

# Digital Gardening with a Forest Atlas

## Designing a Pluralistic and Participatory Open-Data Platform

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### ABSTRACT

This paper details a research project and design, the Smart Forests Atlas, which expands open-data research platforms toward pluralistic and participatory practices. Working with the under-examined practice of 'digital gardening', the project reconfigures the open-data research platform into a dynamic and participatory space for cultivating ideas and generating content. However, we found that digital gardening could risk reinscribing existing colonial and anthropocentric practices of gardening and digital archiving. To challenge these risks, we propose six complementary design qualities that inform the design of the Atlas and could influence other open-data research platforms. We developed these qualities from a design inquiry into open-data platforms, environmental atlases, and digital gardening practices, while designing and developing the Atlas together with a digital tools cooperative. We argue that transformed digital gardening practices could advance more pluralistic, participatory, and more-than-human approaches to open-data research platforms while contributing to epistemic justice.

### CCS CONCEPTS

• **Human-centered computing** → Interaction design; Interaction design process and methods; Participatory design.

### KEYWORDS

Digital gardening, open-data platforms, pluralistic design, participation, digital infrastructure, environmental data

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## 1 INTRODUCTION

Digital infrastructures for gathering, sharing, and making sense of multimedia data are increasingly important in interdisciplinary research projects. At the same time, the movement toward open-data management requires attention to the design of platforms where researchers and project stakeholders can engage with project

content. Besides open-data research policies outlined by funding bodies, the research fields of Participatory Design (PD) and Human-Computer Interaction (HCI) have specifically reflected on the design of such open-data platforms and archives to build relational commons [34, 41]. While many open-data platforms involve one-way communication for sharing research with wider audiences, some platforms use emerging digital infrastructures as research tools for generating new knowledge, engaging in conversation with stakeholders, and producing reflections and perspectives on ongoing research. This paper details the design of one such participatory platform, the Smart Forests Atlas (<https://atlas.smartforests.net/>), developed as part of the Smart Forests research project that investigates the sociopolitical impacts of digital technologies as they monitor and manage forest environments [22]. The Atlas, currently tested in its first iteration, is designed to bring together project data and participatory research that engages with changing forest environments as they are impacted by digital technologies.

The Atlas is designed in response to the practice and concept of 'digital gardening', which reconfigures web-spaces as places to cultivate ideas more publicly and share experimental multimedia content in less structured and more open-ended formats [5]. Rather than presenting finished ideas, digital gardens grow content visibly over time. Although digital gardening practices have gained traction among designers and online content creators over the last few years, researchers in HCI or PD have not yet discussed their use or design implications. We chose to work with this concept because digital gardening offers a renewed approach to online knowledge generation following participatory and pluralistic design structures. Similar to a garden, we created the Atlas to transform the open-data research platform from a repository of primarily polished research content into a working digital field site. We define open-data as data that is freely available, accessible, searchable, usable, understandable, traceable, and sharable [33, 46]. With the Atlas, we seek to expand these principles through participatory and pluralistic research approaches to open data. Drawing on research practices engaged with epistemic justice and decolonizing design [10, 16, 32, 38, 39], more-than-human participation [1, 13, 15, 23, 25, 44, 45], pluralistic design [19, 28], and digital infrastructures as relational commons [29, 31, 41], this paper reflects on the design of an open-data platform that offers different ways of navigating and contributing research materials while discussing design implications for digital gardening practices.

The paper next discusses related work in open data and environmental atlases that challenges colonial, anthropocentric, or unilateral ways of representing and sharing research data. The third section of this paper outlines the practices and challenges of digital gardening that inform the design of participatory research



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platforms. After a brief overview of the Smart Forests Atlas design process in section four, section five expands digital gardening approaches by suggesting six design qualities that emerged from the design process. This paper contributes to PD by advancing discussions on the design of pluralistic and participatory research platforms and further expanding these through the concept and practice of digital gardening. This contribution offers novel ways of creating open-data research platforms that expand both PD research and digital garden practices. As open data is not static but continuously evolving, these qualities do not formulate universal design principles. Instead, they seek to generate more pluralistic, participatory and dynamic design and PD approaches to open-data platforms.

