 2017).

To date, few approaches have been published for calculating the carbon storage capacity of urban trees compared to forest stands. Moreover, hardly any of these equations are explicitly adapted to urban or site-specific conditions (McHale et al., 2009). The state of research in the urban context of this field is therefore rather deficit and harbors uncertainties (Gardi et al., 2016; McHale et al., 2009). The concept of the Miyawaki forests is also quite new in Europe, so these young, planted temperate forests need more monitoring and further research.

Rock (2017) states that the carbon sink capacity of Berlin's forests is primarily determined by forest management, including afforestation and timber storage. In terms of climate change mitigation, he notes that with the current plans of the Berliner Forsten, who manage most of the forests in Berlin and Brandenburg, an increase in carbon stored in the forests is expected, e.g., through measures to switch to higher proportions of hardwoods. The contribution of Berlin's forests to climate protection will therefore not decrease in the medium term if current uses are maintained. Looking at biomass and mineral soil, calculations show that Berlin's forests today store a total of about 10.972 million tons of CO2. They are also currently said to remove about 0.335 million tons of CO2 from the atmosphere each year. A quarter of this is due to the increase in carbon in the soil, another quarter comes from the growth of wood in the forest, and the other half results from the substitution performance of the harvested wood. The latter does not really apply to urban forests, as they are usually not used economically but rather for recreational purposes. Nevertheless, about 55% of the total CO2 output is realized within the city limits, while 45% is contributed by Berlin's forests in the surrounding area of Brandenburg. In times of climate change, saving CO2 has become a very important and essential measure, and the carbon storage capacity of forests is only one aspect. Its monitoring has become another important measure in the efforts to combat climate change. The member states of the United Nations Framework Convention on Climate Change and the international agreements based on it, especially the Kyoto Protocol, are subject to a reporting obligation on national greenhouse gas inventories, including Germany as a member of the EU, which has committed itself as an association of states (Rock, 2017). Vollrodt et al. (2012, p. 89) state that “urban vegetation represents a CO2 sink whose contribution to reducing atmospheric CO2 concentrations can be optimized”. Even though the approach described above for calculating the CO2 sequestration of Tiny Forests is a feasible method, it can be concluded that the main argument for Tiny Forests is not primarily that of carbon storage, but rather the biodiversity aspect and the social aspect through the involvement of citizens and the creation of educational spaces. Vollrodt et al. (2012) further state that high biodiversity and healthy growth safeguards the stability of an ecosystem and that this impact effect can be strengthened by orienting the selection of tree species to the local effects of climate change. Therefore, Tiny Forests can be a piece of the puzzle in the efforts against climate change if many are planted.

1.2 Objective & Research questions

The main question that arises from the existing studies for this research are whether the Tiny Forest concept according to Akira Miyawaki could also be suitable for the implementation in an urban area like Berlin. Since the concept was originally developed for non-urban environments, it is worth posing the question to what extent a modification of the goals or of the concept itself seems appropriate in the context of a global city like Berlin. It is therefore relevant to analyze the opportunities and challenges of the approach specifically for the Berlin context. There is reason to believe that Tiny Forests, implemented according to the Miyawaki method can be a viable possibility for the greening of small and degraded areas and the redevelopment of urban forests in Berlin. The method promises to establish complex and self-regulating ecosystems in a timely manner, thereby fulfilling many functions with low care and maintenance costs compared to other UGI. Tiny Forests can therefore act as another element in Berlin's urban greenery and conserve native diversity and the corresponding species. The feasibility of Tiny Forests regarding the land use pressures in Berlin will be reviewed and areas that are particularly suitable will be identified. There is also a need to explore the various options for adapting the Tiny Forest to the urban context to withstand the impacts of climate change in these areas in the long term. Finally, the study will examine what differentiates Tiny Forests from other UGI that is already common and known to the citizens.

1.3 Approach & Structure

The specifics of Tiny Forests have already been described in this first chapter, the possible locations and feasibility of Tiny Forests by Akira Miyawaki will be addressed in the next chapter. Furthermore, the advantages of the concept as well as possible adaptations for Berlin are discussed. A systematic literature review forms the basis of this thesis and is one of three applied methods listed in the following chapter. Further, a spatial analysis was conducted to find out if an implementation of Tiny Forests is possible regarding the land use pressure in Berlin and to determine what kind of areas are particularly suitable. Fallow land without vegetation and areas with potential for unsealing were looked at in more detail, and two examples of each were selected. Expert interviews were conducted with four experts from different fields, all of whom seemed important in answering the research question of this study on Tiny Forests by

Akira Miyawaki in Berlin. The interviews were analyzed using the qualitative content analysis (QCA) to reveal their valuable content. This also allowed to address the question of how the concept needs to be adapted to cope with the effects of climate change in urban areas in the long term and what differentiates Tiny Forests from existing UGI.

2 Material & Methods

In this chapter, the methodological approach of the research work is presented, and the study area of Berlin is described in more detail. The results of the study are derived firstly from a systematic literature review and a spatial analysis with the free geographic information system software Quantum GIS (QGIS), in which spatial environmental datasets were analyzed (QGIS.org, 2022). The third method was to conduct and analyze expert interviews.

An initial review of the existing literature on Tiny Forests revealed that there are few studies on this topic in Europe. To the author's knowledge, there are many studies on Tiny Forests according to Miyawaki in the Asian region, some for Europe since the last years, but only a few for Germany and for urban areas. This results in the interest to see if Tiny Forests can also be a possibility for a big German city like Berlin. Once the research question of this study was determined, a systematic literature search was conducted using common portals such as Google Scholar to search for literature and keywords were applied such as *Tiny Forest*, *Akira Miyawaki*, *Forest Restoration*, *Miyawaki method*, among others. Synonyms such as *miniature forest* and *pocket forest* were also used. For the thematic foci such as *UGI*, *urban forests*, *climate change*, *carbon storage and sequestration of urban forests*, *urbanization*, *urban heat island*, *NBS*, *environmental justice in the city*, *qualitative content analysis* and many more, these keywords were also used for specific information, at best for Germany or even Berlin. English as well as German sources were used and translated if necessary. The university library was also accessed, and individual literature copies were borrowed as part of the elaboration.

2.1 Study area of Berlin

The study area of Berlin, Germany, was chosen because, to the author's knowledge, Akira Miyawaki's Tiny Forest concept is still quite new for Europe and therefore also for Berlin. At the time of the development process of this study, only a handful of Miyawaki forests had been implemented in Berlin, mostly by the professional association for the promotion of the Miyawaki method MIYA e.V. The first Tiny Forest planted in Germany using the Miyawaki method was established by the association in Brandenburg in 2020. More Miyawaki forests followed and were planted by MIYA e.V. in other German cities and one in Poland (MIYA e.V., 2022). Since 2022, the association has also been bringing the Tiny Forest concept to Berlin, mostly working closely with schools to create green oases and nature experience spaces in the city.

2.1.1 Site characteristics

The evaluation of the Tiny Forest method is carried out regarding the specific ecological conditions in Berlin, Germany. The Senate Department for Urban Development, Building and Housing (SenSBW) (2015) created a map that shows that the near-natural soil communities mainly consist of rusty brown earth, para brown earth, podsol brown earth as well as gley brown earth, but in the central and densely populated urban areas almost all soils are strongly anthropogenically influenced to degraded. The annual average precipitation is 581 millimeters for Berlin (BerlinOnline, 2022). For the PNV of Berlin, Bohn and Welß (2003) mapped the following forest communities within the vegetation units *III Soil acidic mixed oak forests*, *IV Oak-hornbeam forests* and *V Beech and mixed beech forests*, to which the Tiny Forest approach refers as a guiding target:

- Atlantic-subatlantic soil acidic birch-oak forest
- subatlantic-central European soil acidic oak forest and pine-oak forest
- sessile oak-hornbeam forest alternating with beech forest
- planar-colline woodruff and dog mercury-beech forest
- planar, soil acidic wire-mallow (oak) beech forest

2.1.2 Urban forests in Berlin

Forests can be classified in terms of their spatial location. Their functions change depending on the distance from the cities. Kowarik (2005) defines three forest types: urban woodlands, peri-urban woodlands, and non-urban woodlands. Merely the first forest type is really located within urban areas or on the urban fringe. Therefore, its social functions as well as the urban impacts are the highest compared to the other two forest types, but its production functions are the lowest. Further and according to FAO (2016, p.2), urban forests are described as “networks or systems comprising all woodlands, groups of trees, and individual trees located in urban and peri-urban areas; they include, therefore, forests, street trees, trees in parks and gardens, and trees in derelict corners”. While, for Berlin, the outer urban areas are characterized by contiguous forest and open spaces, their share in the inner-city area is relatively low. As a result, there are significant differences between core and peripheral areas in terms of green space provision and the need for additional green space (SenUMVK, 2021a). According to Rock (2017), the State Forest Act designates the entire forest in Berlin as protective and recreational forest. Due to the history of settlement and use, Berlin's forests as they are today, are predominantly located on rather poor pine and oak forest sites. Most of the forests were created artificially and are subject to the essential criteria for natural management, e.g., by promoting site-appropriate, native tree species as well as mixed stands rich in structure and species, by increasing the proportion of deadwood, and by avoiding the use of fertilizers and pesticides. According to the Senate Department for the Environment, Urban Mobility, Consumer Protection and Climate Action (SenUMVK) (2021a), about 60 % of Berlin's area is settlement and traffic areas, 18 % forest and 12 % public green spaces. The latter are divided into green and recreational areas with about 50 %, followed by allotments, green areas on road land and cemeteries. Further, since June 2002, Berlin's forests have been certified according to FSC and Naturland criteria and are home to 75 of the total 100 tree species found in Germany. The most abundant tree species group in Berlin forests is pine, followed by oaks and other hardwoods with low life expectancy (Rock, 2017). As for street trees in the city, linden, maple, oak, sycamore, horse chestnut, birch and black locust are the most common tree species (SenUMVK, 2021b).

2.2 Spatial analysis with QGIS

The spatial analysis with QGIS was one way to analyze the area potential of Tiny Forests in Berlin. The focus of this study was put on fallow land and areas with unsealing potential, as these two types of land were considered the most promising given the current land use pressure in Berlin. As for the fallow areas, only the areas without vegetation were looked at to ensure that the establishment of Tiny Forests on these areas would not destroy other vegetation that has developed there over time through succession and could be valuable from a nature conservation point of view. Looking at the content of the map used to identify the fallow land areas without vegetation, this type of land is further described there as areas that are mostly excavations, fills, or demolition sites where vegetation has not yet established due to a recent cessation of use or, in some cases, where vegetation cannot establish for a longer period. These areas may have hardly any vegetation due to their very high degree of sealing, or they may be extreme sites with no sealing, such as sand dunes, where spontaneous vegetation establishment is very slow due to nutrient deficiencies or regular disturbance (SenSBW, 2022a). Regarding the issue of environmental justice, it is unfortunately still the case that public green and open spaces are unevenly distributed in cities and municipalities, leaving some neighborhoods at a disadvantage compared to others. In the case of Berlin, multiple stresses can be observed, especially in the inner-city area that have been documented within the Berlin Environmental Justice Atlas to show where action is most urgently needed. Since 2020, there has been a new funding focus on urban nature in the Federal Program on Biological Diversity, in which, among other things, the issue of environmental justice has been further emphasized. In addition, in 2022, the previous four environmental justice indicators were supplemented by a fifth, the social indicator, which also includes the aspect of the living spaces of people with low social status (SenUMVK, 2022).

Overall, there are five core indicators such as the provision of green and open space, noise pollution, air pollutants, bioclimatic stress, and social disadvantage (SenUMVK, 2022). Since green and open spaces can reduce environmental conditions that are harmful to health, their establishment, e.g., in form of Tiny Forests may be particularly useful in areas where the supply of such spaces is low. Therefore, the map of poor green and open space supply was overlaid with the fallow lands without vegetation as

well as the areas with unsealing potential. Two sample areas were selected for this study and are described in more detail below.

2.2.1 Data reference

To begin the spatial analysis, a predefined coordinate reference system (CRS) was set in QGIS as a framework. For the scope of this project, the CRS ETRS89 / UTM zone 33N was used. The geoportal FIS-Broker is an interdisciplinary information system that offers an extensive geodata catalog with maps, plans and other data with spatial reference from Berlin, which are freely available online. The following maps were loaded into the QGIS project as a Web Map Service (WMS) with their respective Uniform Resource Locator (URL):

ALKIS Berlin Bezirke
Reale Nutzung und Vegetationsbedeckung 2020 (Umweltatlas)
Entsiegelungspotenziale (Umweltatlas)
Umweltgerechtigkeit: Kernindikator Grünversorgung 2021/2022 (Umweltatlas)

With the Quick Map Services (QMS) function, Google Maps and Bing Aerial were loaded into QGIS as base maps. Also, for orientation, the district boundaries were inserted as a layer. The German information system is the Authoritative Real Estate Cadastre Information System (ALKIS) and in a next step, the *ALKIS Berlin Bezirke* map of the Berlin districts was used to view their district boundaries. The map data for the district boundaries was derived from the dataset of the real estate cadaster of the district surveying offices in Berlin. The two other maps were the *Reale Nutzung und Vegetationsbedeckung 2020 (Umweltatlas)*, which shows the real use and vegetation cover for Berlin, and *Entsiegelungspotenziale (Umweltatlas)*, which shows areas with unsealing potential for reasons of nature conservation or compensatory measures under building law. The final map was the *Umweltgerechtigkeit: Kernindikator Grünversorgung 2021/2022 (Umweltatlas)* map, which presents the assessment of the environmental justice core indicator green supply for Berlin in poor, medium, and high supply. All four maps are provided with a content and technical description that can be accessed on the FIS-Broker geoportal (SenSBW, 2022b) and their respective URLs for loading the respective maps into QGIS can be looked up in Appendix 1.

2.2.2 Intersection of relevant maps for area determination

The next step was to filter the layer of the core green supply indicator *Umweltgerechtigkeit: Kernindikator Grünversorgung 2021/2022 (Umweltatlas)* by the areas that have poor green supply. The selected objects from the attribute table were exported to a new layer. The same was done for the real use and vegetation cover layer *Reale Nutzung und Vegetationsbedeckung 2020 (Umweltatlas)*, here only fallow land areas without vegetation were filtered, and this selection was then exported to a new layer. As for the areas with unsealing potential *Entsiegelungspotenziale (Umweltatlas)*, the layer did not have to be altered. The layer of fallow land without vegetation and the layer of the areas with unsealing potential were then intersected with the layer of poor green supply to show where green supply is most needed.

2.2.3 Intersection errors and data correction

During this study, some maps were updated on the geoportal FIS-Broker, which is why the procedure described above had to be repeated a few times. This results in the most up-to-date data set to get an impression of the most current area potential for the establishment of Tiny Forests in Berlin regarding the parameters used. Further, the identified areas had to be checked for intersection errors and for other land uses that were assigned to them to generate the actual number of areas that are available for the two area types in Berlin used in this study. Intersection errors are usually small polygons that can result from geometry errors in the original data.

2.3 Expert interviews

In this chapter, the methodic procedure of the four expert interviews is further described. Qualitative interviews, such as expert interviews, are typical methods of qualitative research. According to Wotha and Dembowski (2017) expert interviews are open, semi-structured surveys of individuals with a certain expertise related to a specific state of research. Froschauer and Lueger (2003) state that the base of a qualitative research interview is its research design. To this end, the prerequisites for carrying out the analysis were first created, the quality assurance of the results was carried out, and finally the findings obtained were made available. The literature also identifies seven requirements for the research process: open-ended questioning,

maximizing research freedom while minimizing pressure to act, integrating the research context into the analysis, integrating elicitation and interpretation, avoiding thematic restrictions, starting from concrete sub-areas, and not forcing results (Froschauer and Lueger, 2003). Mayring (2015) states that the aim of a QCA is to analyze written communication in a systematic and theory-based way and that there are three forms for information that can be divided into the summary, explication, and structuring. He further states, that there still are many reservations about qualitative research due to objections such as “lack of intersubjective comprehensibility, violation of classical quality criteria such as objectivity and reliability and insufficient generalizability of results” (Mayring, 2015, p. 8). However, the QCA should take an intermediate position, since the results are often evaluated quantitatively, e.g., with the help of category frequencies, as was also done in this study. Nonetheless, the assignment of the text material to the content-analytical categories remains purely a matter of the author's discretion, even if this process is controlled by content-analytical rules (Mayring, 2015).

2.3.1 Selection of experts

Four experts were asked by email or with phone contact to participate in the expert interview to provide their knowledge, each from a different field, and they all accepted the invitation. One interviewee was Prof. Dr. Ingo Kowarik, who was chosen for his nature conservation expertise regarding the feasibility of Tiny Forests in Berlin. The date of this first interview was December 8th, 2021. The second interviewee was Stefan Scharfe, who founded MIYA e.V. and who, together with his team, is an expert for the establishment of Tiny Forests. The interview with him was held on December 13th, 2021. Also, Stefanie Scholz, who initiated the first Tiny Forest in Darmstadt in 2020 as a local politician and has insights into the political aspects, was interviewed and the interview took place on January 5, 2022. The fourth interview was conducted with Annette Hennemann, who works at the Darmstadt green space office and officially accompanied the Tiny Forest project in 2020 as project manager. The two interviewees from Darmstadt were selected because they already had practical experience with implementation there and this was not yet the case in Berlin.

2.3.2 Creation of the guideline-supported interview

Prior to the first interview with Prof. Dr. Ingo Kowarik, the semi-structured interview guide was prepared. A complete version of it can be found in Appendix 2. The SPSS method according to Helfferich (2011) was used and according to him, the German acronym SPSS stands for the four steps that are necessary for the creation of an interview guide. Translated into English, it means collect, review, sort, and summarize. Wotha and Dembowski (2017) provided an overview of the four steps and this was also considered when creating the interview guide for this study. The first step was an open brainstorming phase that led to the collection of the questions. Subsequently, the questions were reviewed, and unsuitable questions were removed. The remaining questions were then sorted into open-ended narrative questions, entertainment questions, and specific follow-up questions. Finally, the questions were summarized and placed in the appropriate place in the interview guide.

The interview guide was prepared in German and begins with a welcome to the interview partner and gratitude for participation, an introduction, and the presentation of the research question. This was followed by brief information about the course and duration of the interview and a request for consent to record the interview. With the beginning of the recording, the interview guide was divided into three introductory questions, eight main questions and two outlook questions. Some content-related aspects were subordinated to some questions to enable a better understanding for the interviewee to answer the questions. Control questions were also subordinated to the questions for the interviewing author to improve the flow of speech and the interview in general. At the end, there was an open-ended closing question asking the interviewee if there is anything else they wanted to add, followed by the acknowledgements, information on how to proceed, and the timeline. The interviewees were also asked if they would like to have the result at the end in the form of the whole study or a summary.

2.3.3 Implementation of the interviews

Due to the ongoing pandemic at the time, the expert interviews were conducted online and via video using the *Zoom* platform, for which a student license from the Technical University of Berlin was available (Zoom Video Communications Inc., 2022). The

interviews were recorded using a mobile phone after the interviewees gave verbal and written consent for the interview to be recorded. After the first interview with Prof. Dr. Ingo Kowarik, one question was cut out from the original interview guide as another question was better suited. The former question 4 was: "*In your opinion, could urban forests prove their worth as a new open space category of their own in urban redevelopment?".* Prof. Dr. Ingo Kowarik was sent the new question via email and his answer was adopted verbatim as if he had said it in the same way in the interview. The new question 4 was: "*Which native tree species would you use for the implementation of Tiny Forests in Berlin?".* In the following three interviews the question was then already integrated, and the answers were captured right during the interview.

2.3.4 Transcription

At this point, it can be assured by the author that the data collected for this study was processed in accordance with the General Data Protection Regulation (GDPR) and was neither used for other purposes nor passed on to third parties. All four interviewees were sent a consent form, which they each signed, allowing the author to record the interview and use the resulting material in a non-anonymized form for the preparation of this study. A copy of the consent form in German can be found in Appendix 3. Due to time constraints and to simplify the transcription process, the audio files of the four interviews were transcribed one after the other with the transcribing software *Trint*. The online application was used in the context of a trial phase (TRINT^{TM}, 2022). The resulting text files were then subsequently checked in the online application for the transcription rules conceptualized by Mayring (2015). These include rules such as transcribing completely and verbatim, deleting filling words such as "ähm" and the like because the focus was on the content, and smoothing out dialects. In addition, dots such as "(...)" were placed when something was unclear, and dashes "-" when there were pauses or interruptions. Also, salient features such as laughter or the like and other nonverbal features necessary for understanding the content were indicated in parentheses.

2.3.5 Coding

Kuckartz (2018) developed a definition guide to separate the categories, and this approach was also used in this study. All main categories, sub-categories (level 1) and

sub-categories (level 2) can be found in Appendix 4 with a detailed description. First, a name was chosen for the category, followed by a brief content description, the application of the category and examples of the applications. The coding was then done with the *ATLAS.ti* software, for which a license was also available from the Technical University of Berlin (ATLAS.ti Scientific Software Development GmbH, 2022).

2.3.6 Case summary

Before the actual content analysis, it is recommended to develop case-related summaries (Kuckartz, 2018). Thus, an overview of the individual cases in tabular form was created, where the main statements of the cases can be compared with each other. The case summaries of the four interviewees can be found in Appendix 5.

2.3.7 Structured content analysis

Kuckartz (2018) describes three basic content analytic methods, which include the structured content analysis (SCA), evaluative content analysis, and type-forming content analysis. Due to the time frame of this master thesis, a SCA was conducted for the evaluation of the expert interviews. He created a clear structure for the analysis procedure with seven steps, that were also applied for the scope of this study. It started with the initial text work, where relevant texts were marked, and memos were written. Thematic main categories were then formed, and the entire text was coded using the main categories. The text was then summarized using the same main categories and sub-categories were inductively formed. In addition, the text was coded again with the new differentiated categories and at the end the final analysis and visualization followed. To obtain quality assurance, generally applicable criteria had to be factored in. Therefore, the entire research process was designed in a comprehensible way. O Objectivity, reliability, and validity were of great importance for the qualitative content analysis. According to Wotha and Dembowski (2017), this can be achieved with documentation. Froschauer and Lueger (2003) state that studies which were developed within the framework of an interpretative research strategy require an assurance of the validity of their results on three levels: the methodological and procedural level, the level of the research process, and the level of the scientific system. It was checked that the SCA includes the consistency of the content. Further,

the study was checked for relevance and the research process was reflected upon. The SCA serves to summarize and systematically condense the content to its essentials (Froschauer and Lueger, 2003; Mayring, 2015). Three techniques were applied such as the summary, explication, and structuring. The latter is of highest important for the qualitative content analysis because here, certain aspects can be extracted from the material. With the help of previously defined classification criteria, a cross-section of the material was assessed based on certain criteria. The frequency analysis was then used as one form of interpretation in which certain text components were filtered out by the category system. In this way, statements could be made about the relative weight of these text components by frequency (Mayring, 2015). The categories that were created after the interviews were conducted are marked with "(i)", which means inductive, and the rest were formed deductively from the questions in the interview guide. After assigning the codes to the respective text passages, the steps of paraphrasing, generalization to the level of abstraction, and the reduction were performed (Mayring, 2015, p. 72). Thus, the material was reduced by summarization and so the content of the interviews could be analyzed for the purposes of this study.

3 Results

To generate diverse functions on vegetation-free and degraded areas in a timely manner, the concept of Tiny Forests seems predestined. Tiny Forests can offer significant added value for the protection of biodiversity and ecological connectivity systems in Berlin and beneficial ES can be generated through appropriate renaturation.

3.1 Area potential in Berlin

Suitable areas for Tiny Forests can vary, but especially sites that are ecologically stressed or will suffer from temperature and drought extremes in the future can be advantageously developed with Tiny Forests. Areas of low use or quality, such as remote parts of public parks, cemeteries, abandoned industrial sites, interstitial spaces in the urban structure, areas along transportation infrastructure can also serve as potential sites for Tiny Forests besides fallow land and areas with unsealing potential (Kowarik et al., 2019; Rupprecht et al., 2015). There usually already are trees in

existing parks and cemeteries, so it might be advisable to prioritize the other land types to increase the amount of vegetation in areas where it is scarce. As previously mentioned, the fallow land areas without vegetation and areas with unsealing potential were selected as the focus of this study. The two maps showing the total number of these two area types in Berlin can be found in Figure 14 and Figure 15 and the map showing the poor green supply for Berlin can be found in Figure 16.

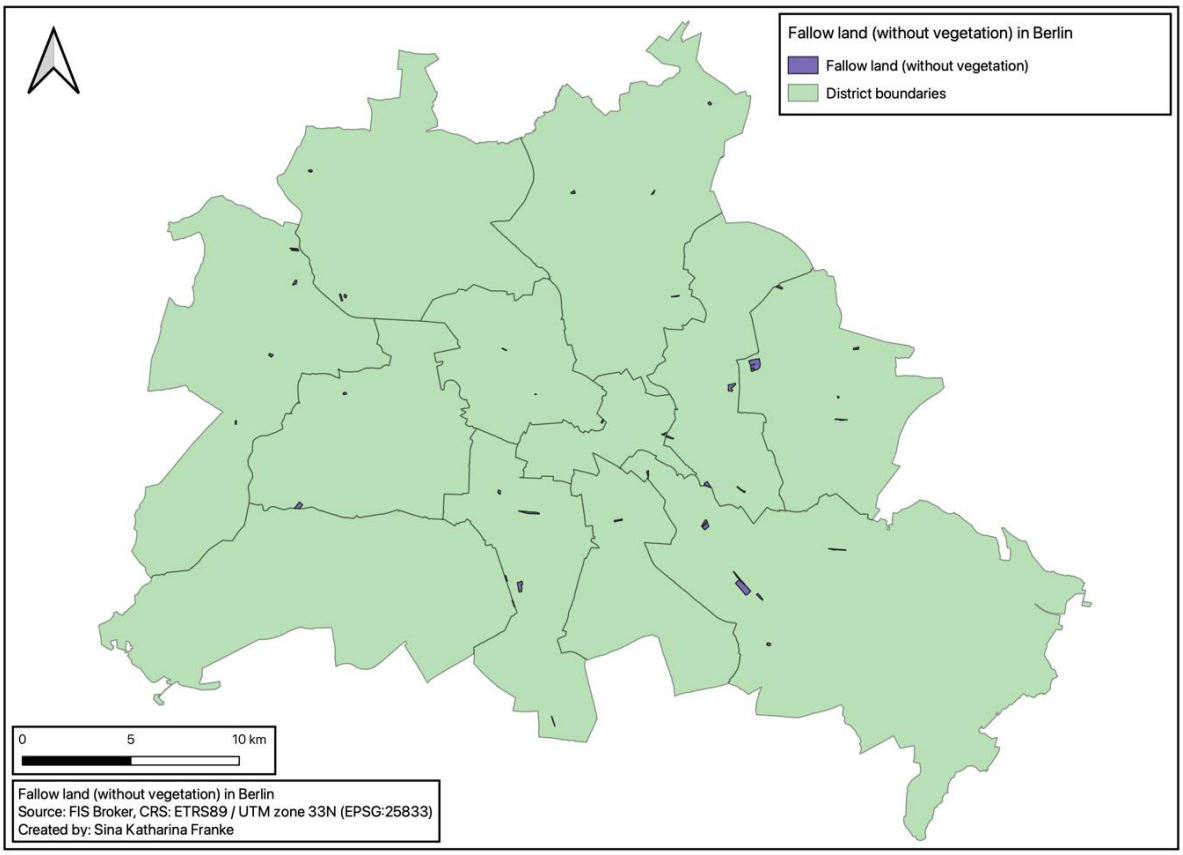

Figure 14: Map of total count of areas with fallow land (without vegetation) in Berlin.

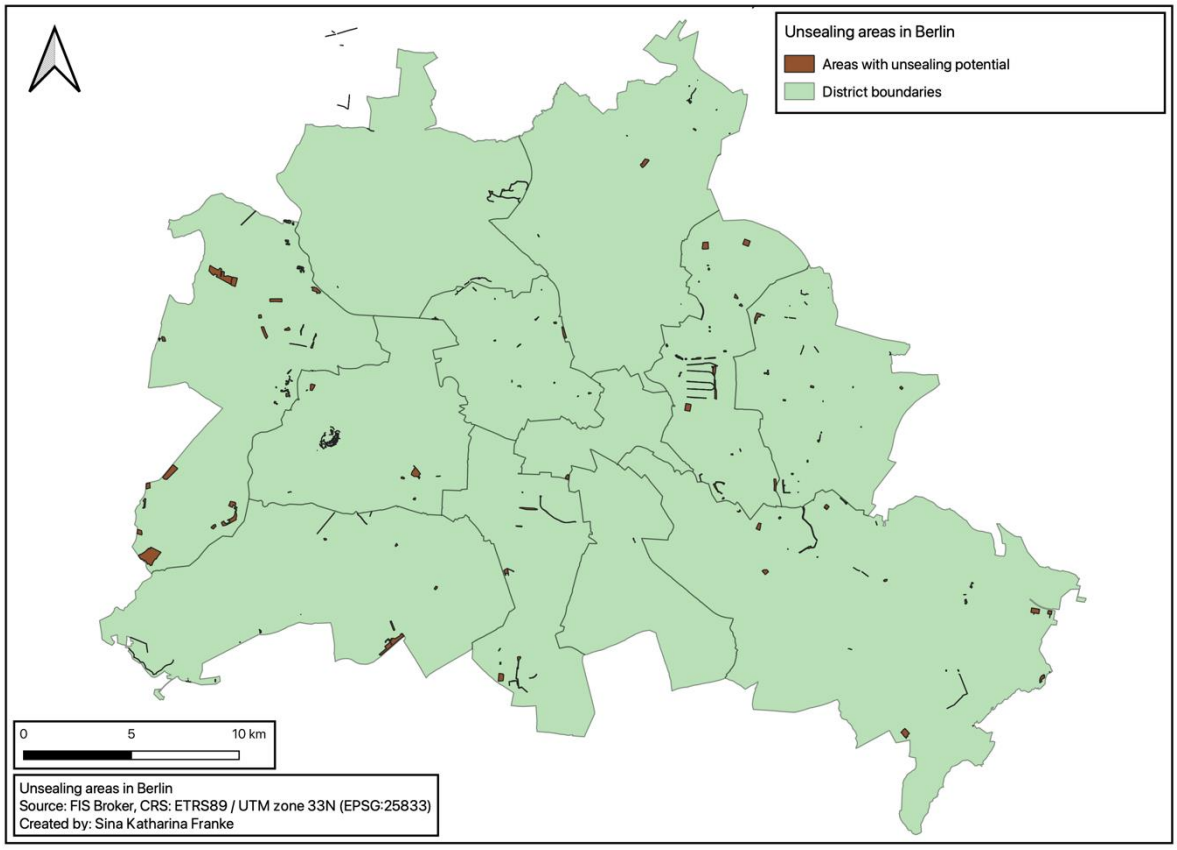

Figure 15: Map of total count of areas with unsealing potential in Berlin.

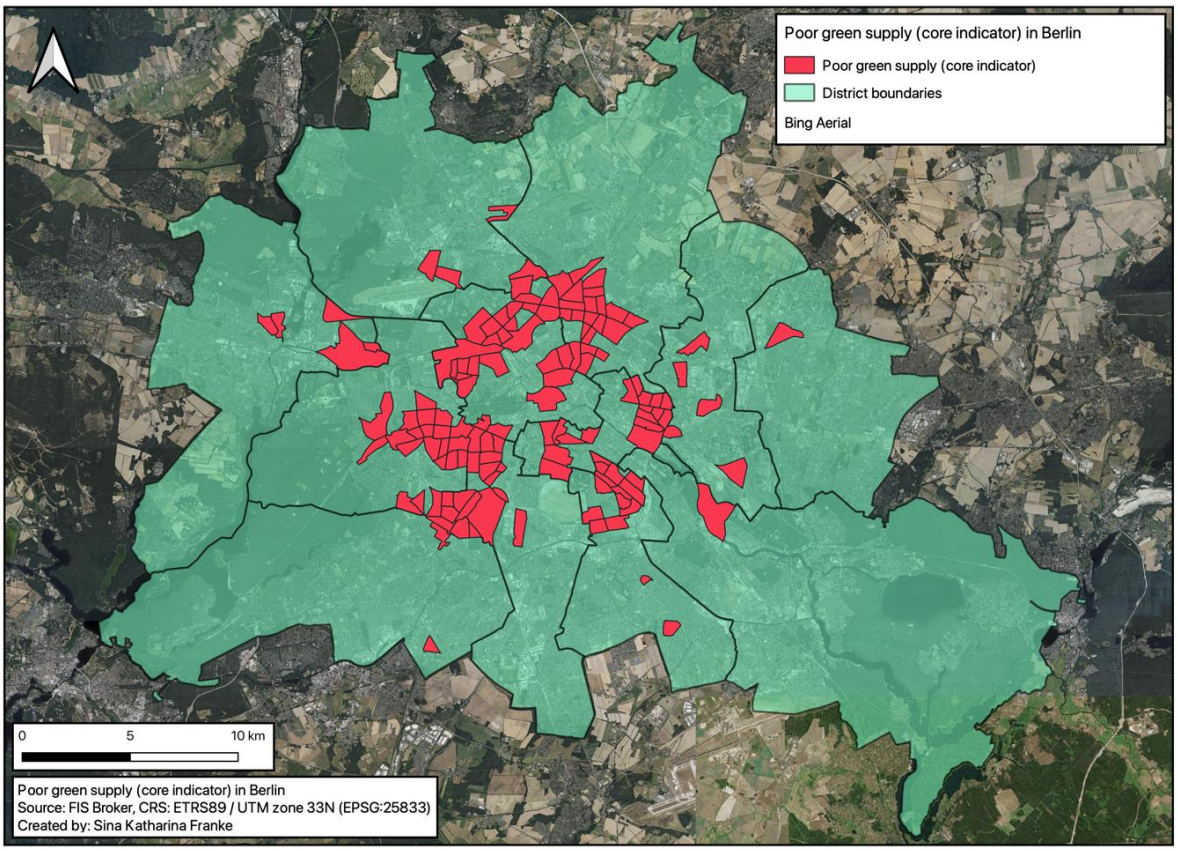

Figure 16: Map of poor green supply (environmental justice core indicator) in Berlin.

By intersecting the total amount of fallow land areas without vegetation in Berlin with the environmental justice core indicator of poor supply in QGIS, ten areas remained. These areas are depicted in Figure 17 and Figure 18. However, after subtracting the areas that were created through intersection errors or areas that are not available anymore, only two of the ten areas remained that could be used as example areas, as explained in more detail in the following Chapter 3.1.1. It is always advisable to check the notes in the attribute table that state what is planned for the respective areas but in this case, not every area had a note indicating the current state of their availability. Therefore, it can also be necessary to check the areas on-site or to contact the appropriate offices to really rule out that the areas in question are still available. The same was done for the areas with unsealing potential in Berlin. Here, the total number of these areas was intersected with the environmental justice core indicator of low green supply in QGIS, leaving twelve areas. These areas can be seen in Figure 19 and Figure 20. The twelve presuming areas were also checked for areas that were created through intersection errors and if they were still available or suitable which then resulted in eight remaining areas. Three of the subtracted areas were created through intersection errors and one area was a stormwater catch basin and therefore not suitable as an area for a Tiny Forest. Two of the then remaining eight areas were selected as exemplary areas, which are presented in more detail in Chapter 3.1.2.

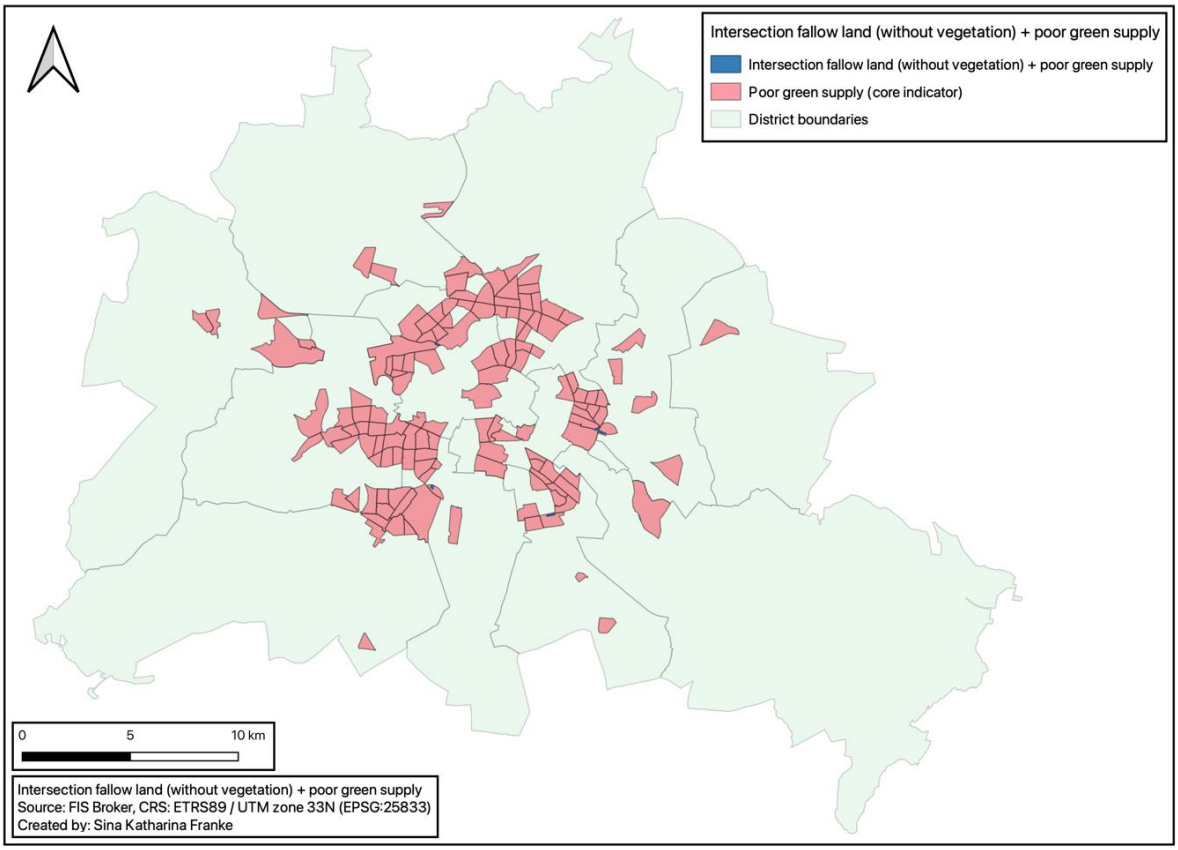

Figure 17: Map with intersection of fallow land (without vegetation) and poor green supply in Berlin.

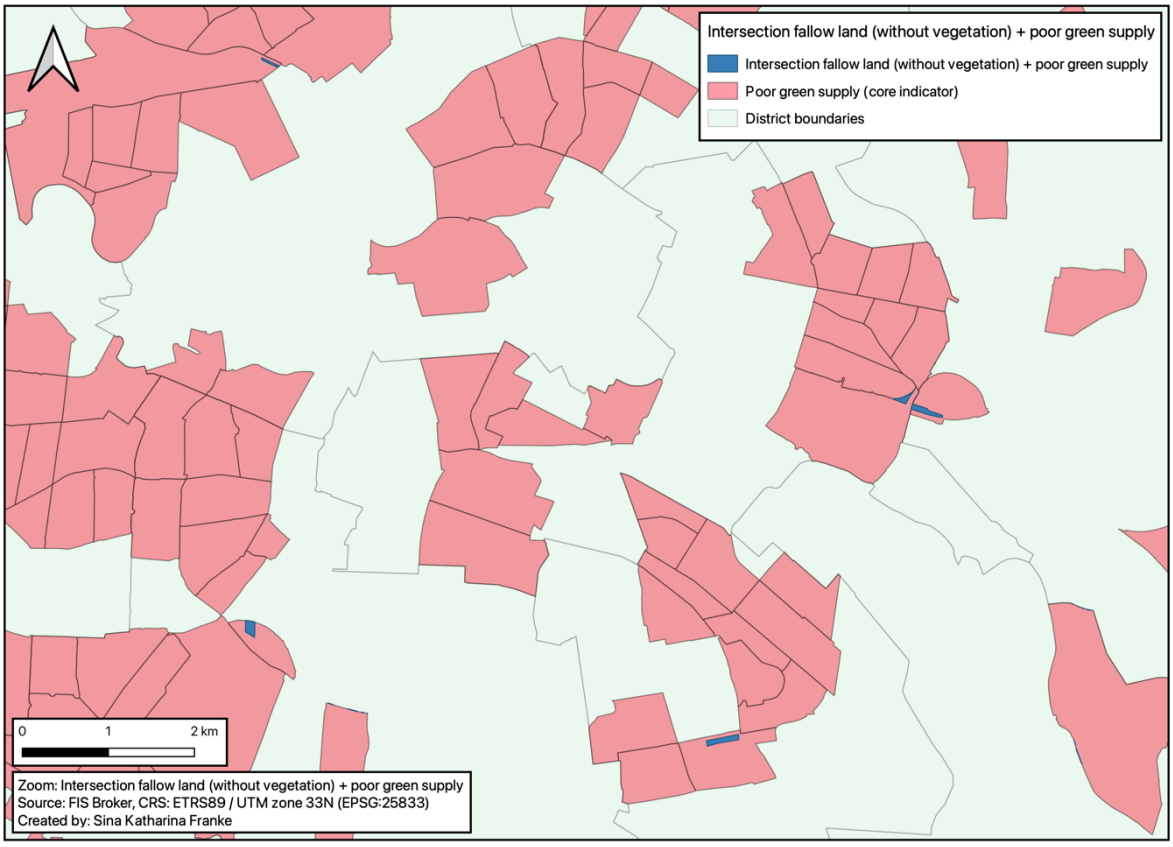

Figure 18: Zoom of map with intersection of fallow land (without vegetation) and poor green supply in Berlin.

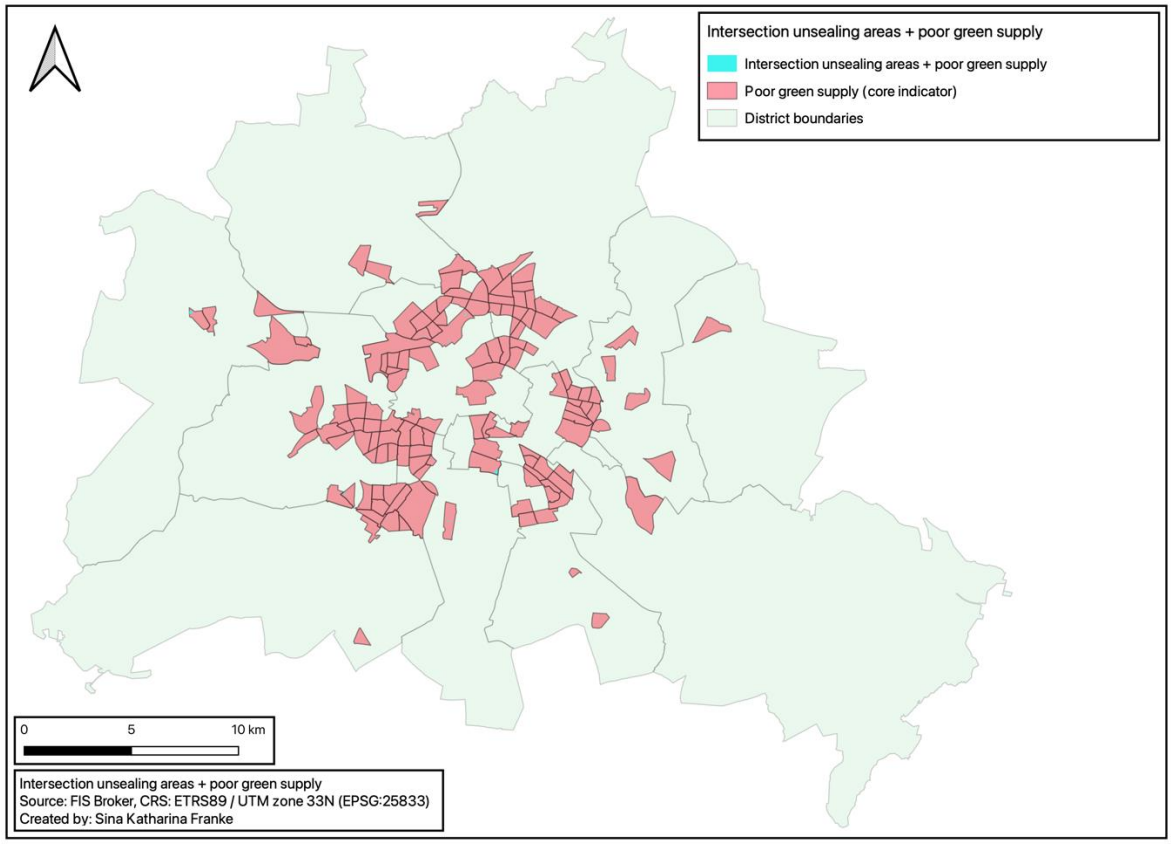

Figure 19: Map with intersection of areas with unsealing potential and poor green supply in Berlin.

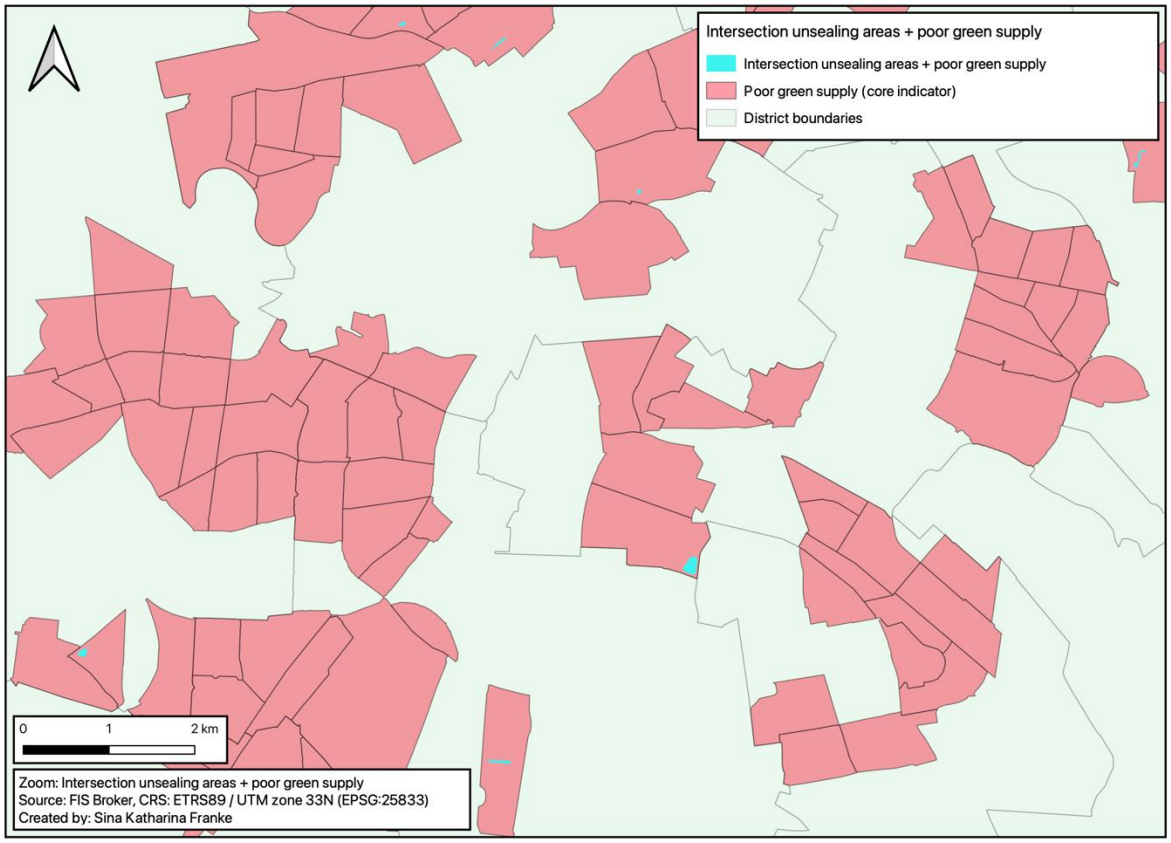

Figure 20: Zoom of map with intersection of areas with unsealing potential and poor green supply in Berlin.