## 2 RELATED WORK

The goal of the Smart Forests Atlas is to configure an open research platform and working space for learning about emerging digital technologies in forest environments through exchanges across researchers, other stakeholders, and publics. The design thereby challenges traditional approaches of atlases as colonial tools that delimit territories to instead build an open-data platform as relational commons.

Related work in the design of open-data platforms and environmental atlases shows plenty of emerging modes of participation and interactivity in relation to ongoing research projects. For example, *More-than-Human Derive*, is a research project and online platform that invites users to ‘drift’ through (urban) forests and share their stories on a map using different kinds of media, sensory impressions, and personal expressions, combining personal stories with other environmental datasets [12]. Some design elements of this map are deliberately ambiguous, such as creatures only appearing during certain times, or random distributions of locations [9]. *Anthropocene Curriculum* is a growing network of initiatives for developing and testing experimental approaches to co-learning and co-producing earthbound knowledge [3]. Hundreds of invited contributors, including academics, activists, and artists, added materials to the platform to be explored and filtered through chronological entries, linked metadata, keywords, or a map. Another experimental publication, *Feral Atlas*, is described as ‘a compendium of vantage points’ including essays, maps, images, and linked entries that presents a highly curated, playful, and experimental exposition of 79 field reports from scientists, humanists, and artists. The atlas invites users to explore the infrastructural effects and feral ecologies that comprise the Anthropocene [43]. These three examples of digital infrastructures offer new design approaches that enable users to contribute stories about humans and environmental relations and explore different ways of linking and navigating content through approaches that embrace relationality and plurality.

Available platforms that share and collect environmental data and local knowledge practices in relation to forests incorporate a variety of accessibility and data collection tools to support open-data principles. Open APIs (Application Programming Interfaces), for example, provide public access to software and datasets that can be reproduced within other environments. In particular, *Global Forest Watch*, is a large open-data portal that provides verified datasets on forest statistics such as tree cover gain or deforestation [21].

Using a Creative Commons CC BY 4.0 license and open-source code, developers can create custom applications or built interactive maps on their own websites or applications. Furthermore, *AmazoniAlerta*, *SOMAI*, and *CIPTA* are three examples of non-English driven platforms used and/or co-developed by Indigenous communities in South America to exchange, collect, and analyse data on Indigenous Lands, territorial conflicts, illegal deforestation, and other ongoing concerns in the Amazon and its surrounding areas [2, 14, 40]. Lastly, citizen-science platforms, such as *Forest Health Watch* make use of the *iNaturalist* mobile application and platform to collect observations of tree species and their health conditions to monitor urban and rural forest in the Pacific Northwest [20]. These are a few examples of many ongoing projects, both in environmental atlases and open-data platforms that show different forms of participation and interactive forms of exploring ongoing research encouraged through their designs. However, these platforms also bring up PD-related questions on how their designs enable project stakeholders and the wider public to participate in generating and reflecting on knowledge created. The next section will outline the concept and practice of digital gardening as a design orientation that shares research data and participant contributions while actively involving users in ongoing research and reflection.

## 3 DIGITAL GARDENING: PRUNING OR PLURALITY?

A recent phenomenon in online content sharing and archiving involves the concept and practice of ‘digital gardening’. A digital garden is an online, often personal web-space where users share and develop thoughts and ideas in progress [5]. It is a more recent form of blogging where instead of polished entries, users engage in more free-form, unfinished, and playful reflection and sharing. The gardening approach is used, for example, to conceptualize online spaces where seeds (or thoughts) are nurtured and grown, cross fertilization of formerly separate entries allow for new reflections, and gardening processes require constant care to flourish. This orientation towards data sharing further inspires the design of web-spaces for participatory reflection and collective knowledge generation that can further expand open-data principles for participatory research projects. The concept of digital gardening shows historical similarities with the notion of hypertext gardens as a format for writing, as outlined by Mark Bernstein in 1998 [8]. Playing with linked online textual pages, Bernstein experimented with the hypertext garden as a tool for exploratory storytelling, different navigational apparatuses, and non-linear reading experiences. These experiments also align with longstanding traditions of non-linear media forms such as interactive narratives in textual forms, text-based adventure games, and Wiki-style hypertext-structured informational content.

The gardening analogy of early Internet exchanges has gained renewed attention from developers and interaction designers online over the last 4 years. In April 2020, Maggie Appleton, design-lead at the HASH agency that builds open-source knowledge systems, wrote a Twitter thread compiling rich examples of digital gardening that circulated in the interaction design Twitter sphere [4]. She also cited related references by Mike Caulfield [11], Tom Critchlow [17], and *MIT Technology Review* [7], which were all foundational to a

renewed conceptualization of digital gardening. In a more extensive essay shared later on her personal website, Appleton dove deeper into the history and concept of digital gardening and outlined six design patterns common to digital gardens, summarized here as:

*Topography over Timelines:* rather than structuring content chronologically, content is structured through contextual relationships and associative links;

*Continuous Growth:* digital gardens are never finished but constantly growing, evolving, and changing;

*Imperfection & Learning:* Rather than hiding the thinking process, researching and refining happens online in public, while individual entries are still imperfect ‘seedlings,’ making digital gardens provisional by design;

*Playful, Personal, and Experimental:* each digital garden is unique and follow the creator’s modes of expression and use of the medium, rather than following a standardized template;

*Intercropping & Content Diversity:* content is not just text-based but also includes embedded or linked multimedia;

*Independent Ownership:* digital gardens should not be walled off by living on servers of other platforms or social media corporations, but ideally should be independently owned [5].

Digital gardening has become an increasingly important and evolving concept for designers and programmers over the last four years [4, 5, 7, 17]. Practitioners are working with these online knowledge structures and architectures as a reinvented form of building and sharing digital resources. Digital gardening practices have clear connections to PD: the creation of public digital infrastructures, the aim to generate knowledge in conversation with different sources and participants, and their iterative design that develops over time. However, despite the rise of these practices, the concept and practice of digital gardening has thus far not been reflected upon in the fields of PD research or HCI.

While digital gardening can inspire new forms of open-data sharing and archiving, however, it also risks reinscribing existing colonial and anthropocentric practices of gardening and digital archiving. Digital gardens primarily rely on western analogies to gardening. Yet within a Eurocentric historical origin, gardens and gardening practices have been sites of extractivism, imperialism, epistemic violence, and power inequalities that are directly linked to colonial plantations, botanical taxonomy, and global ecological destruction [18, 24, 26]. Digital gardening could reinforce practices of controlling content, limiting unwanted growth, and cultivating preconfigured ideals of a perfect botanic garden. To counteract these approaches, the concept and practice of digital gardening could be advanced from a personal, controlled website towards more pluralistic, participatory, and more-than-human engagements with open-data research platforms while contributing to epistemic justice. We further draw upon these references in section 5 of this paper.