With the current political debate in Europe, the importance of green and open spaces is also increasing. Spatial design comes with long development cycles, which is why small-scale solutions are increasingly important, so that the population can already feel improvements after a short period of time. Due to the accumulation of tropical nights and the heat islands in urban areas, there is an increased need for cooling effects that can be created with urban greenery such as Tiny Forests. From the total list of potential areas that resulted from the spatial analysis, four exemplary areas are presented below. Two of each, the fallow land, and the areas with unsealing potential, were selected and visited for a better understanding of their site characteristics. The four areas are in the Berlin districts Mitte and Neukölln. These two districts are the only ones that have up to fivefold environmental burdens in contrast to other districts regarding the environmental justice indicators (SenUMVK, 2022). Here, not only the share of green and open spaces, but also the other four indicators were documented as insufficient. In addition to the previous selection criteria, it was of interest if there are schools or day care centers within a radius of 500 meters of the exemplary sites, so these children could be included in the establishment of potential Tiny Forests. In this way, the social aspect was also considered, since all four sites showed proximity to these facilities and Konijnendijk (2005) also classified the social aspect of urban forests as the most important, with emphasis on an anthropocentric view.

3.1.1 Urban fallow land in Berlin

As mentioned before, for the fallow land that is part of the area analysis, only two areas remained after subtracting the ten areas with intersection errors and those that are knowingly designated for another land use. One in the Mitte district and one in the Neukölln district. The exemplary area in Mitte is in Huttenkiez, Wedding and the complete attribute table can be found in Appendix 6. According to it, the area has a size of about 4945 m², which was also verified again using the integrated QGIS tool to calculate the area of a site. Figure 21 shows the aerial view of the area in question created in QGIS. The other exemplary fallow site in Neukölln is in Glasower Straße and the full attribute table can be found in Appendix 7. The respective area has a size of approximately 21111 m², which was also verified using the integrated QGIS tool. Figure 22 shows the aerial view of the area in question. Both areas have an elementary school in proximity: the Kristall Grundschule, located about 300 meters from the area in Wedding, and the Silberstein Grundschule, located about 100 meters away from the

area in Neukölln. There was no information or comments on possible development plans for these areas in their attribute tables.

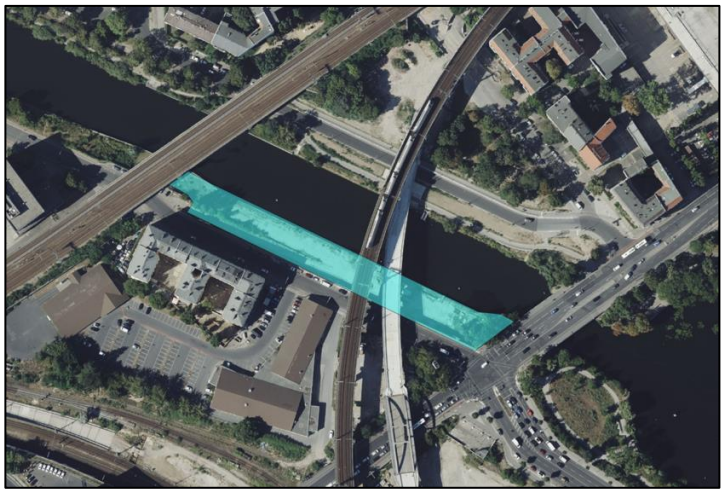

Figure 21: Aerial view of exemplary fallow land in Wedding (created in QGIS).

Figure 22: Aerial view of exemplary fallow land in Neukölln (created in QGIS).

3.1.2 Areas with unsealing potential in Berlin

In the case of areas with unsealing potential, only eight of twelve areas remained from the spatial analysis. Again, as with the fallow land sites and as mentioned before, some areas had to be discounted due to intersection errors or areas already designated for another land use. The two of the eight sites selected by the author as exemplary sites are also located in the Mitte district, more precisely in Wedding, Humboldthain Nordwest. They were selected because they are in an area that has the most environmental stress in terms of environmental justice indicators, so planting an urban forest in form of a Tiny Forest can provide alleviation there, at least in terms of the core indicator for the provision of green and open space. Figure 23 and Figure 24 show the

aerial view of the areas in question. Their full attribute tables can be found in the Appendixes 8 and 9. Both areas also have schools in proximity: the Diesterweg Gymnasium, which is about 150 meters from the area in Wedding, Humboldthain Nordwest I, and the Grundschule am Nordhafen, which is about 100 meters from the area in Wedding, Humboldthain Nordwest II. For the first area, comments were filed as of 2020 that there is a new block concept for the redevelopment of the area, but also that the area delineation would still need to be adjusted in detail. In addition, the area is designated as a public green space in the development plan III - 34 and is said to be a contaminated site. For the second area, it was noted that a development plan exists for a public green area. Also, it says that public path rights should be secured and that a possible continuation to the north to Badstraße through the buildings is planned.

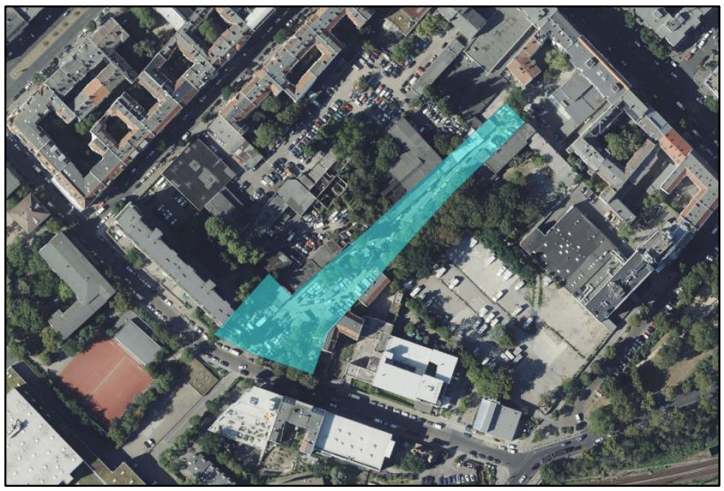

Figure 23: Aerial view of exemplary unsealing area in Wedding, Humboldthain Nordwest I (created in QGIS).

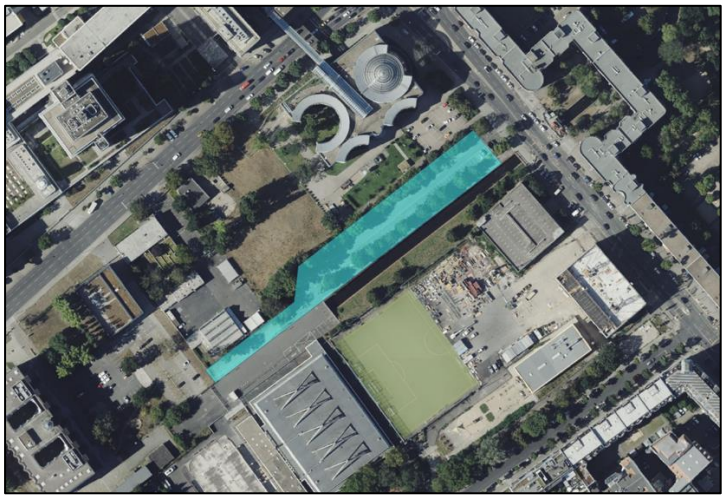

Figure 24: Aerial view of exemplary unsealing area in Wedding, Humboldthain Nordwest II (created in QGIS).

3.1.3 Exemplary areas for implementation

For a better understanding of the site characteristics, images of the four exemplary areas were taken by the author and are shown below (see Figure 25, Figure 26, Figure 27, Figure 28, Figure 29, Figure 30, Figure 31, Figure 32, Figure 33, Figure 34, Figure 35 and Figure 36). A yellow arrow indicates the respective areas. In the case of Berlin, the land use pressure is felt on many levels. The spatial analysis with QGIS has shown that the area potential is quite low in Berlin regarding the parameters used. As mentioned above in the previous chapter, by including the aspect of the core indicator poor green supply and the subsequent intersection with the two chosen area types, only a few areas remained.

3.1.3.1 Exemplary fallow land in Wedding, Huttenkiez

Figure 25: Picture of exemplary fallow land in Wedding (by author, 2022).

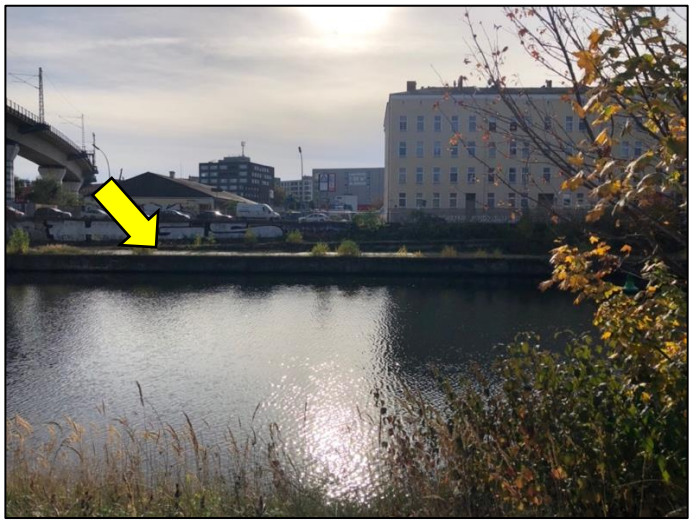

Figure 26: Picture of exemplary fallow land in Wedding (by author, 2022).

Figure 27: Picture of exemplary fallow land in Wedding (by author, 2022).

3.1.3.2 Exemplary fallow land in Neukölln, Glasower Straße

Figure 28: Picture of exemplary fallow land in Neukölln (by author, 2022).

Figure 29: Picture of exemplary fallow land in Neukölln (by author, 2022).

Figure 30: Picture of exemplary fallow land in Neukölln (by author, 2022).

3.1.3.3 Exemplary unsealing area in Wedding, Humboldthain Nordwest I

Figure 31: Picture of exemplary unsealing area in Wedding (by author, 2022).

Figure 32: Picture of exemplary unsealing area in Wedding (by author, 2022).

Figure 33: Picture of exemplary unsealing area in Wedding (by author, 2022).

3.1.3.4 Exemplary unsealing area in Wedding, Humboldthain Nordwest II

Figure 34: Picture of exemplary unsealing area in Wedding (by author, 2022).

Figure 35: Picture of exemplary unsealing area in Wedding (by author, 2022).

Figure 36: Picture of exemplary unsealing area in Wedding (by author, 2022).

3.2 Qualitative evaluation of the interviews

The results of the four interviews are described below. According to the four main categories, the most important results of their sub-categories are presented. Table 1 shows an overview of the main categories and their sub-categories (level 1 and 2).

Table 1: Overview of the four main categories, six sub-categories (level 1) and thirty-four sub-categories (level 2).

Main category	Sub-category (level 1)	Sub-category (level 2)
Stance towards Tiny Forest concept		
Implementation of Tiny Forest concept in Berlin	Potentials and challenges	Area availability Soil preparation Potential natural vegetation Succession Ecosystem services Nature conservation Accessibility Temporary interim use Recreation Carbon storage potential (i) Dense planting (i) Social aspect (i) Biodiversity (i) Climate aspect (i) Political situation (i) Link to ther green infrastructure (i) Adaptation of the concept (i) Nature experience (i) Terminology (i) Costs (i)
	Plant selection	Mix of native and non-native plant species Examples of native plant species
Acceptance of Tiny Forest concept in Berlin	Social component	Target groups Participation of citizens Knowledge transfer (i)
	Aesthetic component	Design (i)
Outlook on the Tiny Forest concept in Berlin	Knowledge gaps for implementation	Risks and uncertainties (i) Area acquisition (i) Land ownership (i) Social acceptance (i) Assured plant care (i) Bureaucratic and political hurdles (i) Soil properties (i) Public outreach (i)
	Future viability	

Since the interviews were conducted in German, the content of the transcripts was translated for the purposes of this study to incorporate the information into the subsequent analysis. As mentioned in the previous chapter, the transcription of the interviews was not anonymized. The following quotations were each chronologically numbered according to the order of the interviews with Prof. Dr. Ingo Kowarik carrying number 1, Stefan Scharfe number 2, Stefanie Scholz number 3 and Annette Hennemann number 4. Behind each number, the number of the coded quotation in the respective interview in ATLAS.ti was placed, e.g., 1:1 means that it was the first coded quotation from the interview with Prof. Dr. Ingo Kowarik. The table in Appendix 10 provides information on how often each category was coded in each interview and shows a quantitative comparison of the four interviews in terms of the number of segments coded. *Gr* is the number of citations coded by a code or the number of citations of a document and *GS* is the number of documents in a document group or codes in a code group. A total of 480 codes were assigned, and the main categories are also counted here, from which further sub-categories 1 and 2 resulted. But, without counting the main categories again, a total of 239 codes were assigned. According to Appendix 10, Stefan Scharfe provided the most extensive statement with 82 marked citations, followed by Prof. Dr. Ingo Kowarik with 57, Stefanie Scholz with 50 and Annette Hennemann with 47 citations. The table shows that the interviewees were able to provide information on all four main categories, but not on all sub-categories (levels 1 and 2). As mentioned in the previous chapter, the results were obtained through the process of initial paraphrasing, generalization, and content reduction, and are provided below with a listing of all citations for each topic. In the following, the respondents are referred to by their last name only to preserve the flow of reading. Most statements were made in the second main category with 169 mentions, followed by the third main category with 35, the fourth main category with 28 and the first main category with 7 mentions. Figure 37 below shows the 12 most frequently used sub-categories (level 1 and 2) throughout all four main categories. Except for one sub-category with level 1, all other sub-categories were level 2, and they include the topics in descending order of area availability, PNV, soil preparation, social aspect, temporary interim use, design, recreation, future viability (sub-category level 1), participation of citizens, accessibility, climate aspect and nature conservation. Except for social aspect, participation of citizens, climate aspect and nature conservation, all four experts commented on the categories at least once.

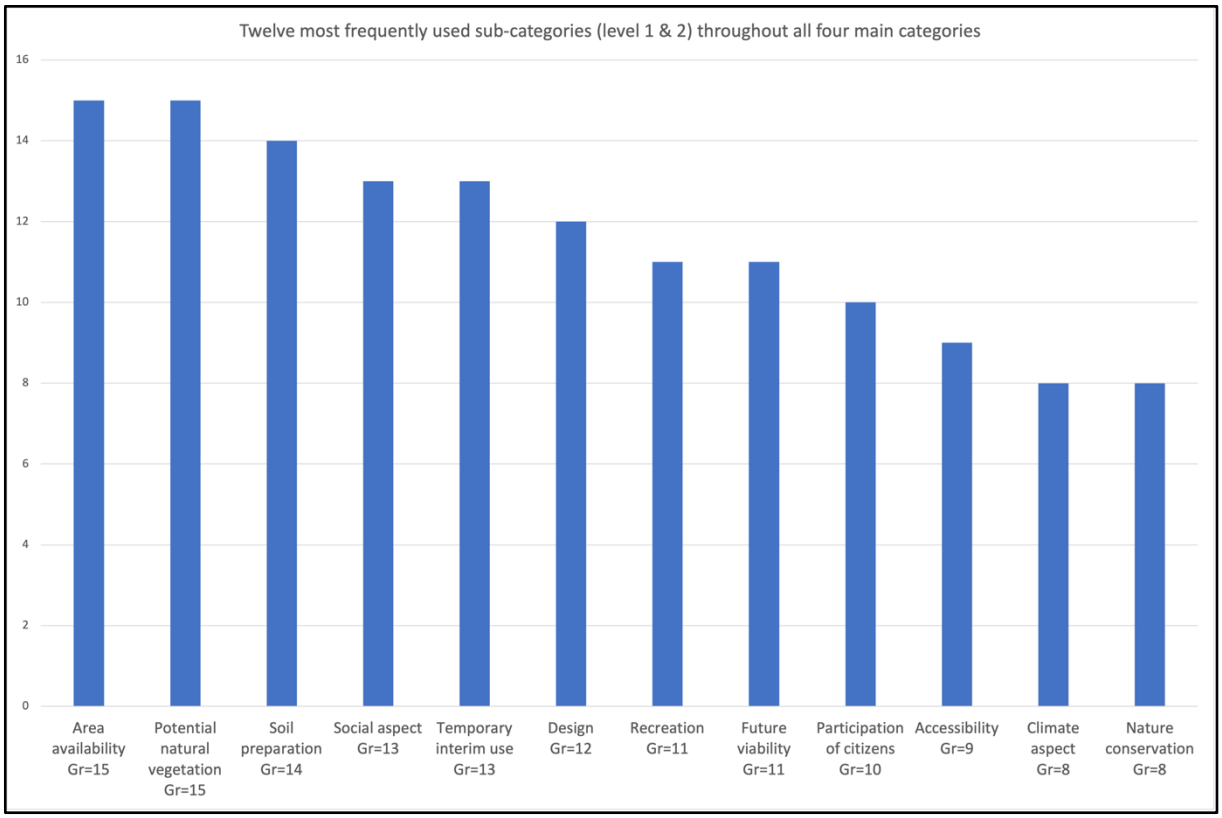

Figure 37: The twelve most frequently used sub-categories (level 1 and 2) throughout all four main categories.

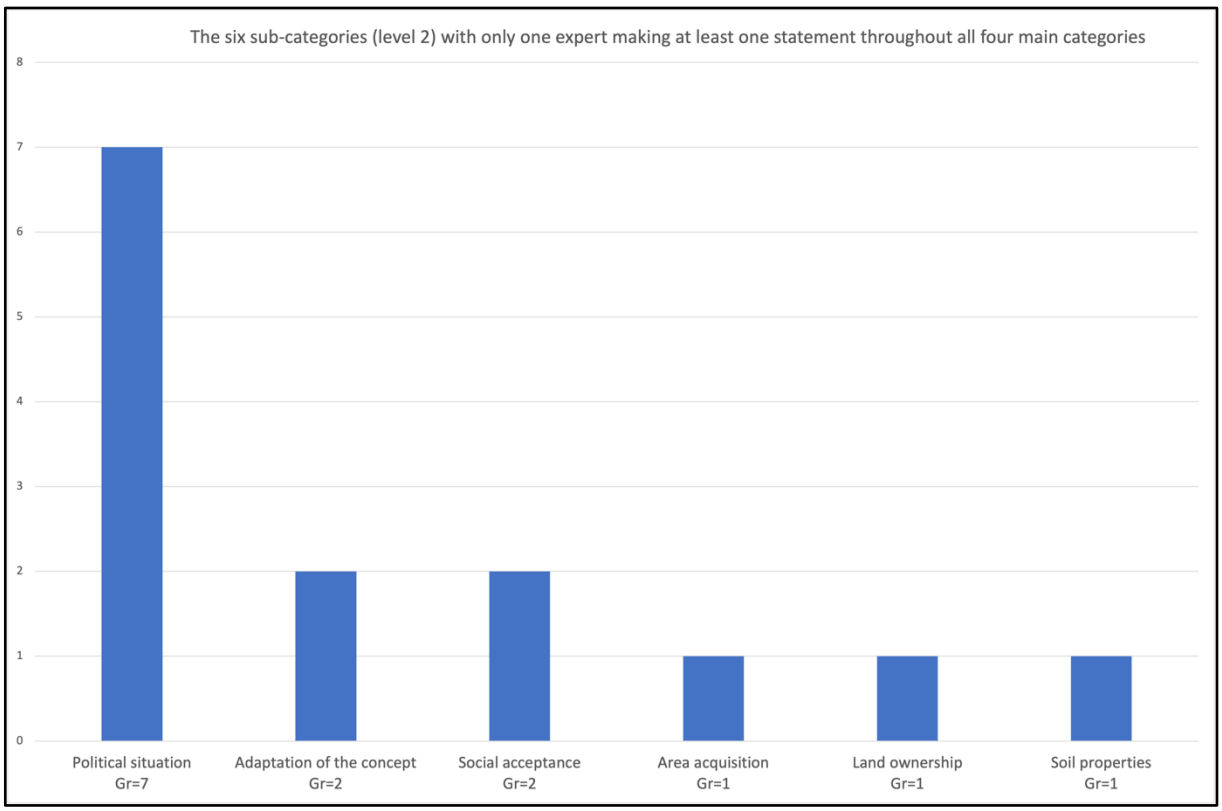

Figure 38: The six sub-categories (level 2) with only one expert making at least one statement throughout all four main categories.

Figure 38 shows the six sub-categories (level 2) in which only one expert made at least one statement across all four main categories. Based on the most frequently used nouns in all four interviews, the following word cloud was created in ATLAS.ti (see Figure 39). Since the interviews were conducted in German, the words in the word cloud are also in German but if translated into English, the nouns mentioned most often are *city, people, areas, species, trees, people, forests, forest, plants, years, concept, area, soil, acceptance,* and *implementation.*

Figure 39: Word cloud of most frequently used nouns in all four interviews (in German).

In ATLAS.ti, it was easy to select the individual topics and experts to access the citations directly, as the categories were listed there in a table. As mentioned before, this table can be found in Appendix 10, which was derived and exported from ATLAS.ti. Moreover, some citations were given more than one category because they could be classified elsewhere. Therefore, if a citation is listed several times in different categories in the following, it has been coded several times at the appropriate place.

3.2.1 Stance towards the Tiny Forest concept

This first main category was created for any information the interviewees provided about their attitudes toward the concept of the Tiny Forest in general, including their personal interest in the topic. Here, no sub-categories were created and there were no overlaps with other categories. All four participants said that they were familiar with the Tiny Forest concept according to Miyawaki. In total, six passages were coded for this main category, and every interviewee gave a statement in this regard. Three of the interviewees were rather positive and curious about the concept. Citations undermarking this statement are: *"[...] when I read this, I thought it actually sounds too good to be true [...]"* (3:33), *"[...] that the forests grow ten times as fast and are almost 30 times as diverse and so on, is of course also mega mega exciting, especially if you have studied in the field."* (2:83) and *"[...] basically I think it's great that this is now being pushed again and [...] that it is now simply being taken seriously and strategically planned and backed up with data, and that the right politicians are simply coming up with it."* (4:25). Kowarik was generally critical when first hearing about Tiny Forests in urban areas, saying, *"[...] in the urban context, the concept doesn't convince me yet because I honestly don't see any advantages. But I do see a lot of disadvantages."* (1:39).

3.2.2 Implementation of the Tiny Forest concept in Berlin

This second main category was applied when the experts provided general information about the potential implementation of Tiny Forests in Berlin. It was divided into two sub-categories (level 1) *Potentials and challenges* and *Plant selection* which were then also subdivided into further sub-categories (level 2) that are described in the following.

3.2.2.1 Potentials & Challenges

This sub-category (level 1) was applied when the experts gave insights or estimations for possible potentials and challenges that may arise when implementing the Tiny Forest concept in Berlin. It has twenty sub-categories (level 2) but not every interviewee commented on all of them. Nonetheless, there is at least one statement from a respondent on each, otherwise the respective category would not exist. The five most frequent statements were made in the sub-categories (level 2) of *Area availability*

(9%), *Potential natural vegetation* (9%), *Soil preparation* (9%), *Social aspect (i)* (8%) and *Temporary interim use (i)* (8%) (see Figure 40). Apart from the *Social aspect (i)*, on which only three respondents commented, all four respondents commented on the other four categories. Looking at the sub-categories (level 2) where only one interviewee commented, there were two out of twenty. It concerns the *Political situation (i)* with seven statements and the *Adaptation of the concept (i)* with two statements, both made only by Scharfe. For the sub-categories (level 2), on which only two interviewees commented, *Succession*, *Terminology (i)*, *Ecosystem services* and *Nature experience (i)* can be mentioned.

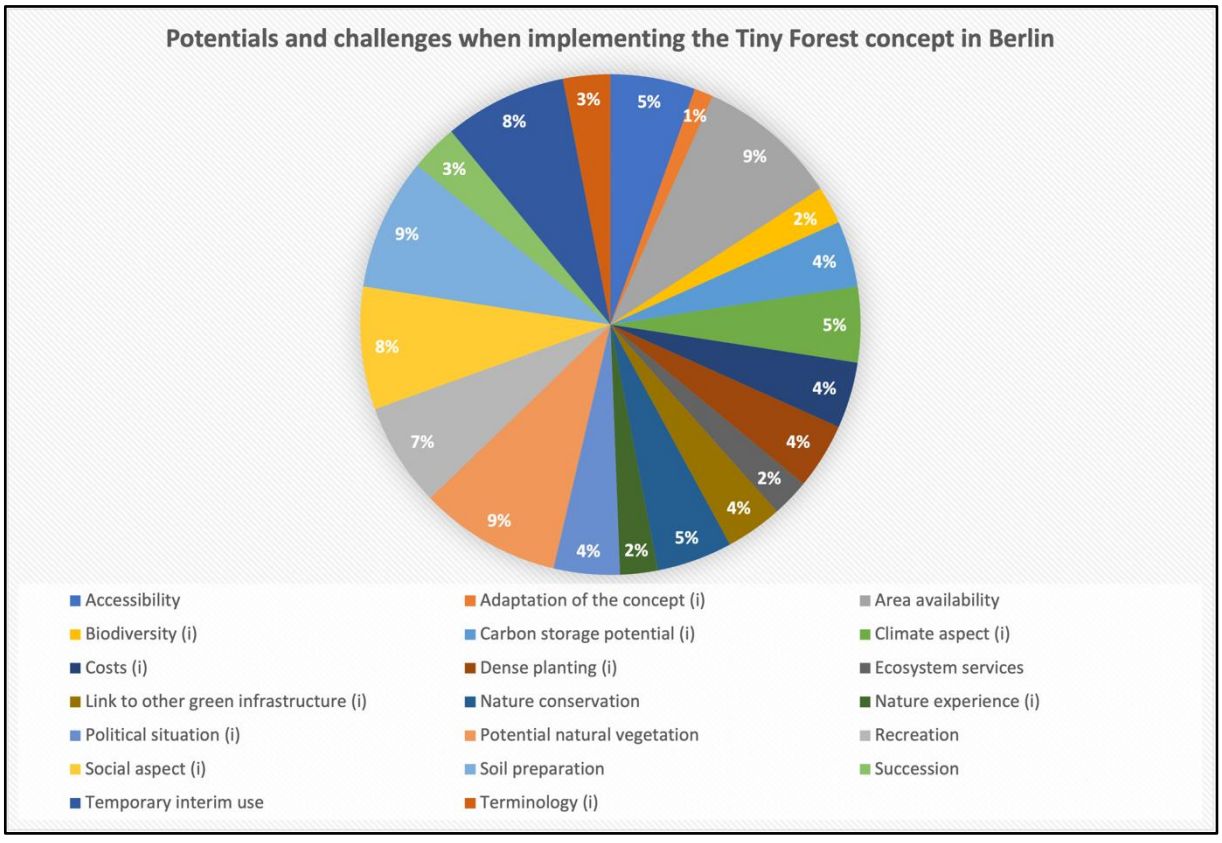

Figure 40: Pie-chart of the frequency analysis of the codes for all twenty sub-categories (level 2) within the sub-category (level 1) Potentials and Challenges. The five most frequently mentioned categories are Area availability (9%), Potential natural vegetation (9%), Soil preparation (9%), Social aspect (i) (8%) and Temporary interim use (i) (8%).

Regarding the area availability, Kowarik states that "*[...] before thinking about land potential, one should consider what functions might be associated with such Tiny Forests and where there are ultimately conflicts of interest and what would actually be gained."* (1:21) and he sees *"[...] more of a problem when areas are then altered in such a way that there are conflicts with other goals."* (1:31). Scharfe says that *"[...]*

without having scanned Berlin super extensively [...] that in all urban areas there is most likely a relatively large, at least potential amount of space available after all." (2:1). According to him, *"[...] the further you get into the urban agglomeration, the higher the prices are, and that it's not that easy to get hold of land there."* (2:25). Moreover, he notes that "*[...] for Berlin explicitly, the most difficult thing would probably be that the decision is made to get the appropriate areas, especially where the forests make the most sense, really further and further towards the city center."* (2:28). Scholz mentions that *"[...] it's not so easy to find a place that is central, that is of importance, that is not yet occupied by something else or that the green space office has not already planned something else."* (3:2) and *"[...] that there is enormous competition for space everywhere."* (3:35). She also argues that one *"[...] can, of course, do it somewhere on the outskirts of the city where there's nobody. That's not bad either, but that's not the point of these Tiny Forests."* (3:22). She concludes that *"[...] there is certainly also some fallow land."* (3:5) and that *"[...] actually it's supposed to be a place that's valuable and has meaning to people [...]."* (3:23). Hennemann states that *"[...] for Berlin, [...] the same applies in part as in Darmstadt. Because simply the search for land is such a problem [...]. And above all, where one would like to have it, exactly there, where so much is sealed, where so much has been built."* (4:27). In her opinion *"[...] industrial areas are another idea [...]"* but she further states that there *"[...] you have less public influence [...]"* and *"[...] you would have to convince the people. [...]".* She adds that *"[...] there are now so many companies that like to put on a green coat. [...]"* and that she *"[...] would look there almost more than in the normal public green in Berlin."* (4:2). In conclusion, all experts are aware of the land pressure in cities and in Berlin, especially in the center where Tiny Forests would make the most sense, but also that it is not impossible to find land there. In addition, when designating areas, one should always consider the aspect of the existing vegetation, so as not to create counterproductive developments in terms of nature conservation.

As for the PNV, Kowarik gave the most comprehensive statements with almost half of the total citations in this sub-category (level 2), saying, that *"[...] Miyawaki's concept was to use species of the PNV. And this works well in non-urban areas. In the urban area, however, we see that the PNV cannot be realistically determined on anthropogenically altered sites."* (1:22). He further argues that "*[...] you can't apply this classic concept, the PNV of the original Berlin-Brandenburg landscape, [...] to urban*

locations in Berlin [...] ", because it *"[...] doesn't add value, it adds potential harm."* (1:45). Rather, he states that *"[...] on highly modified sites, ultimately all species that may not even naturally occur there, but that can cope with the new natural potential that is anthropogenically modified, have to be included." (1:1)* and his *"[...] practical consequence has always been to say PNV is good for relatively unmodified sites."* (1:2). In conclusion, he says that the *"[...] PNV, [...] you don't need in the city center"* and he *"[...] would just take the species of which you know that they grow well there."* (1:29). Further, *"[...] if you want to use completely new species, you can of course do that with experimental design. There are no legal objections in the interior of the city."* (1:30). Regarding the PNV, Scharfe says that they *"[...] look at what would be the leading tree species in the region in terms of potential natural vegetation and try to place it somewhere in the center in terms of quantity, e.g., to use it as the main tree species."* (2:34). He further states that he is "*[...] quite excited, but actually very very optimistic that the whole thing will work fully well, even with native species."* (2:37) and that in their Tiny Forest implementations *"[...] the plant composition is a bit different for each project. But it is actually a matter of planting native trees and shrubs, which could in principle grow at this location, with the highest possible diversity."* (2:72). In his opinion, *"[...] in nature conservation circles or in the broader mass of the population, it simply feels good or meets with more acceptance when you say we use native species. That is somehow more familiar to people."* (1:71). Scholz argues that the PNV *"[...] gives [...] very much more than these 23 trees or bushes [...]"* that *"[...] would come into question [...]. Now one would probably then take the trees and bushes that are more likely to withstand heat and drought."* (3:8). Hennemann states that *"[...] in order for the ecological benefit to be there, this PNV would have to have a large share [...]. So, you can't replace it by any means, you could supplement it a bit [...]"* and adds that *"[...] the main share would have to be with PNV."* (4:33). She further states that *"[...] then it's actually pretty clear. It's not really that complicated [...] with this planting planning."* (4:32). In summary, the exclusive use of plant and shrub species according to PNV, as envisaged in the Miyawaki method, is not recommended by all four experts. Rather, a mixture of native and non-native plant species might be more appropriate, although plants according to PNV should still have the largest share and plant compositions adapted to the particular site should always be created.

Regarding the soil preparation, Kowarik says: *“Site modification in Miyawaki's original plantings was aimed at ensuring that [...] the young plants could grow well.”* and *“[...] in Berlin, the site modification cannot aim at reversing the anthropogenic changes.”* (1:42). He considers *“[...] big exchange events and so on [...] counterproductive.”* (1:3) and concludes that *“[...] because of CO2 balance reasons [...] you have to work with the substrates that are there.” (1:24)* and *“[...] then you do what any reasonable gardener would do. You loosen the soil and then you plant [...].”* (1:43). In conclusion, Kowarik believes the soil preparation step, as envisioned in the original concept, is inappropriate for Berlin and would simply loosen the soil a bit before planting.

Scharfe states that Tiny Forests are *“[...] totally in tune with the spirit of the times on a social level.”* (2:4) because *“[...] this is a very important component, especially for people in the city, who are so separated and disconnected from nature these days.”* (2:8). He further says that *“[...] the idea is ultimately also that one simply plants with ideally [...] young people, so with children together and then also transfers the responsibility for the forest to them and they also learn and continue to use it.”* (2:30). That way *“[...] it is also people who help plant this forest, also help plan it in the participatory process [...]”* and they are *“[...] ideally children and school classes.”* (2:3). Nowadays, there are *“[...] cities that actually simply have on their political agenda that they would like to bring, if possible, in an ecological way, as cost-effectively as possible, [...] various ecosystem services simply into the city. For ecological and social reasons.”* (2:70), says Scharfe. Lastly, he argues that *“[...] the greatest potential [...]”* is *“[...] really on the social level and in the symbolic power that such a project has.”* (2:6). Scholze also highlights that Tiny Forests are *“[...] a social project on top of that [...]”* (2:44) and *“[...] that one connects the people in the city and nature in some way again. And therefore, it is important that it is also a place where this forest is seen and where you can also observe the changes then.”* (3:1). She further states that *“[...] what is also important is that you have, for example, a school or a neighborhood that then also takes care of it. That's also part of this concept, that it's not just the green space office that takes care of it, but that there's really a team that's responsible for this planting.”* (3:4). Hennemann agrees with both her previous speakers by saying that *"It is also very important that it has this social aspect, that people plant and learn about it.”* (4:5). She further states that *“[...] the social aspect should also be such that the topic of ecology and forests and greenery is transported to places where it is actually not really*

there or is perhaps not developed enough." That is what she *"[...] would find [...] even more exciting."* (4:6). To summarize, all three experts who commented on this category consider the social aspect to be an important aspect of the Tiny Forest concept in Berlin, for a variety of reasons. First and foremost, because young people can be involved in the implementation, who can also use these areas for education. In general, citizens can be reconnected with nature through the creation of these small green oases.

Regarding the temporary interim use, Kowarik´s *"[...] first thought is: completely off the mark. [...] After all, it is then an investment of a lot of effort, of energy, of plants. And then the whole thing is cleared away again and the whole thing is destroyed."* and he does not *"understand what the advantage is supposed to be."* (1:13). He says: *"Hopes are also invested there [...]. When people are involved in the planting, it grows on them. And then to say: So now, after five years, after 10 years, it will be gone again."* which is why he finds that *"[...] difficult."* (1:14). Further, he thinks "*[...] it's much better to sow a lawn or a meadow. That's something that, on a symbolic level, is not as much of a promise of eternity as a forest."* (1:15). Scharfe, on the other hand, states that *"[...] it would be better than not to do it. [...]"* and that *"[...] we have no guarantee at all how long such a forest will actually stand there [...]"* or *"[...] how the political situation will change, how the world situation will change in general [...]"* and he thinks that *"[...] every tree or every area that is forested today makes sense somewhere."* (2:16). Moreover, he argues that if people know, that *"[...] after 20 years a house will be built there, then it is a bit more difficult to argue for it [...]. But still, from an ecological point of view, it will probably still make sense, even if the forest only stands for 20 years."* (2:49). Scholz also thinks that establishing Tiny Forests as a temporary interim use on vacant land is *"[...] better than not doing it [...]"* (3:15) and she *"[...] would rather say: Let's plant something, then something will be there for the next 10 to 15 years and then it will disappear again and be replaced in another place."* With that, she would *"[...] have no problem [...]"* (3:16). Hennemann also agrees that a temporary interim use is *"[...] actually very good. [...]"* and that the *"[...] question is, [...] from which shortest possible period of time it makes sense [...]."* (4:8). She does not think that if *"[...] you get them for five or eight years [...] a Tiny Forest makes sense anymore. [...]"* and *"[...] if you now want Tiny Forests for Berlin, [...] where you say it also makes sense in the period, [...] then you need them for 20-30 years."* (4:17). She further argues that the

"[...] problem is on the one hand [...] an emotional one, if there really is a little forest there, then to cut it down again is of course scary." (4:9). In general, she states that it is *"[...] actually more of a problem that Germany generally has with interim solutions [...]"* because one *"[...] can only ever do it for good [...]"* and that *"[...] interim solutions and temporary solutions are extremely difficult [...]"* but *"[...] as an ecological point, that would be cool [...]."* (4:10). She adds that *"[...] there are always corners that are basically speculative areas, where no one builds for ages."* (4:38). In summary, apart from Kowarik, all other three experts would plant Tiny Forests as an interim use on vacant land, arguing that it would be better than not to do so. However, the duration would have to be defined for which shortest period this would be useful, otherwise the effort would be too high compared to the actual benefit.

As for the succession, Kowarik states that *"[...] there is actually nothing new about it at all, but [...] one can skip succession stages, if one simply plants species of older stages."* (1:28) and that this *"[...] has nothing at all to do with succession theory [...]"* but that *"[...] it is simply a succession anticipated by human intervention, namely by plants of certain species."* (1:9). He further says that the new succession theory as it was described by Miyawaki above in Figure 2, cannot be taken *"[...] over one to one [...]"* because the described evergreens *"[...] don´t exist here. [...]".* He acknowledges Miyawaki to be *"[...] a very important applied ecologist. [...]"* but he does not think that he is a *"[...] succession theorist."* (1:46). Kowarik argues that *"[...] within a relatively short period of time, there are many spontaneous succession forests in the city, which all look different, because the question of which species migrate there and in what numbers is really dependent on the environment and what comes up there is actually adapted to the location, otherwise it would not come up there. Even to the craziest locations."* And says that *"[...] there are very different forests."* (1:47). Scharfe thinks that *"[...] with the succession it is just also exciting. [...]"* and *"[...] that humus builds up [...] over a longer period of time [...]"* which is skipped with the new succession theory and *"[...] that the theory is ultimately that [...] simply directly through a soil preparation and the close planting [...]"* the plants quickly pull up. He also says that for the MIYA e.V. Tiny Forests, they *"[...] always mulch properly. [...]"* and *"[...] usually apply a ten-centimeter-thick layer of mulch so that the forest simply grows much faster as a result of this combination."* (2:10). Finally, both experts commented on the induced succession of Tiny Forests planted according to the Miyawaki concept. Kowarik argues

that Miyawaki's novel succession theory is not a new idea, and Scharfe notes that proper mulching of Tiny Forests in combination with the use of plant species of a later successional stage can help these small forests grow faster.

Kowarik did not specifically talk about the ES of Tiny Forests but the ES that arise when there is *"[...] a species-rich wildflower seeding, [...] dry grassland seeding, ruderal seeding. [...]"* on open ground and noted that *"[...] structurally rich, [...] herbaceous vegetation also binds a lot of dust and so on and so forth. [...]"* and that same goes for woody plants, but he doubts *"[...] whether these woody plants look good, [...]."* (1:58). Further, Scharfe says that one cannot *"[...] expect too much from individual pilot projects as far as ecosystem services are concerned."* (2:5) but also that one should not talk them *"[...] down too much [...]"* and that they *"[...] are perhaps more in the focus of a larger sum of forests."* (2:32). *"Municipalities and cities that actually simply have on their political agenda that they would like to bring as ecologically as possible, as cost-effectively as possible, [...] various ecosystem services simply into the city. For ecological and social reasons."* (2:70), says Scharfe. In summary, Kowarik comments on the ES of woody plants as they could bind dust as well as other seedings, such as those of ruderal vegetation, but he doubts that these woody plants would look good then. Scharfe adds that one cannot expect too much in terms of ES for a single Tiny Forest, but scattered throughout the city this could again look different.

Kowarik being the expert on nature conservation commented that *"[...] from a nature conservation point of view, there is no need at all to expand the woody plants or the proportion of forest in Berlin. The reason for this is that the non-woody vegetation is infinitely richer in terms of biodiversity of plants, and that the woody planting sites in particular are very important for wild bees, for the sand lizard, for all kinds of things."* (1:4) and that *"[...] if it's fallow vegetation, for example, or ruderal vegetation or urban meadows, then these are often much, much, much more important from a nature conservation point of view than stands of woody plants."* (1:26). Further, if the establishment of Tiny Forests *"[...] pushes back structurally rich, open vegetation, they're counterproductive. It doesn't matter what you plant there."* (2:18). In his opinion, *"[...] you then need very good arguments if you turn ruderal areas or areas planted with grassland into a Tiny Forest."* (1:44). Therefore, *"[...] from a nature conservation point of view [...]"* he does not *"[...] see any synergies there, rather conflicts. [...]"* But he als

says that *"[...] you can never say never, of course."* (1:50). Scholz adds that it *"[...] is also what we know from studies in Holland, that not only the diversity of species increases enormously, but also the individuals [...]"* and *"[...] that [...] the number of individuals of a species is very strong."* (3:11). She further states that *"[...] from that point of view, [...] that's pretty important. However, only if it is also in connection with other green spaces, so that you have a kind of [...] stepstones. [...]."* (3:28). Hennemann says that urban forests have a significance for nature conservation and adds that *"[...] in the past, people always talked about steppingstone biotopes, [...] which have to be there at a certain distance, also for certain bird populations or insect populations. [...]"* (4:4). In summary, the three experts assess the nature conservation potential of Berlin's Tiny Forests differently, with Kowarik being more critical and Scholz and Hennemann more positive. Kowarik argues that, for example, fallow and ruderal vegetation in Berlin is more important than woody stands in terms of their conservation potential. Scholz and Hennemann, on the other hand, add that Tiny Forests could play an important role for nature conservation in the city, especially if these small forest patches are distributed and connected throughout the city.

As for the accessibility of Tiny Forests, Kowarik says: *"Many green spaces, especially on residual areas of the city are physically inaccessible. They are not accessible."* (1:6) but adds that *"[...] they are visually accessible. That is a very important point. You can see them, so they are part of our environment. They are perceived by people in the city and therefore they have to be measured by how they look."* (1:7). Scharfe states: *"If the focus is more on the recreational function, then you can also manage to design the entire project in such a way that you can do justice to it and meet the requirements."* (2:59). Scharfe further says that one *"[...] could also equip the entire park design or larger public areas with small patches, small islands, Tiny Forests, or have a meadow next to them, and the shape doesn't have to be round, but can be u-shaped or something, so that you somehow create a protected space where you can simply sit on a bench."* (2:60). Scholz adds that *"[...] it's also okay to give back a few areas sometimes even in a city. [...]"* (3:9) but also that *"[...] people [...] have to sit somewhere in the shade. Of course, you can stay at the edge."* (3:40). Further, she comments that it *"[...] is also sometimes done, that [...] small paths are put through or that you make such a half moon that you then also have a bench in the middle, that the forest is so a bit around you. [...]"* but she also finds it interesting *"[...] that we give a little bit back to*

nature. [...]" (3:41). Here, there was also an overlap with another sub-category (level 2) Design, mentioned below in Chapter 3.3.3.2. Hennemann says that *"[...] of course it would be exciting if you could walk in there [...]"* but also that she *"[...] wouldn't do that in such big cities [...]"* because, e.g., *"[...] you have homeless people who sleep there because it's more sheltered than outside. You can understand that, but [...] it doesn't work. Otherwise, someone has to constantly look at what's going on there [...]."* (4:35). She further states that the first ones to use the Tiny Forests if they are accessible are *"[...] some drug dealers who can then carry out their trade there without anyone looking in. That would be exactly the same in Berlin. Therefore, this possibility to let the people in, one should perhaps not make. [...]"*. However, she also says that one could establish them *"[...] in such a way that there is also an area on the outside where you can simply look to see which bird is sitting there [...]."* and for the *"[...] local recreation, [...] that you put maybe a bench or something, so that you can just linger there, that attracts people [...]."* (4:36). This quote was also assigned to the following sub-category (level 2) *Recreation*, as it fits both categories. In conclusion, the experts agree that for a successful implementation of Tiny Forests in Berlin, accessibility for citizens should be ensured, if this is in line with the development goal. This can be achieved through a certain level of design, such as a fence, benches or paths laid through the Tiny Forest.

Kowarik states that *"[...] from the point of view of recreation, landscape, where a woody structure is basically necessary to divide spaces, to accentuate entrance areas, to screen a traffic road. That's where [...] dense, compact vegetation of whatever kind, can make sense there. And Tiny Forests, of course."* (1:49). He further says that *"[...] any such nice, open, semi-open forest stand that is achieved for recreation, after the environmental psychology studies, you know what people like, that's going to take a very, very, very long time."* (1:51) and says that *"[...] it actually makes more sense to provide for such loose woody plantings [...] right from the start and not to go down the path of this [...] initial planting, which is pushing itself upwards."* (1:52). In this regard, Scharfe comments that *"[...] for recreation [...] you can say quite quickly [...]"* that it *"[...] just depends on the area where you plant such a thing then."* (2:44) and that *"[...] it depends on the size of the area and the size that is really available for such a forest. [...]"*. Moreover, he adds that *"[...] especially if you establish several such Tiny Forests and also other urban green spaces somehow in a district, that in principle it probably*

also has a fairly measurable effect on the well-being of the people." (2:58). He further states: "*If the focus is more on the recreational function, then you can also manage to design the entire project in such a way that you can do justice to it and meet the requirements."* (2:59). He thinks: *"Recreation is always a question of definition. [...]"*. In addition, he adds that *"[...] there have been studies on the subject, simply that people who look out of their windows onto greenery are psychologically much healthier than people who look at concrete. [...]"* (2:62). Moreover, in his words, if *"[...] you somehow still create a protected space where you can simply sit on a bench. So, depending on how much space is available, you can also somehow embed the whole thing in a kind of landscape design. That means, of course, that the recreational function is fully given."* (2:73). Scholz comments that *"[...] the recreation is ultimately also when it is cooled, when the temperature is somewhat lower, when you have shade, when you have then filtered the fine particles. In the end, that is also part of the recreation somehow [...]."* (3:42). Hennemann adds that as for the *"[...] local recreation, [...] you put maybe a bench or something, so that you can just linger there, that attracts people [...]."* (4:37). In conclusion, this category has some overlaps with the previous one, as accessibility, design and recreation go hand in hand in the implementation of Tiny Forests in Berlin. The experts argue that recreation is a matter of definition and depends on the size of such an area and that the ES of urban forests can also be viewed in terms of recreation. Further, design elements like benches that invite citizens to stay in such a place, may also be beneficial in that regard.

When it comes to the carbon storage potential, Kowarik says that if you *"[...] have a rubble soil, it can't mean that I now dig out 2x2 meters and fill in topsoil or any substrate. That can't be, because of CO2 balance reasons and you have to work with the substrates that are there."* (1:24). Scharfe states that *"[...] the CO2 that is now stored in this forest is not decisive either. So, you can't really argue with that." (2:43).* He adds that MIYA e.V. is working with pure charcoal or the Terra Preta substrate when planting Tiny Forests in Berlin and that they *"[...] are also considering whether this can also be accounted for. Because [...] this charcoal stores three or four times its weight in CO2 equivalent."* (2:52). By doing so, *"[...] this forest stores already [...] 50 tons of CO2 and that is then as much as 2 people, two Germans in the year somehow consume on average [...]. And that is simply a number that you can work with."* (2:54). He further states that *"[...] what is stored in the coal is also tied up for at least 1000 years. And*

that's just a cool argument." (2:55). Also, he adds that *"[...] besides all the cool functions like microorganisms moving into these coal structures and that this coal can then just hold huge amounts of water, bind nutrients and so on, it's just also a really cool carbon store. And then you can really argue in the direction of CO2 much better than just with the forest."* (2:56). In addition, Scholz also comments that *"[...] you actually have a climate project, because CO2 is bound."* (2:43). In conclusion, Kowarik says that the intensive soil preparation before planting Tiny Forests must be considered when arguing the CO2 storage potential of these small forests. Scholz and Scharfe say that Tiny Forests do store CO2, but Scharfe also adds that this is not a decisive factor. However, he adds that you can increase the storage potential by adding charcoal or Terra Preta to the soil, especially if many of them are planted in a city.