## 4 DESIGNING A SMART FORESTS ATLAS

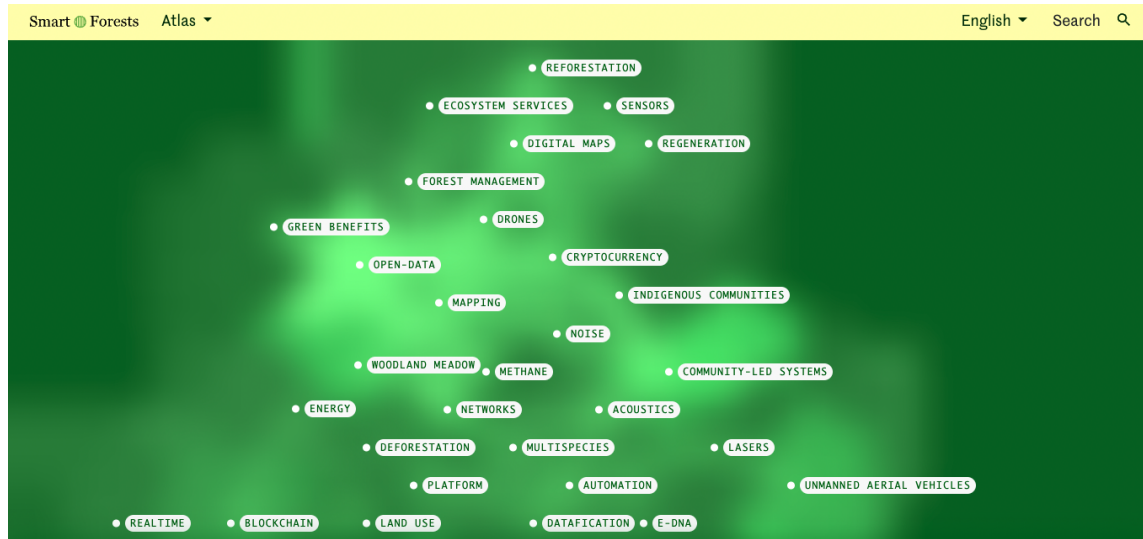
Between March 2021 and April 2022, we designed and developed a first version of the Smart Forests Atlas together with digital tools cooperative Common Knowledge. This Atlas is part of a larger research project that investigates how digital technologies are remaking forests worldwide [22]. These transformations involve digital

infrastructures that include forest sensors, satellites, drones, tree-planting apps, restoration platforms, and monitoring devices that can transform forests, shape forest governance, and impact local communities. The stakeholders who are part of this project include researchers, technologists, governmental institutions, NGOs, local and Indigenous communities, and more-than-human entities such as forest organisms. The Atlas aims to provide tools for stakeholders who are residing in diverse places across the planet to gather, explore, share, and discuss forest-related open-data.

As mentioned in section 2, the first phase of the design process entailed an inquiry into existing open-data platforms and environmental atlases to identify design characteristics and available open datasets in relation to forests worldwide. Secondly, we engaged in a collaborative design workshop and interviews with the digital tools cooperative to develop Atlas ideas and anticipated scenarios for different users. Thirdly, the Atlas project was thus far discussed with eight different participants in online semi-structured interviews to further probe potential usage. While the design process involved participatory methods, the focus of this paper is not to empirically ground the design decisions in participatory data, but rather to argue how practices of digital gardening can be expanded based on our broader design-based inquiry into this concept. The practice of digital gardening initially helped to identify design characteristics, but through this process we found that this concept expanded beyond its usual scope. Building on these insights, we created an interface composed of four ‘wayfinding devices’: logbooks, a map, a radio, and stories. Participants navigate the platform by exploring related tag-networks. Content creators tag each Atlas entry with different terms and these tags form a network of possible relations that can be explored by visitors and contributors. This non-hierarchical network structure weaves together multiple voices, perspectives, and worlds that enable different connections and readings of site content. By using an algorithm that plots tags non-hierarchically and in proximity to other related tags, the homepage encourages users to interact with content without a pre-defined structure. The practice of digital gardening is reflected in this design through the four wayfinding devices and tag-network structure to create a topographic and experimental approach to navigating and exploring content from multiple entry-points. Figure 1, Figure 2, Figure 3, and Figure 4 show different screenshots of the first iteration that is currently live.