Regarding the dense planting when establishing Tiny Forests according to the concept of Miyawaki, Kowarik states that it requires *"[...] probably high maintenance, and if you have species that respond well to pruning, [...] that make stem cuttings or that grow clonally, poplars, birches, black locust, etc., thinning will make the stands denser because it will promote regeneration of a lot of shoots. So that's counterproductive."* (1:33) and planting *"[...] three plants per square meter, that becomes dense there and [...] those are also problematic from clearings then. Firstly, it also does not look good, secondly, people have problems with the fact that then trees are cut again."* (1:54). Scharfe says that because they *"[...] simply create a high diversity and a high competitive pressure [...]"* they *"[...] assume that ultimately, in whatever way, a certain number of trees and tree species and shrub species simply find very good conditions on the site, grow mega fast and everything else that grows in between and rots, has nevertheless simply made sense insofar as it also serves various ecological niches in the meantime, as long as it grows there, as a habitat [...]"* and *"[...] that it opens up nutrients and takes them out of the soil, makes them available to plants, that the biomass decomposes and simply becomes humus again, that microorganisms feed on it and so on."* (2:35). He further adds that it is *"[...] also kind of exciting [...]"* and that *"[...] the theory is ultimately that you just directly through a soil preparation and the close planting, so what actually happens in succession, that [...] over a longer period of time humus builds up, we ultimately skip that."* (2:63). Scholz says that she does not *"[...] believe that all the trees will be there in 30 years. That would not be possible at all. Then we would have a block of wood in the middle. So of course, some trees won't*

survive as well as others [...]" and adds that *"[...] at some point, the nice thing is, [...] that we immediately have a very nice biotope and that it changes over the years and is always a bit different."* (3:26). She further comments that she is *"[...] curious to see what it's like when all the tall trees, which will then be close together, look like."* (3:38). Hennemann hopes that *"[...] practically through the fact that it is also planted so closely and the plants also support and shade each other a little bit and in the soil there is still this option through the plant carbon that water is stored and kept and nutrients and so, that perhaps it works a little better with the native vegetation, especially in the Tiny Forest [...]"* and *"[...] that perhaps it gets along there even better than if we now plant individual city trees from native vegetation, which have a harder time in the city."* (4:3). In summary, except for Kowarik, all three experts are curious and positive about the impact that dense planting of Tiny Forests will have in Berlin. Scharfe says that the competition will cause plant species to grow faster, Scholz adds that these biotopes will then change over the years and always be a little different, and Hennemann hopes that the dense vegetation will have it better than individual trees. However, Kowarik argues that the dense planting and maintenance is not practical because if pruning becomes necessary for Tiny Forests in urban areas, some plant species that respond well to pruning will grow even more, making the small forest even denser.

As for the biodiversity, Kowarik says that *"[...] until [...] young woody plantings become biodiversity-relevant from the point of view of nature conservation, it takes an extremely long time."* (1:32) and he thinks *"[...] that you have to weigh up: What was there before and what are actually alternative design options?"* (1:34). On the other hand, Scharfe adds that *"[...] in total the effect can probably be quite strong, especially in terms of biodiversity and genetic exchange, that these forests are strategically located so close to each other that the trees can pollinate each other, that insects and birds can fly from one small oasis to the other. [...]"* and thinks that it *"[...] really makes sense from an ecological perspective."* (2:7). Scholz also adds that *"[...] what we know from studies in Holland, that not only the diversity of species increases enormously, but also the [...] number of individuals of a species is very strong."* (3:11). The three experts say Berlin's Tiny Forests can host a wide variety of species, but Kowarik also says it will be a long time before these woody plantings become relevant for conservation.

Looking at the climate aspect, Scharfe comments that by planting Tiny Forests they want to *"[...] avoid consequential damage to the climate [...]"* and that they *"[...] don't want to use a technological solution, but rather a natural solution."* (2:47). He further states *"[...] that if you forested in two places a hundred or two hundred square meters, then of course it's good for nature somewhere in that place and there will also be insects and there the microclimate will probably be cooled down a bit. But it will not change the city climate now."* (2:29). He also adds that he does not *"[...] know exactly how the climatic conditions will change."* (2:66) and *"[...] that this is a solution, or these forests that we are planting right now are [...] on the one hand adapted to a little more precipitation and a little colder temperatures, but also a little less precipitation and a little warmer temperatures."* (2:67). Scholz also says that it *"[...] is a climate adaptation project, because water is absorbed, because pollutants are stored [...]"* (3:45) and that *"[...] there's also the fact that we have a changed climate, so you have to think about whether you take what you had fifty or a hundred years ago, or do you tend to go a bit more south, because it tends to be warmer in the meantime?"* (3:7). Moreover, she recommends that one *"[...] would probably take the trees and bushes that are more able to withstand heat and drought [...]"* and *"[...] probably wouldn't plant birch trees now, [...] because they don't like heat."* (3:39). Hennemann hopes *"[...] that the plant charcoal and the chips and all that stuff can store so much water that that's just enough. But it's already an uncomfortable situation for tree growth here, [...] especially for the native trees [...]. So, practically in the city, we definitely get along better with all these Mediterranean trees, because they can simply withstand this drought better."* (4:19). In summary, the three experts see great potential for Tiny Forests in Berlin to have a positive impact on combating the effects of climate change in urban areas. Scharfe sees Tiny Forests as a viable natural solution for cooling cities, but also that they cannot change the urban climate just like that, and Scholz and Hennemann add that future impacts must be considered by also choosing plant species that are more heat and drought resistant.

Unlike the other experts, Scharfe solely commented on the topic of the political situation by stating: *"Political actors seem to be encouraged and motivated to actually tend to implement such projects, and, above all, there is funding for them. That is actually the most exciting thing."* (2:2) and that the *"[...] politicians love to adorn themselves with the idea of being photographed planting a tree."* (2:69). Even though

he is not *"[...] able to talk specifically about Berlin [...]"* he adds that they *"[...] are simply receiving a great deal of interest and inquiries from a wide variety of people, but also simply from municipalities and cities that actually have it on their political agenda that they would like to bring various ecosystem services into the city in the most ecological way possible, as cost-effectively as possible. For ecological and social reasons."* (2:26). Moreover, he believes that *"[...] in the current time in which we find ourselves, [...] topics such as CO2 emissions, etc. are also mega relevant from the political side."* (2:27) and thinks *"[...] that if you plan something like this as a city or as a mayor in a district, then many people will probably be skeptical at first [...]"* because they might *"[...] think it's greenwashing and so on [...]"* but that you *"[...] can't do anything about that anyway."* (2:31). He says that the *"[...] question is how to justify the whole thing. The political decision-makers usually have to justify themselves, do public outreach work, and so on."* (2:48) and adds that he has *"[...] seen this in many other large cities, where political goals are clearly formulated, that urban greenery is to be strengthened, that nature-based solutions are to be implemented."* (2:68). In conclusion, Scharfe says that there is now more political awareness and more funding for the implementation of such climate projects that can help sequester CO2 in urban areas. In addition, Tiny Forests can be attractive to political actors because they are an ecological and cost-effective way to increase the amount of green in cities by also incorporating the social aspect of working with and for citizens.

Regarding the link to other green infrastructure, Kowarik says: *"We have in Berlin as a green city, the situation that we have [...] many woody plants. We have the forests, of course, we have the street trees, we have the parks, we have the gardens. There are trees everywhere."* (1:25). He further adds: *"Many green spaces, especially in the remaining areas of the city, are not physically accessible. They are not accessible. That applies to many things."* (1:55). Scholz comments that planting Tiny Forests is *"[...] actually not terribly expensive at all, even compared to other green spaces."* (3:47). Hennemann states that *"[...] Berlin itself already has a lot of large green spaces, the Tiergarten and so on [...]"* and imagines that planting a *"[...] Tiny Forest is also suitable for Berlin in terms of scale [...]"* but adds that she *"[...] would find it almost more important in Berlin to promote proper green corridors and to maintain the merging of the different parks and the parks. Because in Berlin there is also an extreme pressure of use on all the parks [...]. So, you actually have to make sure that the parks stay*

green at all." (4:18). She says that *"[...] you also have [...] in the city relatively rarely this gradation [...] from shrubs, border area with shrubs and then small trees [...]"* and that *"[...] these gradations are relatively rare, because in the conventional green spaces you either have the solitary individual large trees or you have these cut down shrub corners, which are simply there for the spatial zoning. [...]"*. She further argues that *"[...] this whole potpourri, so to speak, also for the fauna and so you have then perhaps rather in the Tiny Forest [...]."* (4:20). In conclusion, the experts note that there are already many large green spaces in Berlin and that there are generally many woody plants. Hennemann adds that Tiny Forest could serve as green corridors between these large parks, but also argues that the existing green spaces are under a lot of pressure and their maintenance should not be neglected.

When it comes to the adaptation of the concept, only Scharfe made statements in this regard by saying that *"[...] one must relativize later then for, in any case the moderate climate still a little bit."* (2:24) and that by looking at the original concept by Miyawaki, *"[...] the locations are of course also not comparable in the city with a natural site and also the size of the system is not comparable [...]."* He further states that, when thinking about the plant species, they would consider *"[...] simply everything that would grow on this site at these climatic conditions in principle."* (2:65). In conclusion, Scharfe argues that urban areas are not comparable to natural sites in non-urban areas and that one cannot simply adopt the original Miyawaki concept, but must take steps to adapt the concept to cities.

As for the aspect of the nature experience, Scharfe thinks that *"[...] this is a very important component, especially for people in the city, who are so separated and disconnected from nature these days."* (2:8). Scholz also adds that by planting Tiny Forests by Miyawaki in Berlin, *"[...] we can ultimately create a bond and an interest. [...]"* because *"[...] if you've planted something like that, then maybe you know what kind of tree it is. Then you are interested in it."* (3:29) and that *"[...] ultimately it's very important, that's actually one of the very important things [...] that you reconnect there."* (3:30). She further believes "*[...] that it is important that if you want to protect nature, that it is at least not a hindrance if you also know nature a little bit [...]."* (3:31). In conclusion, both experts consider the involvement of citizens in the planting and maintenance process of Tiny Forests in Berlin to be very important, as these areas can

also serve as spaces for experiencing nature. Connecting city dwellers with nature can lead to a higher awareness of nature conservation and current aspects and pressing issues such as the effects of climate change.

Regarding the terminology, Kowarik comments that *"[...] there is such a label [...] trying to market: Tiny Forest Miyawaki Method Japan for the first time in Berlin. That's a nice advertisement. [...]"* and that *"[...] the novelty value is, if you look closely, limited."* (1:35). Moreover, he states that *"[...] if you understand by this that narrow or dense groves of young woody plants are planted in a small area, this is of course something that happens in urban areas all the time. [...]"* such as a *"[...] forest planting ultimately in a small area with a young planting or with a heister planting."* (1:38). He thinks that *"[...] such a label sounds more exciting for the population than saying, here [...] in the park we make a woody planting now. Woody planting sounds boring, Tiny Forest sounds exciting. [...]"* and adds that he *"[...] would say that the content is perhaps even more important."* (1:37). Ultimately, he says: *"Just because it's a modern word, nice packaging and a nice story, that that wouldn't convince me as a concept."* (1:41). Hennemann further states that *"[...] you also have to be a bit careful with the term so that it doesn't wear out, [...] because then every kindergarten starts and somehow plants some trees on 50 square meters that the kindergarten teachers bring from their own garden and then says that's a Tiny Forest."* and that *"somehow a certain quality is also upheld [...]."* (4:23). To conclude, both experts argue that the terminology of Tiny Forests should be looked at with caution so that the term is not misused.

Looking at the aspect of the costs, Scharfe notes that *"[...] as soon as you find an area, where mostly the city is the owner, or whoever is the owner, who wants to establish something like that, you will find the financial means in any case. That is our experience."* (2:36). He also says that if Tiny Forests are on the political agenda of municipalities and cities, it can be done *"[...] in an ecological way, as cost-effective as possible [...]"* to bring *"[...] different ecosystem services simply into the city. For ecological and social reasons."* (2:46). Scholz states that from her experience of the planting of the Tiny Forest in Darmstadt, *"[...] compared to other green spaces, it wasn't terribly expensive."* (3:46) and that in that specific case *"[...] everything had to be sieved through and these dredging works, they were just enormously expensive. That was what ultimately blew up all the costs."* (3:37). She further adds that it *"[...] was a*

relatively expensive story because you had to go down so deep. [...]" and they had *"[...] to excavate a meter and it was ultimately much more expensive than [...] thought. [...]"*. She *"[...] assumed about 10,000 euros per hundred square meters. [...]"* because that was what she heard from Belgium and thought she was *"[...] in the right range [...]"* but in the end *"[...] it was much more expensive because of this underground work, and of course you don't have that if you plant some bushes or something. But it doesn't have to be that way. Whereby in the areas in cities, in Germany, in Berlin will not be different. [...]"* (3:34). Hennemann also highlights that it has *"[...] to be clear what the disposal situation [...]"* is like to know what kind of costs can be expected. (4:31). In summary, the three experts say that planting Tiny Forests in a city like Berlin is not too costly if everything goes according to plan and if there are no hidden costs, such as soils that require more intensive preparation than anticipated.

3.2.2.2 Plant selection

Regarding the two sub-categories (level 2) *Mix of native and non-native plant species* and *Native plant species for Berlin* within this sub-category (level 1), the frequency analysis showed that the number of statements is the same for both. Each one of the interviewees made at least one statement to the two topics and the category was applied when they gave specific information, estimates or examples for suitable native or non-native plant species for Tiny Forests in Berlin.

Kowarik states that, regarding the potential mix of native and non-native plant species, he has *"[...] always been in favor of such a mix and then this has nothing to do with PNV in the sense of Miyawaki."* (1:10). As a former state representative for nature conservation in Berlin, he has *"[...] always been openly in favor of such combinations and against bringing out native species everywhere come hell or high water. Whereas, of course, one should also take advantage of the opportunities to plant indigenous species, species native to the area, on urban sites that are newly greened."* (1:11). Scharfe also says that he *"[...] would actually find it cool to use non-native tree species as well."* (2:12) and that *"[...] it would also be mega cool to simply establish totally new ecosystems that have never existed before and to see what grows and how well. [...]"* and thinks that *"[...] it would also be a very creative task. [...]".* So, he does not *"[...] rule out the possibility that [...]"* he *"[...] will do that in the future as well."* (2:13). Scholz also agrees that one *"[...] should definitely try that out here."* (3:12). Hennemann, too, is in

favor of such a mix but argues *"[...] so that the [...] ecological benefit is still there, this PNV would have to have of course already a large share [...]"* and that one *"[...] can't replace it by any means [...]."* She says that one *"[...] could supplement it a bit [...]"* but highlights that *"[...] the main part would have to be with the PNV, otherwise it would somehow become even more artificial [...]."* (4:7). To conclude, all four experts would be in favor for a mix of native and non-native plant species when creating Tiny Forests in Berlin, but Kowarik sees that separately from the Miyawaki concept.

As for the native plant species for Berlin, Kowarik would use a *"[...] mixture of fast and slow growing species that are drought resistant: pedunculate and sessile oak, hornbeam and sand birch."* (1:12). Scharfe states that he also *"[...] would try to work with beech and oak. And maple would probably be in as well. Basswood would probably be with as well. Elm. So much for the larger tree species [...] and ultimately there's a wide range of shrubs or smaller trees [...]."* For that he would use *"[...] something like wild apple, wild pear. Bird cherry [...]. What's also cool is yew and holly, which are actually mega rare only used now, but actually native here [...]."* (2:14). Scholz says that she does not know of specific native plant species and that Stefan Scharfe should be asked regarding the species composition. Hennemann also did not have a *"[...] current inspiration specifically [...]"* but she says that she finds it quite good if there is *"[...] just a bit of evergreen [...] also there"*. (4:39). To conclude, the experts were able to state exemplary native plant species and they added that further aspects like e.g., drought resistance would also be beneficial in this context.

3.2.3 Acceptance of the Tiny Forest concept in Berlin

This third main category was divided into the sub-categories (level 1) *Social component* and *Aesthetic component* as is further described below. The main category was applied when the experts gave insights or estimations about the acceptance of the Tiny Forest concept in Berlin.

3.2.3.1 Social component

This sub-category (level 1) was applied when the experts gave insights or estimations about the social component regarding the acceptance of the Tiny Forest concept in

Berlin. It was further subdivided into three sub-categories (level 2) *Target groups*, *Participation of citizens* and *Knowledge transfer (i)*.

Regarding the target groups, Kowarik states that *"[...] people can be inspired, especially children and young people, to participate."* (1:16). Scharfe also says that *"[...] the idea is ultimately that you simply plant together with ideally young people, e.g., with children [...]."* (2:30). In another comment, he says that the target groups are *"[...] ideally children and school classes."* (2:76). Scholz mentions that *"[...] the people, the children [...] and the parents and the students and teachers and so on, were all very enthusiastic. So it was very well received."* (3:51). Moreover, she has experienced that *"[...] first of all there is always, from the laymen [...] a great enthusiasm very quickly."* but that *"[...] the experts [...] from the [...] green space office and those [...] have a different thinking. They think that this is simply a concept that is really new and does not fit at all. That you plant so densely and so much on top of each other. At first, there was no acceptance, the spark didn't go off right away.". But now she has "[...] the impression that it has already been understood."* (3:17). Hennemann argues that *"[...] the topic of neighborhood is still quite important, because then these are simply also the people who walk past it every day. [...]"* and that "*[...]* these people should also be considered next to the schoolchildren." (4:11). To conclude, the experts agree that young people can benefit the most as a target group from planting Tiny Forests in Berlin.

About the participation of citizens, Kowarik says: *"People like trees and you can see it everywhere in Berlin that people are committed to preserving trees in their surroundings."* (1:5). Still, in his opinion, he does not *"[...] see that there is an insane need. [...]"* to include the citizens and thinks that *"[...] people have greater, [...] more sensible [...] needs, for example to do something for bees and create wild bee areas, and the ecological functions of such young woody plantations are extremely meager in terms of biodiversity."* (1:17). On the other hand, Scharfe argues that *"[...] the more urban we become, [...]"* the more he *"[...] would definitely involve the people who live there in the process. [...]"*. He then thinks that the *"[...] acceptance is given at many locations."* (2:17), *"[...] at least among all the people who are involved [...]"* (2:40), but *"[...] if people simply have other needs than ecological needs, then it is of course difficult for them to accept the whole thing."* (2:39). He believes that *"[...] if the citizens*

and citizens are involved, on the one hand in the decision-making process and on the other hand even in the implementation process." (2:41), there is acceptance from the citizens to plant the Tiny Forests in Berlin and that *"[...] already in the planning process, [...] open letters are written to the citizens who live in the region, inviting them to planning meetings, to information events, to small workshops. And whoever wants to can then [...] become part of the project."* (2:75). He adds: *"That way, you can simply bring in the different skills and potentials of the people who are already working there in a pretty multifaceted way."* (2:78). Hennemann suggests *"[...] that they should address the neighborhood. So people who live around there. Because in areas where it is necessary to plant a Tiny Forest, there are also people who don't have so much green."* (4:21). In conclusion, Scharfe and Hennemann attach great importance to the involvement of citizens, especially citizens from the surrounding area of potential Tiny Forests in Berlin, to achieve a high level of acceptance and to attract many motivated people to plant these small forests. However, Kowarik believes that people in Berlin have bigger conservation tasks, such as projects to save the bees.

Only Scharfe and Hennemann gave statements about the knowledge transfer. Scharfe thinks that *"[...] the most important thing is public relations."* (2:74) and that *"[...] there is also the possibility [...] of simply informing the citizens."* (2:77). Hennemann also thinks that the *"[...] acceptance depends very much on how people are informed about it [...]"* (4:42) and that *"If you don't say anything at all about it, [...] the acceptance is also worse [...]* (4:40). She further argues that *"[...] you really have to transport the information about it [...]"* (4:44) and that it is beneficial for the acceptance of Tiny Forests in Berlin if people *"[...] were really informed in a concrete and nice way, and in a way that was understandable to citizens, about what was happening ecologically."*. She also thinks *"that the better you do that with the Tiny Forests, the more understanding there will be among the population [...]."* (4:43). In conclusion, both agree that the acceptance of Tiny Forests in Berlin is high if people are properly informed.

3.2.3.2 Aesthetic component

This sub-category (level 1) was applied when the experts gave insights or estimations about the aesthetic component regarding the acceptance of the Tiny Forest concept in Berlin. The statements of its sub-category (level 2) *Design* are mentioned below.

Considering the design of a Tiny Forest in Berlin, Kowarik says that *"[...] you have to weigh: What was there before and what are actually alternative design options?"* (1:34) and *"[...] that dense planting doesn't look great, rather the opposite, it looks boring."* (1:53). He further argues that *"[...] for design reasons, it could make much, much more sense to plant any kind of ruderal vegetation there, that is, if there is no ruderal vegetation there, but if you really have an open ground, if you then make a species-rich wildflower seeding, dry grass seeding, ruderal seeding. [...]"* (1:27). He concludes that if you have *"[...] a Tiny Forest, it will look dense and green, and what the added value is there, in terms of design and aesthetics, that would have to be critically questioned."* (1:8). On the other hand, Scharfe says that *"[...] depending on how much area is available, you can also somehow embed the whole thing in a kind of landscape design. [...]" and "[...] then the recreational function is of course fully given."* (2:9). As for the shape of the Tiny Forest, he comments that *"the shape doesn't have to be round but can be u-shaped or so that you somehow create a protected space where you can then simply sit on a bench."* (2:33) and that they *"[...] will always put benches around it [...], depending on what space you have and what the respective requirements of the clients look like [...]."* (2:42). Scholz says that it is *"[...] also sometimes done, that [...] small paths are put through or that you make such a half moon that you then also have a bench in the middle, that the forest is [...] around you. So, there are many, many possibilities."* (3:10). Also regarding the size the Tiny Forest, she adds that *"[...] in the city, [...] 100 square meters or 200 are already a lot [...]"* but you also *"[...] ultimately need more space, because you still need the edge. You have to keep a distance of 5 meters to infrastructure, streets and houses. You can't plant a Tiny Forest right next to a house, that's not possible. That means that ultimately you need more space than these 200 square meters or 100, minimum."* (3:27). Hennemann also recommends that *"[...] there must also be a certain basic level of design [...]"* and that *"[...] you also have to make sure that the thing is not littered [...]. So, in the time where it is still so small, so that there is [...] this chestnut fence [...] around the outside."* (4:15). Further, if *"[...] the remaining meadow area [...] was mowed and then you saw this fence, then it suddenly looked designed."* (4:16). She concludes that as for the *"[...] local recreation [...]"* that *"[...] you put [...] a bench or something, so that you can just linger there, that attracts people [...]."* (4:41). In conclusion, all four experts except for Kowarik are of the opinion that a well-tailored design for each Tiny Forest can determine its success. In

detail, he thinks that one must critically question the added value of a Tiny Forest in Berlin in terms of design and aesthetics in general.

3.2.4 Outlook on the Tiny Forest concept in Berlin

The fourth main category was created to assemble all the information the interviewees gave on the outlook of the Tiny Forest concept in Berlin. It was further divided into the sub-categories (level 1) *Knowledge gaps for implementation* and *Future viability*.

3.2.4.1 Knowledge gaps for implementation

This sub-category (level 1) was applied when the experts gave specific insights or estimations about potential knowledge gaps that may inhibit the implementation of Tiny Forests in Berlin. The statements of its eight sub-categories (level 2) *Risks and uncertainties (i)*, *Area acquisition (i)*, *Land ownership (i)*, *Social acceptance (i)*, *Assured plant care (i)*, *Bureaucratic and political hurdles (i)*, *Soil properties (i)* and *Public outreach (i)* are mentioned below and the result of their frequency analysis can be seen in Figure 41. It shows that the experts commented the most on the two sub-categories (level 2) *Risks and uncertainties (i)* and *Public outreach (i)*.

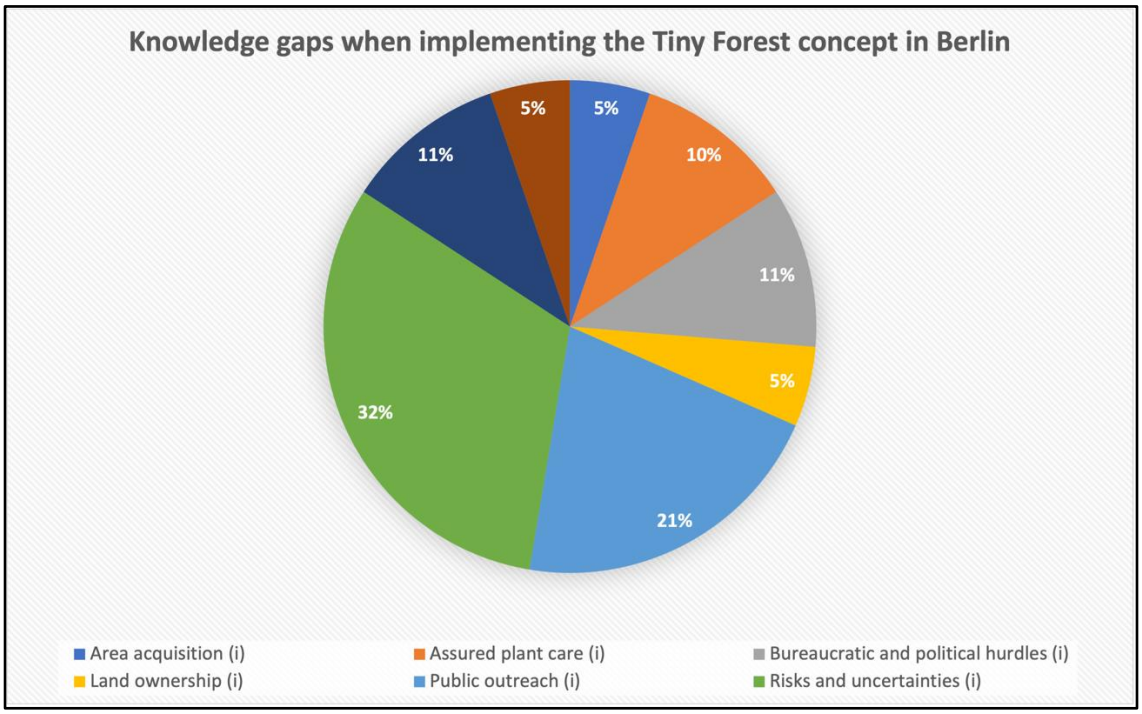

Figure 41: Frequency analysis of the codes for all eight sub-categories (level 2) within the sub-category (level 1) Knowledge gaps for implementation. The two most frequently mentioned categories are Risks and uncertainties (i) (32%) and Public outreach (i) (21%).

Kowarik says that the *"[...] main knowledge gap is, you may not know exactly which species are suitable."* (1:19) and that *"[...] the risks are maybe higher than the benefits [...]."* (1:36). He further states that *"[...] the crucial or even more essential gap is that you might not immediately see how it turns out when you relate the advantages against the disadvantages [...]"* and therefore his *"[...] reservation would be [...]"* that he sees *"[...] a lot of disadvantages and little advantages."* (1:36). Scharfe states that his *"[...] claim is definitely to keep adapting and improving the method and not to drive rigidly as the people before [...] have driven now. [...]"* and that *"[...] with such natural systems it just always takes time until you can really see the results."* (2:11). He also explains that there is "*[...]* no guarantee at all how long such a forest will actually stand there. *[...]*" and that *"[...] you don't know how the political situation will change, how the world situation will change in general."* (2:61). Moreover, Scholz comments that *"[...] the problem we currently have when we want to renew our forests. [...]"* is that we *"don't know what the result will be. I mean, the forests we have today are 200 years old, in part. We probably have to bet on different horses as well. That's the way it is."* (3:25). In conclusion, the three experts note various gaps in knowledge, ranging from appropriate plant species composition, the lack of certainty in predicting what these small forests will look like based on various factors, the fact that one may not know all the pros and cons in advance or how long they can stay in their intended location, and the political and global situation. Scharfe also says it's critical to adapt and improve the method over time.

Regarding Public outreach (i), Scharfe asks the question: *"Especially in the case of larger projects, how do we really involve people effectively?"* (2:22) and: *"How do we ensure social acceptance across the board and how do we get this communicated properly across the board?"* (2:21). Hennemann also thinks that, when it comes to public outreach, *"[...] it would make sense for a city like Berlin, which also has a huge administration, to transport it in this way."* (4:13) and thinks that it is *"[...] also easier if you pass on the information again in general."* (4:14). In conclusion, both experts agree that adequate communication and public relations about the planned project, in this case the Tiny Forests in Berlin, are crucial to ensure citizen engagement and acceptance.

As for the area acquisition, Scharfe, unlike the other experts, made a statement in this regard by asking: *"[...] a knowledge gap, if you want to call it that, is just quite central, where do we get the areas?"* (2:20). To conclude, area availability and acquisition are said to be another knowledge gap when implementing Tiny Forests in Berlin.

Scholz mentions the aspect of land ownership as another knowledge gap when planning Tiny Forests for Berlin by saying that *"[...] when you're looking for the properties [...]" it is also important "[...] to know the ownership."* (3:19).

Regarding the assured plant care, Scharfe asks: *"How do we ensure that these things don't wither away in two dry summers, but that strategies are really considered to enable and motivate people on site to look after the whole thing, at least in the initial phase?"* He thinks *"[...] that it would be more of a logistical step [...]"* but not *"[...] a huge obstacle."* (2:18). Scholz also states that *"[...] you still need a little care now and then, at least for the first three years [...]"* (3:3). In conclusion, he considers the aspect of maintenance very important to ensure that Tiny Forests can grow well and old.

As another knowledge gap, Scharfe comments on the bureaucratic and political hurdles by saying that it is *"[...] more of a structural, bureaucratic political problem [...] than it is easy to implement."* (2:19). Hennemann says that the acceptance of the Tiny Forest concept in Berlin *"[...] depends a little bit [...] on the commitment in the respective administration [...]"* and if *"[...] people are open [...]."* (4:45). Finally, both experts note that the willingness of the respective offices involved in the planning of Tiny Forests in Berlin must be present so that bureaucratic and political hurdles can be circumvented to some extent, if possible.

As for the soil properties being another potential knowledge gap when implementing Tiny Forests in Berlin, Scholz says that *"[...] the subsoil is also important. You have to know where cables are running now, [...] that's relatively important [...]."* (3:20). Thorough pre-investigation of the ground conditions can, for example, prevent sudden surprises such as underground lines and pipes that were not expected. This ultimately also has a positive effect on the budget, as no additional costs are incurred and the success of the creation of a Tiny Forest in Berlin is thus not hindered.

3.2.4.2 Future viability

This sub-category (level 1) was applied when the experts provided specific estimations about the future viability of the Tiny Forest concept in Berlin.

In his opinion, Kowarik does not think that the Tiny Forest concept is a concept with future. He states that *"[...] here in Germany, that is ultimately, as they say, carrying owls to Athens, because forestry, the near-natural establishment of new forests outside the city, has a long tradition. It's nothing special."* (1:56). On the other hand, Scharfe says that it *"[...] fully has a future [...]"* and that otherwise he *"[...] would not go for it."* (2:82). He further states that his *"[...] feeling is that the people who are involved in this are really people who think in a very visionary way and also have a very special drive. In other words, the network that is currently being created throughout Europe is a pretty cool network. [...]"* but that one cannot be certain *"[...] 100 percent, because [...] you don't know at all how the political world situation will change on the one hand and also here in Germany, Europe in the world. We [...] don't know exactly how the climatic conditions will change."* (2:81). He has a vision *"[...] to create [...] much greener and also visually just more appealing cities where people just don't suffer so much psychological stress. Simply more relaxed, more productive, more creative. [...]"* and thinks that *"[...] Tiny Forests are definitely a building block that can be used to design cities of the future in a very promising way."* (2:80). About the future viability of the Tiny Forest concept in Berlin, Scholz also says that she is "curious about that" (3:48) and that she hopes that it is a concept with future, but she does not know it. She hopes *"[...] that these plants in the association [...] not only compete in some way, but also promote and provide shade for each other and in this association are perhaps actually more resilient."* (3:49). Hennemann also hopes *"[...] that it is a future project [...]."* but also argues that *"[...] it is not a substitute for the maintenance and structuring of public green space in the city, but [...] like a piece of the puzzle, which also complements it well somehow."* (4:46). In summary, all of the experts except for Kowarik believe that Tiny Forests planted using the Miyawaki method can be a viable concept for the future in Berlin.

4 Discussion

In the following, the methods and results from chapters 2 and 3 of this study are discussed. Regarding the preceding literature review, the little availability of literature on Tiny Forests by Akira Miyawaki in the European area has not made it easy to find material that perfectly suits the topic. For this reason, the generation of interpretative knowledge (see Chapter 3.2) was prioritized and selected as one of the three main methods of this study, along with the systematic literature review and the area analysis for Berlin (see Chapter 3.1). The latter is especially important, because if no suitable areas are available, no Tiny Forests can be established in Berlin in the first place.

4.1 Discussion of methods

Below, the main methods of the spatial area analysis with QGIS and of conducting the expert interviews are discussed.

4.1.1 Spatial analysis with QGIS

For the spatial analysis of this study, the focus was placed on the two land types of fallow land without vegetation and land with unsealing potential. By intersecting the two maps for Berlin with one of the five core indicators of environmental justice, namely the poor green supply, a good overview of the areas that fall under these criteria was created. However, by this alone or by the comments that were entered into the attribute tables by the creators of the maps, one cannot be sure that these areas remain available. Even if the most up-to-date maps were obtained from the FIS-Broker geoportal, the area owners or responsible agencies must be contacted if such an area is designated for the further establishment of a Tiny Forest.

4.1.2 Expert interviews

At this point, it should be noted that conducting expert interviews with only four experts may not yield the most statistically meaningful results. More interviewees would have had to be interviewed for this. However, since the topic is still quite new, the knowledge of the four experts is nevertheless of great importance, and therefore the interviews were subjected to a qualitative analysis to capture the invaluable expert knowledge for this study. In addition, the coding was done at the authors' own discretion and could have been different if someone else had to assign the categories to the quotes in the

interviews. Nevertheless, the information provided by the four experts can serve as interpretive knowledge for answering the research question of this study and as a basis for future research. To this end, more experts could be consulted to expand the knowledge base and round-table meetings with experts, responsible authorities and other relevant stakeholders like citizen groups could be a first step towards the potential establishment of Tiny Forests in Berlin.

4.2 Discussion of results

Below, the results of the spatial area analysis with QGIS and the qualitative evaluation of the expert interviews are discussed.

4.2.1 Area potential in Berlin

As it is already evident from the results, the area potential of Tiny Forests in Berlin is classified as low with the selected parameters. By only looking at the two area types used such as fallow land without vegetation and areas with unsealing potential as well as their intersection with the poor green supply indicator, that limits the number of possible areas. Even though, the two land types seemed promising for the establishment of Tiny Forests, and there are some areas of each available in Berlin, other ways to find suitable areas should be further examined. Or, to generate a higher count of available areas in both area types, one could refrain from intersecting the areas of the two land types with the core indicator green supply and thus expand the radius again, which would then show 45 areas for the fallow land without vegetation and 223 areas for the areas with unsealing potential. Expanding the fallow land areas by considering not only those without vegetation but also those with vegetation may not be recommended, as altering these areas by establishing Tiny Forests could be counterproductive for nature conservation reasons. The choice of urban fallow land without vegetation was made as there would be no conflict with the existing value of successional vegetation for conservation reasons on these areas. If one were to neglect this aspect, one could of course also take a closer look at the other two types of fallow land with mixed or meadow vegetation. In this case, a site visit could determine if the areas have existing successional vegetation value. Fallow lands that have been invaded by invasive species may be suitable for conversion to Tiny Forests to provide more desirable ecosystem services than the current vegetation. Nevertheless, there would be 954 fallow areas with mixed vegetation and 228 fallow

areas with meadow vegetation. Further uncertainties may also arise that can result in these areas not being suitable, e.g., if they are already designated for another land use or if bureaucratic or political hurdles come into play. Therefore, the highest potential for establishing Tiny Forests in Berlin might be for schools or other facilities like daycare centers to approach implementation partners like MIYA e.V. directly if they are interested to establish a Tiny Forest on their premises. However, for the purposes of this study, it seemed relevant to find areas where there is not enough urban green space and potentially prioritize them for pilot projects. Other districts that are already greener might also seek to do so later.

In addition, due to the ongoing urbanization in cities, the areas with unsealing potential were selected, as these can also be used to increase the amount of vegetation. For climatic reasons, increasing the amount of vegetation is beneficial and by establishing Tiny Forests, positive effects can be achieved because they can be created where there is not yet as much green space and where only small areas are available due to densification. There, these forests can be a solution, as they do not require much space and can even be planted on degraded land, but they are not to be seen as the only way to green these areas. Further studies could look at the totality of Tiny Forest areas throughout the city, rather than limiting the land potential to the city center, as it happened to be the focus after the intersection with the poor green supply indicator in QGIS. Also, as mentioned before, some areas may not be available even though the most recent maps have been used and even if the comments in the attribute table say otherwise. This was also one of the two reasons, besides the intersection errors, why these areas had to be subtracted from the original outcome of the area analysis, resulting in even fewer available areas. As mentioned before, further area types, e.g., abandoned, or former industrial sites might also be an idea to investigate as potential areas for the establishment of Tiny Forests in Berlin. Furthermore, it is important to contact the relevant planning authorities and discuss where they can and cannot envision Tiny Forests or newly created green spaces in general.

4.2.2 Qualitative evaluation of the interviews

There are reservations from some professional circles about the Tiny Forest concept according to Akira Miyawaki in the urban context and it is important to take a closer look at them to make sure that all aspects are considered when implementing Tiny Forests in Berlin. This way it can be evaluated if these forests are truly a possibility for Berlin. Some of these reservations have also been reported in the expert interviews that were conducted for this study. For example, four of the five most common statements about the potentials and challenges of establishing Tiny Forests in Berlin can also be related to the reservations, namely land availability, PNV, soil preparation, and temporary interim use. As can be seen in the interview guide in Appendix 2, these topics were also mentioned by the author as a rough guide when the experts did not know directly what to start with and to keep the flow of the interview going. Therefore, it is logical that these topics were mentioned most frequently, if the experts had the opportunity to provide an answer to these topics due to their professional background. Further statements, which can also be assigned to reservations, were made for future viability as well as knowledge gaps, or more precisely on risks and uncertainties.

However, not to be neglected are also other issues such as possible disservices or funding, that have not been covered by the interview but are nevertheless crucial for the implementation of Tiny Forests in Berlin. When planting forests in the city, there can always be disservices like, e.g., the pollen of certain tree species that citizens may be allergic to and many more. And regarding the funding of Tiny Forests, there were only a few comments about the costs compared to other UGI, but also a statement that efforts to address climate change or increase UGI have received more attention, especially in times of the COVID-19 pandemic. In addition, politicians are now more aware of these necessary efforts and increasingly more funds are available from the state to increase the proportion of green spaces in cities. However, it must also be seen who exactly receives such funds and how they can be applied for or whether the formalities are fulfilled. This development is promising, and therefore this possibility of funding should be kept in mind. In addition, the institutions or schools are encouraged to approach the implementation companies directly to clarify this aspect among themselves.

Another aspect that has not been touched by the interviewees may be legal hurdles, such as future issues like tree protection bylaws. What happens to these Tiny Forests in a few decades is hardly mentioned in the current movement. The respective property owners will then have to deal with issues such as e.g., traffic safety, pruning of the trees in the future. When the Tiny Forests are first planted in a city, these issues may not play such a big role yet, but once the Tiny Forests are no longer so tiny, they may need to undergo further review to meet city requirements. Since the oldest Tiny Forests in urban areas in Europe are less than a decade old, addressing this issue may be deferred to a later date by current implementing partners, but should still be kept in mind when deciding to plant a Tiny Forest. The same is true for potential future conflicts with infrastructure such as adjacent sidewalks, sewage-pipes or other structures that could be affected by the growing trees. The necessary space that future trees will require and grow into, both above- and below-ground needs to be considered in the planning and site selection processes.

Regarding the frequency analysis conducted in the previous chapter, it was expected that most statements would be made in the second main category, since it has the most sub-categories (level 2), which turned out to be true. According to this scheme, the fourth main category should have had more mentions than the third, since it includes more sub-categories (level 2), but this was not the case. This can perhaps be attributed to the fact that the topics of the fourth main category in the last sub-category (level 2) were all created inductively, e.g., with the material generated during the interview, and therefore not all four respondents always reported on each of these topics. In general, it can be said that due to their different professional backgrounds, the experts have more knowledge or experience on certain topics than on others. This also means that in some categories only one or two experts were able to provide opinions and therefore not all four views on these topics could be included in the evaluation.

4.2.3 Adaptation of the Miyawaki concept & recommendations for action

This study shows that the Miyawaki concept needs to be adapted due to several factors when planting Tiny Forests in Berlin. However, the question remains, if the concept must be heavily modified to meet the demands of urban areas, at what point is it still the Tiny Forest concept according to Akira Miyawaki and at what point is it simply a

horticulturally planted urban forest? Here, reference can be made to the registered trademark *Tiny Forest*, created by IVN and Shubendhu Sharma's company Afforrest. They have established a checklist for the physical and social characteristics of a Tiny Forest and offer to present these Tiny Forests on their website if they correspond 100% to the required characteristics (IVN, 2022a). They also offer to help with the conversion of a miniature forest into a Tiny Forest and ask that the terminology shall not be used if the forest does not meet the given criteria. With the trademark they want to ensure that woodlands carrying the Tiny Forest name meet the criteria of the Miyawaki method.

It must be clear that Tiny Forests planted in a city and for which different factors are decisive, none of these areas will have the same characteristics and therefore will not achieve the same results. Forest growth is generally quite dynamic, and an experimental approach, for example in the selection of plant species, might be advisable, also in view of climate change and the fact that it is not known which plant species will become established in cities in the future. Although the outcome of a Tiny Forest can never be fully predicted due to Miyawaki´s ecological approach of induced succession, it is possible to predict the different survival and propagation strategies of plants and which plants are likely to survive and which are not. According to Haerter (2021), these are assumptions, but they are still reasonable because they can be tested. By testing different scenarios and combinations, it is possible to estimate which combinations are most likely to achieve the desired goal. She also explains that these ecosystems may form a new plant community or approximate the historic PNV ecosystem, and that in either case their ecological function would provide benefits to wildlife and the local community. However, for the future demands placed on urban nature, the exclusive use of plant species according to the PNV as envisioned in the original Miyawaki concept may not be recommended for urban areas as a useful reference (Leuschner, 1997). Also, the use of at least 25 native plant species recommended in the original concept may not be applicable because there are not 25 different native plant species according to the PNV of Berlin and Brandenburg. Contrary to the assumptions that only semi-natural forests can fulfill important functions, urban ecology research shows that new ecosystems are also capable of fulfilling multiple functions (Kowarik, 2011; Kühn, 2006). Vollrodt et al. (2012) states that a suitable urban tree should be heat, drought and winter tolerant, ensure annual

growth, and mitigate mortality. These tree species or non-native species that prove viable or resistant in the urban environment should be supplemented. The Association of German Tree Nurseries (BdB) and the Garden Office Managers Conference (GALK) have also looked at future trees for the city and compiled a list of 65 tree species (BdB e.V., 2012) from which tree species could be selected for species composition. The Senate Department for Urban Development and the Environment also published a guide on native plant species to promote the use of native plants for Berlin and also created a list of native woody tree species (Markstein, 2013). It further states that native plants can help maintain genetic diversity and actively contribute to nature conservation. In addition, only native plant material is to be used for compensation and replacement measures within the built-up area. Although the species composition of Tiny Forests in Berlin would always vary due to the different characteristics of each site and the desired outcome, the following Figure 42 shows an exemplary species composition. If the climate aspect were included and native plant species for Berlin, taken from Markstein (2013), were supplemented with future or climate city trees, taken from the GALK list, BdB e.V. (2012), the following rough composition of 27 plant and shrub species for dry to fresh soils could be used for the city and mixed or adjusted as needed for specific sites. Climate tree species that are native to Berlin are marked with “(n)”.

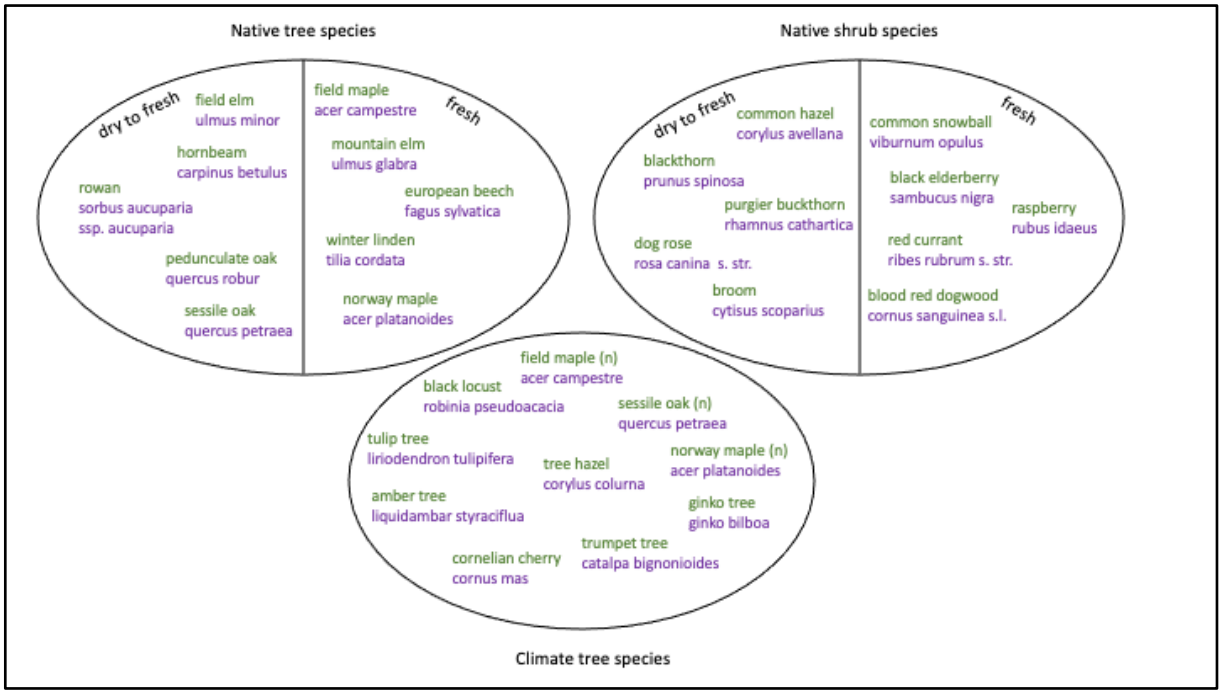

Figure 42: Exemplary tree and shrub species composition for a 200m² Tiny Forest in Berlin (by author).

If 3 plants are planted per 1 m², as the Miyawaki concept suggests, a Tiny Forest of 200 m² would require about 600 individual plants. One half could be trees and the other half shrubs. According to Bruns et al. (2019), there should be at least 25 plant species in a proper Tiny Forest, preferably nursery trees or shrubs with bare roots about 80 cm tall. As mentioned before, Bruns et al. (2019) recommend that these small forests should have a width of 4 meters without interruptions. In this case, about 400 plants would then make more sense since part of the 200 m² must also be used for the paths. They recommend for the forest cover type canopy layer 15-20%, understory 40-50%, shrub layer 25-30% and the herb layer 8-12%. Further, when planting with and for children, it might be best not to use toxic plant species. However, the inclusion of edible plants might be worth considering.