## 5 DESIGN QUALITIES FOR OPEN-DATA PLATFORMS

In drawing together diverse global experiences of Matsutake mushroom foraging with relational commons and ‘capitalist ruins’, Anna Tsing uses the notion of ‘foraging’ to propose ways for fruitful scholarship to emerge through ‘unintentional design’. In this sense, knowledge can be found through foraging and woodland work that is less garden-like and more open to ‘an array of species’ [42, p. 286]. This orientation towards foraging as another type of cultivation is useful for PD as it can inspire further thinking and reflection on designs that encourage open interactions, especially in environments involving complex relations, multiple stakeholders, and participatory research processes. The six design qualities [6, 30] that emerged from our design process are intended to characterize



**Figure 1: Homepage of the Smart Forests Atlas, showing the tag-network structure with a heatmap where related tags are clustered together. When clicking a tag, a side panel opens that shows different contributions related to this tag (see also Figure 3).**

such openness to participatory and pluralistic knowledge generation and sharing via an open-data research platform that extends the scope of digital gardening as articulated in section 3. Aligning with articulations of feminist interaction design qualities by Bardzell [6] such qualities aim to characterize a participatory and pluralistic orientation towards open-data research platforms for both critique-based and generative contributions in design. The following six design qualities emerged:

### 5.1 Building Relational Commons through Open Data

To become a relational commons, digital infrastructures require design and open-data processes that are open to collective inquiry, contributions, and decision making [41]. As a project of creating commons through design infrastructuring [31] this project involves collaborators in an ongoing way to structure future relations beyond the immediacy of designing objects [29]. Thus, we found that the platform and its data must remain unfixed so that relational commons can find possibilities to evolve. New iterations and collaborators are meant to take the Atlas in different directions without aiming for a finished design state, for example through ongoing experiments with data visualizations and digital methods, Geographic Information System (GIS) mapping, or renewed approaches to digital gardening.

### 5.2 Enabling Epistemic Justice through Data Plurality

Political and epistemic decolonizing practices are required for imagining and building democratic, just, and non-imperial societies [32] and forest futures. In challenging totalizing narratives of progress [28], the Atlas aims to enable users to contribute materials and

share local practices, experiences, and concerns that pluralize narratives of data and digital technologies in forest environments. These narratives may pose conflicting or contradicting perspectives that co-exist alongside one another and co-produce experiences that may have been ignored as valuable knowledge and hold broader possibilities for making worlds [10, 27, 38]. While undoing epistemic injustices requires continuous care, the Atlas commits to further these efforts by ensuring that diverse participants can share their stories, in different languages, and that their contributions remain recognized and preserved.

### 5.3 Expanding Participation through More-than-Human Data

Following the emerging discourse on more-than-human participation in design [1, 13, 15, 23, 25, 37, 44, 45], we found it important to recognize the more-than-human entities that are entangled with forests, digital technologies, and data practices. Forest organisms, sensors, algorithms, extinct species, and many other entities (re)configure forest environment and shape technological developments. As a digital gardening platform we actively seek to enable these expanded contributions by including multispecies communities as contributors, in ways that learn from Indigenous and relational conceptions of how more-than-human entities reshape knowledge, co-constitute data, and expand agencies [e.g. 1, 16, 19, 27]. For instance, forest data often focuses on more abstract environmental indicators but a multispecies engagement would attend to the interconnections and relations across entities in lived situations. Digital gardening could then enable such weaving together of pluralistic data and stories.