Another variation of the original concept should be the accessibility of these Tiny Forests. Such a green space in a prominent place like in the center of the city, where it would also make the most sense climatically, must also be accepted by the city dwellers, as they are in the immediate vicinity. If the Tiny Forest is to be opened to the public, different designs may be appropriate, e.g., rectangular, square, u-shaped, and paths could be laid out. Therefore, the design also plays a major role, as you can try to meet all demands with it. Tiny Forests are more than just their plants, because with an attractive and functional design that integrates well with the surroundings they can also provide space for recreation and education (Bruns et al., 2019).

Citizen participation is another important aspect of the Tiny Forest concept and given the pilot projects already underway across Europe, one could say that the Tiny Forest movement is still pretty much a grassroots movement also regarding their funding, but one that is gaining momentum. According to Markstein (2013), the financial resources as well as the chances of implementing individual projects or programs of green and open space development increase if, at the same time, awareness at the political level has also risen. Through citizen participation and involvement, influence can thus be exerted on politics. In turn, politics can also communicate the value of urban green space to the population, e.g., through educational measures.

Looking a little more closely at the aspect of the costs, it is important to realize that some plants may not survive the strong competition caused by the dense planting.

Therefore, working with expensive native vegetation, a percentage of which may not survive, is not attractive to some stakeholders. In this regard, however, Haerter (2021) argues that this does not necessarily have to be the case and that using native plant species for Tiny Forests can have benefits such as supporting native wildlife and engaging people. Thus, if the plants are planted densely, this competition may have another side effect because all the trees will be the same age. Further, she questions whether they will then be that resilient to future challenges but also states that this aspect should be subject for future monitoring and research.

In general, in addition to schools or other institutions approaching implementing partners such as MIYA e.V. and clarifying the question of financing, other ways of generating funds for projects such as Tiny Forests can also be listed. There are also federal awards for such projects, e.g., the Federal Ministry for Housing, Urban Development and Construction (BMWSB) awards projects that highlight the multifaceted importance of public green space with its numerous functions for urban society and the environment. According to Petrin et al. (2022, p.19), “multifunctional uses and meanings of public space and centers are seen as the future normality in discourses on the future” and it is also expected that, in the context of a mobility turnaround, "new potentials for greening, encounters and alternative forms of use" will emerge because of the reduced land use for transport in urban space. For the awards in 2022, the focus was set on the importance of urban greenery for climate adaptation in cities and towns, with a handful of projects receiving an award, and others being nominated or receiving recognition. The federal award represents an important building block in the implementation of the White Paper on urban greening, which focuses on transdisciplinary research when it comes to green in the city (BMWSB, 2022). There was also a thematic overlap with the federal award *Blauer Kompass* in 2022 where MIYA e.V. was awarded and received 25.000€ for their work with Tiny Forest projects (MIYA e.V., 2022).

5 Conclusion

Although the original Miyawaki concept for creating Tiny Forests was not designed for urban areas, the few existing studies show that these small forests can have positive impacts and represent an opportunity for the European region. This study was

conducted to determine whether Tiny Forests created using the Miyawaki method are a viable option for Berlin. It concludes that land availability is low for the parameters chosen and expanding the types of areas as suitable sites may be appropriate. Depending on the location and the requirements, a balance must be struck between various interests. Cities like Berlin are expected to become denser as urbanization continues, and citizens need accessible green space in their immediate surroundings. In addition, urban forests and other UGI have gained in importance in part due to the COVID-19 pandemic and its associated restrictions, as urban dwellers have become more appreciative of the benefits of urban green space within walking distance. Since Tiny Forests planted according to the original Miyawaki method are not intended to be physically accessible, the adapted concept requires an intelligent design that simultaneously meets the recreational needs of the urban population so that acceptance is given. The demands on urban green and open spaces are continuously increasing, which is why these areas should be thought of in multifunctional terms and experimental approaches should be further promoted such as with Tiny Forests. Municipalities should continue to be encouraged to strengthen urban greening locally with the help of experimental research programs and model projects, so that an environmentally sound, climate-adapted city is possible, and cities remain livable. As for the carbon storage potential of a Tiny Forest, one cannot make too much of a case for the individual forest. However, if planted throughout the city, this aspect could become more important, and these small forest patches can further serve as steppingstones for wildlife. Nevertheless, the social and biodiversity aspect of Tiny Forests should take precedence over their carbon sequestration potential at the present stage.

Further, it is demonstrated that the feasibility of Tiny Forests is possible using Berlin as an example, but also that Miyawaki's concept needs to be adapted for urban areas due to several factors. The main reason for this lies in its exclusive reference to the PNV, which has little future prospect in the face of the expected climate change in the city because it is not very practical for the plant selection at anthropogenically modified sites. Therefore, for cities like Berlin, a mix of native and non-native plant species could be better suited, and these species could be combined in field experiments and tested for their functional viability for resilient new ecosystems in Berlin. Moreover, in an urban context, it is likely that not every new forest can meet the physical and social

requirements as well as the limitations of the Tiny Forest approach. Rather, in a large city with different urban regions and site conditions, the desired effect for each individual case must be defined. Therefore, the selection of plant material is of great importance, which sustainably determines the reputation, effect and functioning of Tiny Forests. It can already be said that due to the different sites in Berlin and the various development goals, different species compositions are required. In addition, these designed ecosystems are also subject to ecological dynamics and their outcome can never be predicted for sure. Given the sparse testing of concepts in urban Central Europe, it is more likely that the most effective species composition will emerge as the result of an experimental, speculative, and adaptive process. In addition, attention should be paid to what vegetation is already present in the designated areas so that no counterproductive development takes place here from the point of view of nature conservation.

In summary, Tiny Forests could improve the quality of urban nature in Berlin in an attractive and relatively simple way compared to other UGI, as they require less space, are less costly, and require less maintenance. Further, small forests such as Tiny Forests can be suitable for meeting the various urban ecological challenges in Berlin. However, the objectives achieved by applying the same concept may vary within the urban area to provide tailored ES. Therefore, it is less useful to exclusively follow the standards of the proprietary definition of Tiny Forests than to select appropriate vegetation concepts and species for a particular site. The question therefore arises as to what extent emphasis should be placed on the consistency with the original principles of Miyawaki when planting such small forests in the city and whether the terminology of Tiny Forests should be abandoned here, since some of these original principles of the Miyawaki concept do not seem appropriate in the city. However, if the terminology hurdle results in less vegetation being planted in the city, this may not be beneficial given the current situation, e.g., with climate change and regarding the efforts to increase the amount of vegetation in urban areas. Furthermore, among other things, the data basis for urban nature should also be improved and more awareness for urban nature should be created. Thus, there should be no lack of social acceptance when it comes to green and open spaces. Public outreach for new concepts such as Tiny Forests can therefore be useful to increase their acceptance among city dwellers.

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Appendix

Appendix 1: Data source of the maps used for the spatial analysis with QGIS (URL for WMS upload in QGIS)

Reale Nutzung und Vegetationsbedeckung 2020 (Umweltatlas)
URL: https://fbinter.stadt-berlin.de/fb/wms/senstadt/k06_02_1nutz_vegbestand2020
Published: 16.02.2022

Umweltgerechtigkeit: Kernindikator Grünversorgung 2021/2022 (Umweltatlas)
URL: https://fbinter.stadt-berlin.de/fb/wms/senstadt/k09_01_3UGgruen2021
Published: 26.08.2022

Entsiegelungspotenziale (Umweltatlas)
URL: https://fbinter.stadt-berlin.de/fb/wms/senstadt/wmsk_entsiegelungspotenziale
Published: 01.06.2012 (updated: 15.03.2022)

ALKIS Berlin Bezirke
URL: https://fbinter.stadt-berlin.de/fb/wms/senstadt/k_alkis_bezirke
Created: 04.11.2022

Appendix 2: Outline of the semi-structured expert interview (in German)

Einführung	
Begrüßung und Dank für die Teilnahme	
Vorstellung	
Thema der Befragung und Hintergrund	Thema der Masterarbeit: Tiny Forests by Akira Miyawaki – a possibility for Berlin? Kurze Einführung in die Thematik Fragestellung: 1. Ist eine Umsetzung von Tiny Forests im Hinblick auf den Flächennutzungsdruck in Berlin möglich und was für Flächen eignen sich besonders gut? 2. Inwiefern muss das Konzept angepasst werden, um den Auswirkungen des Klimawandels in städtischen Gebieten langfristig standzuhalten? 3. Was grenzt Tiny Forests von anderer schon bestehender grüner Infrastruktur ab? Ziel des Interviews: Einschätzung der Expert*innen des Tiny Forest Konzeptes und deren Umsetzung in Berlin (Erfahrungs- und praxisbezogenes Wissen)
Informationen zum Ablauf und der Dauer des Interviews	Experteninterview (offene, teilstrukturierte Befragung) Umfang ca. 45 Minuten, 10 Hauptfragen Fragen sind aufgeteilt in 3 Abschnitte: Einstieg, Hauptteil und Ausblick Klärung der Gesprächsaufnahme im Vorfeld
Einverständnisabfrage zur Gesprächsaufnahme bei laufendem Gerät	
Starten der Audio-Aufnahme	
Einstiegsfragen	
Einstiegsfrage 1: Fachlicher Hintergrund der Interviewpartner*innen	„Könnten Sie bitte kurz auf Ihren fachlichen Hintergrund eingehen?“
Einstiegsfrage 2: Erfahrung zum Thema Urbane Wälder	„Was für berufliche Erfahrungen haben Sie im Themenbereich der urbanen Wälder schon gemacht?“

Einstiegsfrage 3: Tiny Forests nach Akira Miyawaki	„Inwiefern haben Sie sich mit der Thematik der Tiny Forests schon befasst?“
Hauptfragen	
Inhaltliche Aspekte	Steuerungsfragen
1. Vorstellung des Tiny Forest Ansatzes nach Akira Miyawaki, Einschätzung des Konzeptes durch Expert*innen	
1.1 Erster Eindruck	
Hauptfrage 1: Was kam Ihnen in den Sinn, als Sie erstmalig von dem Konzept der Tiny Forests erfahren haben?	
1.2 Implementierung des Tiny Forest Konzeptes in Berlin	
Hauptfrage 2: Welche Potenziale und Herausforderungen sehen Sie bei der Implementierung von Tiny Forests nach Akira Miyawaki in Berlin?	
Flächenauswahl/Flächenpotenzial Aufwendige Bodenaufbereitung Potenzielle Natürliche Vegetation Klassische vs. Neue Sukzessionstheorie Ökosystemdienstleistungen Bedeutung Urbaner Wälder für den Naturschutz Erholungseignung	Was ist mit…? Wie verhält es sich mit…?
Hauptfrage 3: Vor dem Hintergrund des Klimawandels, wie stehen Sie zu einem potenziellen Mix einheimischer und nicht-einheimischer Gehölzarten bei der Umsetzung von Tiny Forests?	
Hauptfrage 4: Welche einheimischen Gehölzbaumarten würden Sie für eine Umsetzung von Tiny Forests in Berlin verwenden?	
Hauptfrage 5: Wie finden Sie die Idee, Tiny Forests als temporäre Zwischennutzung auf freien Flächen zu etablieren?	
1.3 Erholungseignung und Akzeptanz von Tiny Forests	
Hauptfrage 6: Wie schätzen Sie die Akzeptanz von Tiny Forests in Berlin ein?	
Zielgruppen Erholungseignung Akzeptanz verschiedener Waldstrukturtypen in verschiedenen Entwicklungsphasen	Was ist mit…?
Hauptfrage 7: Inwiefern können die Menschen in der Stadt in die Umsetzung von Tiny Forests eingebunden werden?	
2. Weitere Aspekte	
Hauptfrage 8: Können Ihrer Meinung nach Naturschutzziele und Erholungsnutzung auf kleinen Flächen wie bei der Anlage von Tiny Forests verbunden werden?	
Vielfältige Wirkungen urbaner Wälder Erholung der Stadtbevölkerung	Wie ist Ihre Meinung zu…?
Ausblicksfragen und Abschlussfrage	

Ausblicksfrage 1: Wo könnten Wissenslücken bestehen, welche die Implementierung der Tiny Forests in Berlin hemmen könnten?	
Ausblicksfrage 2: Tiny Forests werden aktuell vermehrt in europäischen Städten umgesetzt – denken Sie, dass es sich hierbei um ein Konzept mit Zukunft handelt?	
Abschlussfrage: Möchten Sie abschließend noch etwas ergänzen?	
Schluss	
Danksagung Weiteres Vorgehen sowie Informationen zur Datenverwertung	
Zeitplan Offenheit für Rückfragen	
Interesse an Ergebnis	• komplette Arbeit • Zusammenfassung • nein

Appendix 3: Copy of consent form for expert interviews (in German)

Einverständniserklärung zum Expert*innen-Interview

Forschungsfrage:	Tiny Forests by Akira Miyawaki – a possibility for Berlin?
Masterstudentin:	Sina Katharina Franke
Studiengang:	Stadtökologie (M.Sc.)
Institution:	Technische Universität Berlin
Interviewerin:	Sina Katharina Franke
Interviewdatum:	_____
Interviewort:	Zoom (online)

Name der/des Interviewten: _____

E-Mail: _____

Ich, die/der Interviewte,

habe an dem oben genannten Interview teilgenommen. Ich wurde über das Ziel und den Ablauf der Forschungsfrage informiert und war mit der Aufzeichnung des Interviews auf Audioband einverstanden. Ich räume Frau Sina Katharina Franke die Rechte ein, das während des Interviews entstandene Material als Schenkung für die Erstellung ihrer Masterarbeit zu verwenden, ohne die personenbezogenen Daten an Dritte weiterzugeben, und stimme der Verwendung zu ausschließlich wissenschaftlichen Zwecken in nicht anonymisierter Form zu.

_____

Ort, Datum, Unterschrift Interviewte*r

Appendix 4: Document for division of main categories and sub-categories (level 1 and 2)

1 Stance towards Tiny Forest concept

Description: The stance towards the Tiny Forest concept

Application: Will be applied when experts provide insights on their initial and general stance towards the Tiny Forest concept including their personal interest for the topic.

Example: *"[...] when I read this, I thought it actually sounds too good to be true [...]"* (3:33)

Differentiation: Will only be applied when the personal view or estimations about the Tiny Forest concept is provided. Will not be applied when specific estimates on the Tiny Forest concept for the location of Berlin are mentioned.

Type: Deductive

2 Implementation of Tiny Forest concept in Berlin

Description: General aspects regarding the implementation of the Tiny Forest concept in Berlin

Application: Will be applied when experts provide general information about the potential implementation of Tiny Forests in Berlin.

Example: "*[...] for Berlin explicitly, the most difficult thing would probably be that the decision is made to get the appropriate areas, especially where the forests make the most sense, really further and further towards the city center."* (2:28)

Differentiation: Will only be applied when aspects of implementation for Tiny Forests in Berlin are mentioned, not for other locations.

Type: Deductive

2.1 Potentials and challenges

Description: The potentials and challenges when it comes to implementing the Tiny Forest concept in Berlin

Application: Will be applied when experts give insights or estimations for possible potentials and challenges that may arise when implementing the Tiny Forest concept in Berlin.

Example: *“[...] without having scanned Berlin super extensively now, I would say that in all urban areas there is most likely a relatively large, at least potential, amount of space available after all.”* (2:1)

Differentiation: Will not be applied when potentials and challenges are mentioned for locations other than the area of Berlin.

Type: Deductive

2.1.1 Area availability

Application: Will be applied when experts talk about the area availability, area selection and area potentials for Tiny Forests in Berlin.

2.1.2 Soil preparation

Application: Will be applied when experts talk about the characteristic soil preparation phase when establishing Tiny Forests in Berlin.

2.1.3 Potential natural vegetation

Application: Will be applied when experts talk about the potential natural vegetation in connection with creating Tiny Forests in Berlin.

2.1.4 Succession

Application: Will be applied when experts talk about the succession of Tiny Forests in Berlin.

2.1.5 Ecosystem services

Application: Will be applied when experts talk about the ecosystem services in connection with the establishment of Tiny Forests in Berlin.

2.1.6 Nature conservation

Application: Will be applied when experts give insights or estimations about the nature conservation potential of Tiny Forests in Berlin.

2.1.7 Accessibility

Application: Will be applied when experts talk about the accessibility of Tiny Forests in Berlin.

2.1.8 Temporary interim use

Application: Will be applied when experts talk about the potential temporary interim use of vacant areas for implementing Tiny Forests in Berlin.

2.1.9 Recreation

Application: Will be applied when experts talk about recreation potential of Tiny Forests in Berlin.

2.1.10 Carbon storage potential (i)

Application: Will be applied when experts talk about the carbon storage potential when implementing Tiny Forests in Berlin.

2.1.11 Dense planting (i)

Application: Will be applied when experts talk about the characteristic and dense planting when establishing Tiny Forests in Berlin.

2.1.12 Social aspect (i)

Application: Will be applied when experts talk about the social aspect when implementing Tiny Forests in Berlin.

2.1.13 Biodiversity (i)

Application: Will be applied when experts talk about biodiversity in connection with establishing Tiny Forests in Berlin.

2.1.14 Climate aspect (i)

Application: Will be applied when experts talk about the climate aspect of establishing Tiny Forests in Berlin.

2.1.15 Political situation (i)

Application: Will be applied when experts talk about the political situation regarding the implementation of the Tiny Forest concept in Berlin.

2.1.16 Link to other green infrastructure (i)

Application: Will be applied when experts mention the connection to other green infrastructure when talking about Tiny Forests in Berlin.

2.1.17 Adaptation of the concept (i)

Application: Will be applied when experts talk about potential adaptions of the Tiny Forest concept for urban areas in temperate zones like Berlin.

2.1.18 Nature experience (i)

Application: Will be applied when experts talk about the aspect of nature experience when establishing Tiny Forests in Berlin.

2.1.19 Terminology (i)

Application: Will be applied when experts talk about the term *Tiny Forest* and the potential effect this terminology may have on the quality of implementation of Tiny Forests in Berlin. Will also be applied when the Tiny Forest trademark is mentioned.

2.1.20 Costs (i)

Application: Will be applied when experts talk about the aspect of the costs when establishing Tiny Forests in Berlin.

2.2 Plant selection

Description: The potential plant species used for the implementation of Tiny Forests in Berlin

Application: Will be applied when experts give specific information, estimates or examples for suitable native or non-native plant species for Tiny Forests in Berlin.

Example: *"[...] mixture of fast and slow growing species that are drought resistant: pedunculate and sessile oak, hornbeam and sand birch."* (1:12).

Differentiation: Will not be applied when they talk about native or non-native plant species for locations other than Berlin or Brandenburg.

Type: Deductive

2.2.1 Mix of native and non-native plant species

Application: Will be applied when experts talk about their stance on the mix of native and non-native plant species when implementing Tiny Forests in Berlin. Examples of specific plant species will not be included.

2.2.2 Examples of native plant species

Application: Will be applied when experts talk about specific examples for native plant species that could be used for the establishment of Tiny Forests in Berlin.

3 Acceptance of Tiny Forest concept in Berlin

Description: Aspects regarding the general acceptance of the Tiny Forest concept in Berlin

Application: Will be applied when experts give insights or estimations about the acceptance of the Tiny Forest concept in Berlin.

Example: *"[...] acceptance is given at many locations."* (2:17), *"[...] at least among all the people who are involved [...]"* (2:40)

Differentiation: Will not be applied when the acceptance of Tiny Forests is referred to locations other than Berlin.

Type: Deductive

3.1 Social component

Description: Aspects regarding the social acceptance of the Tiny Forest concept in Berlin

Application: Will be applied when experts give insights or estimations about the social component regarding the acceptance of the Tiny Forest concept in Berlin.

Example: *"[...] would definitely involve the people who live there in the process. [...]"* (2:17)

Differentiation: Will not be applied when the social acceptance of Tiny Forests is referred to locations other than Berlin.

Type: Deductive

3.1.1 Target groups

Application: Will be applied when the experts talk about the main target groups that can be involved with the implementation of Tiny Forests in Berlin.

3.1.2 Participation of citizens

Application: Will be applied when the experts talk about the different ways that citizens can participate when it comes to the implementation of Tiny Forests in Berlin.

3.1.3 Knowledge transfer (i)

Application: Will be applied when the experts talk about the knowledge transfer of the Tiny Forest concept when implementing Tiny Forests in Berlin.

3.2 Aesthetic component

Description: Aspects regarding the aesthetic acceptance of the Tiny Forest concept in Berlin

Application: Will be applied when experts give insights or estimations about the aesthetic component regarding the acceptance of the Tiny Forest concept in Berlin.

Example: *"[...] there must also be a certain basic level of design [...]"* (4:15)

Differentiation: Will not be applied when they refer the aesthetic acceptance of Tiny Forests to locations other than Berlin.

Type: Deductive

3.2.1 Design (i)

Application: Will be applied when the experts specifically give insights or information on the design of Tiny Forests in Berlin.

4 Outlook on Tiny Forest concept in Berlin

Description: The outlook on the Tiny Forest concept in Berlin

Application: Will be applied when experts state their estimations about the future viability and practicability of the Tiny Forest concept in Berlin.

Example: *"[...] it is not a substitute for the maintenance and structuring of public green space in the city, but [...] like a piece of the puzzle, which also complements it well somehow."* (4:46).

Differentiation: Will not be applied when specific estimations about the outlook of the Tiny Forest concept in Berlin are provided.

Type: Deductive

4.1 Knowledge gaps for implementation

Description: Potential knowledge gaps when implementing Tiny Forests in Berlin

Application: Will be applied when experts give specific insights or estimations about potential knowledge gaps that may inhibit the implementation of Tiny Forests in Berlin.

Example: *"[...] a knowledge gap, if you want to call it that, is just quite central, where do we get the areas?"* (2:20)

Differentiation: Will not be applied when they talk about knowledge gaps for the implementation of Tiny Forests for other locations than the area of Berlin.

Type: Deductive

4.1.1 Risks and uncertainties (i)

Application: Will be applied when experts state risks or uncertainties that may arise when implementing the Tiny Forest concept in Berlin.

4.1.2 Area acquisition (i)

Application: Will be applied when experts give insights or estimations about the aspect of area acquisition when implementing the Tiny Forest concept in Berlin.

4.1.3 Land ownership (i)

Application: Will be applied when experts give insights or estimations about the aspect of land ownership when implementing the Tiny Forest concept in Berlin.

4.1.4 Social acceptance (i)

Application: Will be applied when experts state aspects of the social acceptance of the Tiny Forest concept in Berlin.

4.1.5 Assured plant care (i)

Application: Will be applied when experts talk about the aspect of plant care when implementing the Tiny Forest concept in Berlin.

4.1.6 Bureaucratic and political hurdles (i)

Application: Will be applied when experts talk about the bureaucratic or political hurdles that may arise when planning Tiny Forests in Berlin.

4.1.7 Soil properties (i)

Application: Will be applied when experts talk about the soil properties when implementing the Tiny Forest concept in Berlin.

4.1.8 Public outreach (i)

Application: Will be applied when experts talk about the public relations or public oureach regarding the Tiny Forest concept in Berlin.

4.2 Future viability

Description: The future viability of the Tiny Forest concept in Berlin

Application: Will be applied when experts provide specific estimations about the future viability of the Tiny Forest concept in Berlin.

Example: *“[...] Tiny Forests are definitely a building block that can be used to design cities of the future in a very promising way.”* (2:80)

Differentiation: Will not be applied when they talk about estimations about the future viability of the Tiny Forest concept for other locations than the area of Berlin.

Type: Deductive

Appendix 5: Case summaries for the interviews of all four experts

Nature conservation component (research) – Prof. Dr. Ingo Kowarik

Stance towards Tiny Forest concept	
	To date, Prof. Dr. Kowarik has a skeptical view of the Tiny Forest concept in a city context as it was initially created for the non-urban area. Nonetheless, he thinks that the Miyawaki method is still a fantastic method for non-urban areas to build up new forests of the future with the participation of children and young people in landscapes where not many native woody plants are left. In general, he sees a lot of disadvantages and very little advantages for the implementation of the Tiny Forest concept in Berlin.
Implementation of Tiny Forest concept in Berlin	
Potentials and challenges	When thinking about area potentials, Prof. Dr. Kowarik says that the added value of the Tiny Forest method should first be clear, then it can be considered where to apply it. According to him, on highly modified sites, all species that may not naturally occur there, but that can cope with the new natural potential that is anthropogenically modified, must ultimately be included. In his opinion, the classic concept of the PNV of the original Berlin-Brandenburg landscape cannot be applied at all to urban locations in Berlin. His practical consequence of this is then always to say PNV is good for relatively unmodified sites. Regarding the preparation of the soil, he states that big soil replacements and so on would be counterproductive. Further, he says that there are already a lot of woody plants in the city and that woody plants are wonderful, but from a nature conservation point of view, there is absolutely no need to expand the woody plants in Berlin or the proportion of the forest. His reason for that is that the non-wooded vegetation is infinitely richer in terms of biodiversity of plants and animals. Prof. Dr. Kowarik explains that many green spaces, especially on residual areas of the city are physically inaccessible but they are visually accessible which is a very important point because if you can see them, they are part of the

	environment. Regarding the succession of Tiny Forests, he says that there is nothing new about it at all and that the succession stages are simply skipped if one plants species of older stages. In his opinion, that has nothing to do with succession theory at all and he would not accept it as a new theory. It is simply succession anticipated by human intervention, namely by planting certain species. He would not establish Tiny Forests as a temporary interim use on free areas as he does not see a benefit. There would only be a lot of investment when it comes to the plant material, time, effort and even hope. In that case, he would rather sow lawn or a meadow because, on a symbolic level, it is not an eternal promise like a forest. From a nature conservation perspective, Prof. Dr. Kowarik does not see any synergies between nature conservation goals and the recreational use of Tiny Forests in Berlin, but rather conflicts.
Plant selection	As a former state representative for nature conservation in Berlin and with his nature conservation work, Prof. Dr. Kowarik has always and openly declared himself in favor of mixing native and non-native plant species in the urban area. According to him, that has nothing to do with the potential natural vegetation in the sense of Miyawaki. For the selection of native plant species, he would choose a mix of fast and slow growing species that are drought resistant like, e.g., pedunculate and sessile oak, hornbeam, and sand birch.
Acceptance of Tiny Forest concept in Berlin	
Social component	Prof. Dr. Kowarik thinks that people can be inspired for Tiny Forests, especially children and young people, but he also states that people have bigger and, according to him, more meaningful needs like, e.g., saving bees. He says that people like trees which is why they are committed to preserve them, but also that the novelty value of the concept is limited, and that the label of Tiny Forests sounds more exciting for the population than the plantation of woody plants.

Aesthetic component	When it comes to planting woody plants, as a state representative Prof. Dr. Kowarik used to say that trees are wonderful, but trees everywhere would also be boring. He says that many green spaces are physically not accessible but visually accessible. According to him, a Tiny Forest would look dense and green, and it would be critical to question what the added value would be in terms of design and aesthetics.
Outlook on Tiny Forest concept in Berlin	
Knowledge gaps for implementation	According to Prof. Dr. Kowarik, the two essential knowledge gaps are that one might not know exactly which species are suitable and one might not immediately see how it turns out when the advantages are related against the disadvantages.
Future viability	Prof. Dr. Kowarik does not think that it is a concept with future for Berlin.

Service provider component (implementation of Tiny Forests) – Stefan Scharfe

Stance towards Tiny Forest concept	
	Stefan Scharfe and his team from Miya e.V. have experience in the project planning, coordination and implementation of Tiny Forests and know how to implement Tiny Forests in urban agglomerations. He likes the network that is currently being created throughout Europe because the people involved are very visionary and have a special drive. They want to avoid consequential climate damage and not use a technological solution, but rather a natural solution.
Implementation of Tiny Forest concept in Berlin	
Potentials and challenges	Stefan Scharfe estimates that, without having scanned Berlin super extensively, in all urban areas there is most likely a relatively large potential of areas. In his opinion, the most exciting thing is that there now is funding for such projects because political actors seem to be encouraged to implement them. Also, on a social level, Tiny Forests totally meet the zeitgeist with the people who help plant the forest and help plan it in a participatory process, ideally also with

	children and school classes. Regarding the ecosystem services and the carbon storage potential, he states that one cannot expect too much from individual pilot projects and that one cannot really argue with that. If there would be more of these Tiny Forests all over Berlin, it would make sense from an ecological perspective because in total the effect can be quite strong regarding biodiversity and genetic exchange. According to him, the biggest potential is on the social level and in the symbolic power of such Tiny Forests, especially for the people in the city who can reconnect with nature again. Regarding the plant composition, it will always be different in each project, and it is important to always mulch properly. He says that establishing a Tiny Forest as a temporary interim use on a free area would be better than not to do it. In his opinion, there is no guarantee at all how long a Tiny Forest can stand because of the political situation or the city´s plans so every tree or every area that is forested today makes sense somewhere. Stefan Scharfe says that recreation is always a question of definition. He thinks that conservation and recreational goals can be combined when establishing Tiny Forests on small areas. In his opinion, when several Tiny Forests and other urban green are established in Berlin, it probably has quite a measurable effect on people´s well-being.
Plant selection	Before choosing the plant species, Stefan Scharfe would take a close look at the respective location. He stated a few species they also plant in urban areas with MIYA e.V. For the larger tree species, he would try to work with beech, oak, maple, linden, and elm. Regarding the smaller trees and shrubs, for the most part, he would include something like wild apple, wild pear, bird cherry, yew, and holly. Against the background of climate change, he also would not rule out the possibility of mixing native and non-native tree species in the future and thinks it could be a creative task.
Acceptance of Tiny Forest concept in Berlin	

Social component	As mentioned before, Stefan Scharfe emphasizes that, on the social level, Tiny Forests really meet the spirit of the times, especially when working with young people and school classes. Besides school children, there could also be the possibility of informing the citizens if they want to participate. He also states that the acceptance might really depend on the location, district and population group and how satisfied people are with the political decision makers. Further, if people are involved in the decision making and implementation process, Stefan Scharfe estimates the acceptance to be higher.
Aesthetic component	Depending on how much area is available, Stefan Scharfe states that Tiny Forests can be embedded in a landscape design where the recreational function would fully be given then. He also says that it depends on the respective requirements of the client, how the Tiny Forest will be designed. He would also put benches around for the citizens, if possible.
Outlook on Tiny Forest concept in Berlin	
Knowledge gaps for implementation	According to Stefan Scharfe, potential knowledge gaps in Berlin might be on how to get the areas for implementation, how to ensure social acceptance and communicate it across the board and how to really involve people effectively, especially with larger-scale projects. Also, how to enable and motivate local people to take care of the Tiny Forest in the initial phase and make sure that they do not wither away in two dry summers. Further, he says there should not be big obstacles but rather logistical steps and that it is more of a structural, bureaucratic political problem than it is easily implementable. For him it is important to keep adapting and improving the Tiny Forest method and as it is with all natural systems, it takes time until results are shown.
Future viability	According to Stefan Scharfe, it is a concept with future, but he also states that one cannot be sure 100 percent because of the changing political world situation and the climatic conditions.

Political processes component (local politician) – Stefanie Scholz

Stance towards Tiny Forest concept	
	When Stefanie Scholz first heard about the Tiny Forest concept, she thought that it sounds too good to be true because it brings together three components that often do not go together. On the one hand, it is a climate project because CO2 is sequestered. It is also a climate adaptation project because water is absorbed, and pollutants are stored. On the other hand, it is a social project and not terribly expensive compared to other green spaces. She also hopes that when establishing Tiny Forests, the plants do not only compete but also promote and provide shade for each other in the association and perhaps are more resilient. She argues that one should plant everything today in such a way that is optimal and has the possibility to last for a long time. She also initiated and accompanied the implementation of the first Tiny Forest in Darmstadt as a local politician of the Green Party there.
Implementation of Tiny Forest concept in Berlin	
Potentials and challenges	By implementing Tiny Forests in Berlin, Stefanie Scholz sees a great potential to reconnect people in the city with nature in some way. She also says that it is important that they are established in a place where they are seen and where one can observe the changes. Further, she states that is important that there is a school or neighborhood next to it that takes care of it. So, it is not the green space office that has to take care of it but that there really is a team that is responsible for the care, especially in the first three years. She also knows from studies in Holland, that not only the species diversity can increase enormously, but also the individuals, when establishing Tiny Forests. Nonetheless, Stefanie Scholz also argues that it is important that the Tiny Forests are in connection with other green spaces and can therefore act as steppingstones. Further, she says that the tremendous competition for land everywhere is a challenge and that it is not easy to find a place that is central and of importance

	and is not yet occupied elsewhere by the green space office. In Darmstadt, where they are planning to establish a second Tiny Forest, they are also trying to find an area to unseal, and she sees potential for that in Berlin as well. Regarding the soil preparation, she says that, especially in cities and in areas where the Tiny Forest really is needed, there might not be the best soil on-site and one might have to deal with an explosive ordnance survey prior to planting the Tiny Forest. Stefanie Scholz also states that, due to the changing climate, one should consider a plant selection that might extend the PNV to also have trees and bushes that are more likely to withstand heat and drought. She likes the idea of establishing Tiny Forests on free areas as a temporary interim use and argues that it might be better than not doing it. Stefanie Scholz states that conservation and recreational goals can be combined but only on the edge of the Tiny Forest.
Plant selection	Regarding her professional background, Stefanie Scholz cannot give specific examples for the plant selection for Tiny Forests in Berlin but refers to the professional knowledge of Stefan Scharfe and his team at Miya e.V. She was merely able to talk about the Tiny Forest that was implemented in Darmstadt where they had around 23 different trees and bushes like e.g., roses, hazel bushes, broom.
Acceptance of Tiny Forest concept in Berlin	
Social component	Stefanie Scholz distinguishes the enthusiasm of the Tiny Forest concept between laymen and the green space office. Laymen show a great enthusiasm very quickly whereas the experts have a different way of thinking and from what she experienced they think it is simply a new concept that does not fit at all. During the implementation process of the first Tiny Forest in Darmstadt, there first was no acceptance but with time, an understanding grew. On a social level, she says it is important that the citizens are reconnecting with nature and that a bond and interest is connected.

Aesthetic component	Regarding the aesthetic component, she was able to talk from experience again when they established the Tiny Forest in Darmstadt. According to Stefanie Scholz, the Tiny Forest was planted in three steps. At the very edge, lower woody plants were used. In the middle area, half-high trees were planted and in the inner area there were all the high trees. She also says that, as a counterexample, in Belgium the plants for the Tiny Forests were planted in a mix and that there are many ways to design a Tiny Forest like to put small paths through or to create a half moon with a bench in the middle.
Outlook on Tiny Forest concept in Berlin	
Knowledge gaps for implementation	According to Stefanie Scholz, knowledge gaps could be avoided if the ownership is known when looking for properties. More precisely, to know what belongs to the city, railroad, companies and what is private. Also, the subsoil of the potential area is important. She also highlights that one must check where the pipes and cables are running. Nevertheless, she says that the knowledge gaps are not the bottleneck when it comes to implementing Tiny Forests in Berlin.
Future viability	Stefanie Scholz hopes that it is a concept with future, but she does not know for sure.

Official and administrative component (green space office) – Annette Hennemann

Stance towards Tiny Forest concept	
	Being the contact person in the green space office for the implementation of the first Tiny Forest in Darmstadt, she was able to accompany the project throughout the whole project phase. She shared initial concerns with her colleagues at the office but unlike them, was able to drop the skepticism.
Implementation of Tiny Forest concept in Berlin	
Potentials and challenges	Annette Hennemann compares the potentials and challenges of the Tiny Forest concept in Berlin with Darmstadt. From her search for areas in Darmstadt she found out that it would make the most sense on publicly owned sealed and built areas like e.g., parking lots or schoolyards and

	that the search for land might be similarly problematic. That and the issue with the gas supply pipeline situations underneath might be two of the biggest hurdles. She says that she would rather look at commercial areas instead of the normal public green in Berlin. According to her, there would be less public influence and that the people would have to be convinced but she argues that there are a lot of companies that like to put on a green coat. According to her, for Berlin it would be almost more important to promote proper green corridors and to maintain the merging of the different parks. She also mentions the extreme pressure of use on all the parks in Berlin so one major issue is to make sure that the parks stay green at all. Annette Hennemann hopes that through the dense planting and the use of native tree species that the plants support each other, and that water and nutrients are stored better in the soil through the plant carbon. She also says that urban forests have a conservation potential by e.g., acting as steppingstones for populations. Finally, she also mentions the importance of the social aspect by establishing Tiny Forests in Berlin and says that it is important that the citizens are part of the planting process and learn something about it. Transporting the topic of ecology, forests and green where it is not there or too little developed is something that she finds even more exiting. She likes the idea of establishing Tiny Forests on free areas as a temporary interim use but questions from which shortest possible time it would make sense. Further, she states that it could get emotional if the Tiny Forest gets cut down but as an ecological point it would be nice to do it. In general, she says that Germany has a problem with interim solutions. She also says that conservation and recreational goals can be combined when establishing Tiny Forests in Berlin.
Plant selection	For Berlin, Annette Hennemann has no specific recommendations when it comes to the plant selection but from her experience with the Tiny

	Forest in Darmstadt, she would recommend evergreen plants and liked that they planted yew and holly as a green basic structure. Regarding a potential mix of native and non-native plants, she would not be against it but she would prefer a higher share of native than non-native trees so they could act as a safe scaffold, also visually. For there to still be an ecologic benefit, the PNV would have a large share. She suggests that the PNV should not be replaced by any means but rather supplemented a bit, otherwise it would somehow become even more artificial.
Acceptance of Tiny Forest concept in Berlin	
Social component	In her opinion, the acceptance of the Tiny Forest concept depends very much on how people are informed about it. Telling citizens what might be going on ecologically when planting Tiny Forests in a way that is understandable, might increase the understanding about it among the population. Also, including the neighborhood is very important because these are the people that walk past the Tiny Forests every day. According to her, having one contact person when it comes to watering the Tiny Forest might also be beneficial.
Aesthetic component	In Darmstadt there is a chestnut fence around the outside of the Tiny Forest, which could also be an idea when establishing Tiny Forests in Berlin. This way, Annette Hennemann argues, there is a certain basic level of design which might prevent the area to from getting littered. Further, by also tending and mowing the remaining meadow area outside of the Tiny Forest, it suddenly looks designed as well. In her opinion, it is important to think a little bit about design.
Outlook on Tiny Forest concept in Berlin	
Knowledge gaps for implementation	Since the Tiny Forest concept is still afflicted with a bit of skepticism amongst the green space office, she suggests transporting the information for a better understanding. This would similarly make sense for a city like Berlin, which also has a huge administration.
Future viability	How well the Tiny Forest concept will succeed and for how long it might be a future concept, depends entirely on how it is implemented, says

	Annette Hennemann. She hopes that it is a concept with future in Berlin but also adds that it is not a replacement for maintaining and structuring public green spaces in the city. In her opinion, the Tiny Forest concept can be a puzzle piece for the big picture.

Appendix 6: Attribute table of the exemplary fallow land area in Wedding, Huttenkiez

fid	1
schl5	0200015081000000
bez	01
bezirk	Mitte
woz	NULL
woz_name	NULL
grz	171
grz_name	Brachfläche, vegetationsfrei
ststrnr	18
ststrname	Nicht oder gering bebaute Fläche der Gemeinbedarfs- und Sondernutzung sowie Grün- und Freifläche
typ	57
typklar	Brachfläche
nutz	171
nutzung	Brachfläche, vegetationsfrei
nutz_bauvo	171
nutzung_ba	Brachfläche, vegetationsfrei
flalle	4944,683008792571
plr	01200517
plr _name	Huttenkiez
kategorie	schlecht

Appendix 7: Attribute table of the exemplary fallow land area in Neukölln, Glasower Straße

fid	6
schl5	1400789051000200
bez	08
bezirk	Neukölln
woz	40
woz_name	Gewerbe- und Industrienutzung, großflächiger Einzelhandel
grz	171
grz_name	Brachfläche, vegetationsfrei
ststrnr	15
ststrname	Geringe Bebauung mit überwiegender Nutzung durch Gewerbe und Industrie
typ	30
typklar	Gewerbe- und Industriegebiet, großflächiger Einzelhandel, geringe Bebauung
nutz	171
nutzung	Brachfläche, vegetationsfrei
nutz_bauvo	40
nutzung_ba	Gewerbe- und Industrienutzung, großflächiger Einzelhandel
flalle	21111,162491695613
plr	08100209
plr_name	Glasower Straße
kategorie	schlecht

Appendix 8: Attribute table of the exemplary unsealing area in Wedding, Humboldthain Nordwest I

infoq	BA Mitte,Umwelt- und Naturschutzamt
bez	Mitte
ortst	Wedding
adr	Panke Grünzug Mündung,Sellerstraße 26,Chausseestraße 74,13353 Berlin
vgart	versiegelt
vgart_det	Asphalt
nutz	Straßenland,Stellplätze
plan	öffentliche Grünfläche
prio_hydr	nein
klaer	Es liegt ein neues Blockkonzept zur Umgestaltung des Gebietes vor,die Flächenabgrenzung müsste jedoch im Detail angepasst werden (2020)
kom	Im B-Plan III - 34 als öffentliche Grünfläche festgesetzt,Altlast
fl_ges	4388
fl_beb	0
flant_beb	0
fl_ubeb	-1
flant_ubeb	-1
flant_sum	-1
fl_ents	0
eintr_erst	26.01.2017
eintr_letz	04.12.2020
koor_geo	52.53858188,13.37057223
koor_sold	389490 5822191
foto0	[[img]]http://@@FotoServer@@/fb_daten/fotos/Entsiegelung/10013_steck.jpg
foto1	[[img]]http://@@FotoServer@@/fb_daten/fotos/Entsiegelung/10013_002.jpg
foto2	[[img]]http://@@FotoServer@@/fb_daten/fotos/Entsiegelung/10013_003.jpg
foto3	NULL
foto4	NULL
foto5	NULL
foto6	NULL
foto7	NULL
fstanz	2

fnp	Grünfläche,gewerbliche Baufläche
fnp_einsch	entwickelbar
bplan	III-34
bplan_fest	ja
bplan_10	ja
lplan	III-L-4_TÖB
oekokonto	nein
bodensch	geringe
prio_e	hoch
prio_f	hoch
prio_t	gering
prio_z	n.a.
prio_kom	NULL
umsetz	nein
umsetz_kom	NULL
plr	01300836
plr_name	Humboldthain Nordwest
kategorie	schlecht

Appendix 9: Attribute table of the exemplary unsealing area in Wedding, Humboldthain Nordwest II

infoq	BA Mitte,Umwelt- und Naturschutzamt
bez	Mitte
ortst	Wedding
adr	Grüntaler Grünzug / Stettinerb.,Böttgerstraße 19+9,13357 Berlin
vgart	versiegelt,mit Gebäuden
vgart_det	ca.8 Gebäude,Beton
nutz	genutzte Schuppen
plan	öffentliche Grünfläche,B-Plan-Entwurf,öffentliche Wegerechte sichern (Fortführung nach Norden zur Badstraße durch Gebäude / Luftgeschoss)
prio_hydr	nein
klaer	-
kom	Fachplan Grün Entwurf sieht öffentliches Grün vor,Altlastenrecherche erforderlich
fl_ges	6087
fl_beb	1373
flant_beb	23
fl_ubeb	-1
flant_ubeb	-1
flant_sum	-1
fl_ents	0
eintr_erst	26.01.2017
eintr_letz	04.12.2020
koor_geo	52.54928078,13.38119487
koor_sold	390237 5823365
foto0	[[img]]http://@@FotoServer@@/fb_daten/fotos/Entsiegelung/10010_steck.jpg
foto1	NULL
foto2	NULL
foto3	NULL
foto4	NULL
foto5	NULL
foto6	NULL
foto7	NULL
fstanz	6

fnp	Grünfläche,Wohnbaufläche
fnp_einsch	entwickelbar
bplan	III-218
bplan_fest	nein
bplan_10	ja
lplan	ohne
oekokonto	nein
bodensch	geringe
prio_e	gering
prio_f	mittel
prio_t	mittel
prio_z	n.a.
prio_kom	NULL
umsetz	nein
umsetz_kom	NULL
plr	01300836
plr_name	Humboldthain Nordwest
kategorie	schlecht

Appendix 10: Table of the complete frequency analysis for the QCA

	Hennemann Gr=47	Kowarik Gr=57	Scharfe Gr=82	Scholz Gr=50	Sum
○ **Stance towards Tiny Forest concept** Gr=7	2	2	1	2	**7**
○ **Implementation of Tiny Forest concept in Berlin** Gr=169	30	45	57	37	**169**
• **Implementation of Tiny Forest concept in Berlin: PLANT SELECTION** Gr=0	0	0	0	0	**0**
• Implementation of Tiny Forest concept in Berlin: Plant selection: Mix of native and non-native plant species Gr=6	1	2	2	1	**6**
• Implementation of Tiny Forest concept in Berlin: Plant selection: Native plant species for Berlin Gr=6	1	1	2	2	**6**
• **Implementation of Tiny Forest concept in Berlin: POTENTIALS AND CHALLENGES** Gr=0	0	0	0	0	**0**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Accessibility Gr=9	2	2	2	3	**9**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Adaptation of the concept Gr=2	0	0	2	0	**2**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Area availability Gr=15	4	2	3	6	**15**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Biodiversity Gr=4	0	2	1	1	**4**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Carbon storage potential Gr=7	0	1	5	1	**7**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Climate aspect Gr=8	1	0	4	3	**8**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Costs Gr=7	1	0	3	3	**7**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Dense planting Gr=7	1	2	2	2	**7**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Ecosystem services Gr=4	0	1	3	0	**4**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Link to other green infrastructure Gr=6	2	3	0	1	**6**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Nature conservation Gr=8	1	5	0	2	**8**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Nature experience Gr=4	0	0	1	3	**4**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Political situation Gr=7	0	0	7	0	**7**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Potential natural vegetation Gr=15	2	7	5	1	**15**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Recreation Gr=11	2	3	5	1	**11**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Social aspect Gr=13	2	0	8	3	**13**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Soil preparation Gr=14	3	4	4	3	**14**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Succession Gr=5	0	4	1	0	**5**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Temporary interim use Gr=13	6	3	2	2	**13**
• Implementation of Tiny Forest concept in Berlin: Potentials and challenges: Terminology Gr=5	1	4	0	0	**5**
○ **Acceptance of Tiny Forest concept in Berlin** Gr=35	10	7	14	4	**35**
• **Acceptance of Tiny Forest concept in Berlin: AESTHETIC COMPONENT** Gr=0	0	0	0	0	**0**
• Acceptance of Tiny Forest concept in Berlin: Aesthetic component: Design Gr=12	3	4	3	2	**12**
• **Acceptance of Tiny Forest concept in Berlin: SOCIAL COMPONENT** Gr=0	0	0	0	0	**0**
• Acceptance of Tiny Forest concept in Berlin: Social component: Knowledge transfer Gr=6	4	0	2	0	**6**
• Acceptance of Tiny Forest concept in Berlin: Social component: Participation of citizens Gr=10	2	2	6	0	**10**
• Acceptance of Tiny Forest concept in Berlin: Social coponent: Target groups Gr=7	1	1	3	2	**7**
○ **Outlook on Tiny Forest concept in Berlin** Gr=28	5	5	11	7	**28**
• **Outlook on Tiny Forest concept in Berlin: FUTURE VIABILITY** Gr=11	2	2	4	3	**11**
• **Outlook on Tiny Forest concept in Berlin: KNOWLEDGE GAPS FOR IMPLEMENTATION** Gr=0	0	0	0	0	**0**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Area acquisition Gr=1	0	0	1	0	**1**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Assured plant care Gr=2	0	0	1	1	**2**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Bureaucratic and political hurdles Gr=2	1	0	1	0	**2**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Land ownership Gr=1	0	0	0	1	**1**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Public outreach Gr=4	2	0	2	0	**4**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Risks and Uncertainties Gr=6	0	3	2	1	**6**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Social acceptance Gr=2	0	0	2	0	**2**
• Outlook on Tiny Forest concept in Berlin: Knowledge gaps for implementation: Soil properties Gr=1	0	0	0	1	**1**
Sum	**92**	**117**	**172**	**99**	**480**