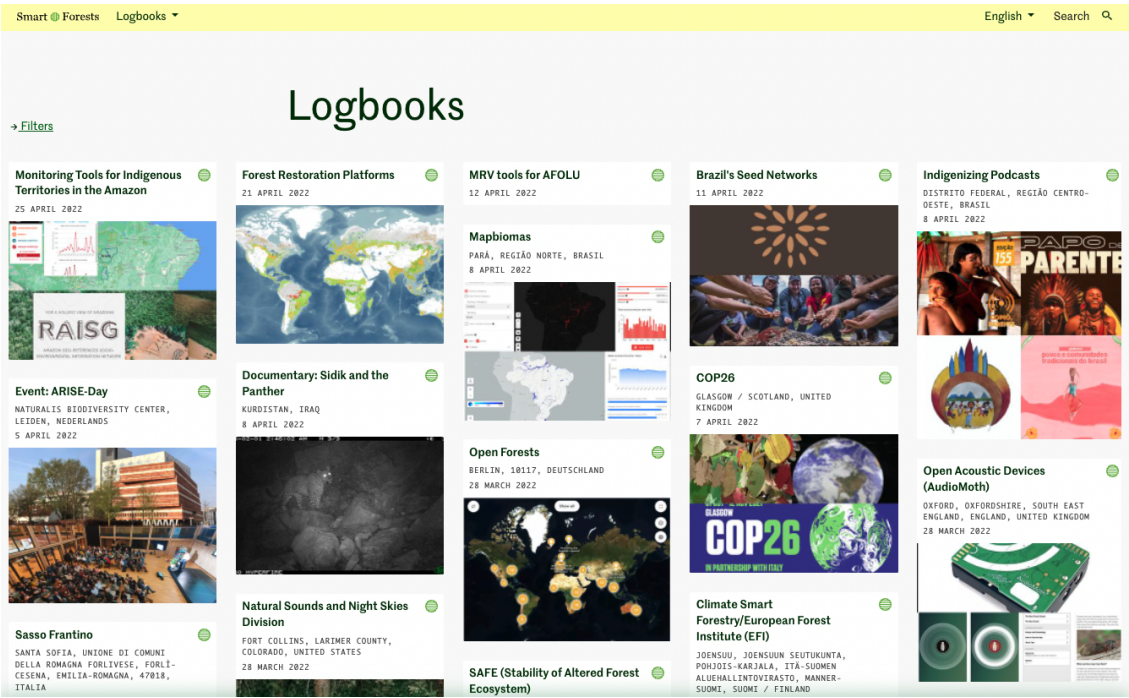
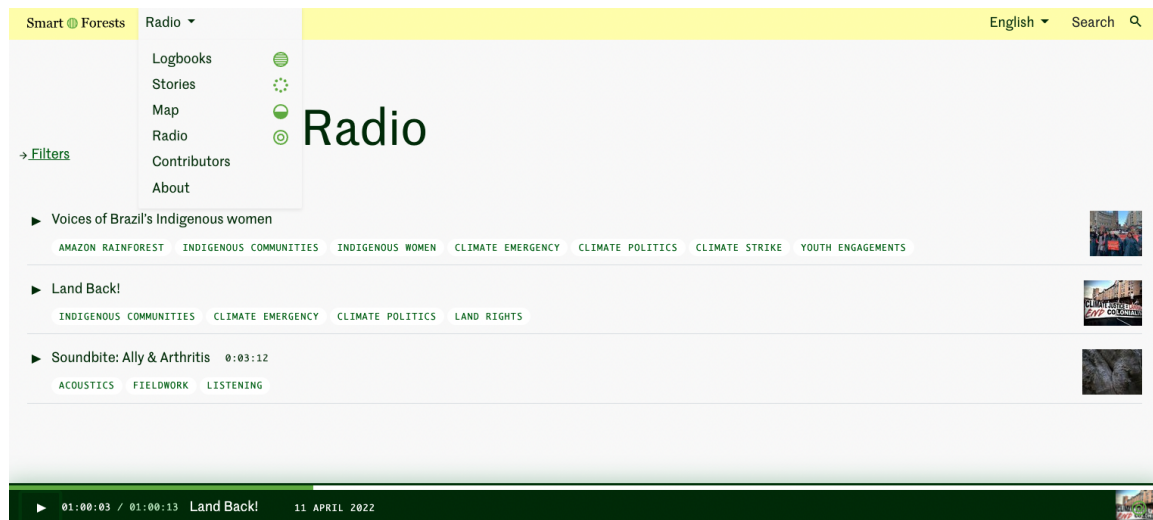


Figure 2: The Logbook wayfinding overview page with visual and textual open-data resources. Logbooks are smaller working garden patches where contributors can add short entries with raw data, fieldwork findings, or unfinished thoughts and questions. Logbooks can be navigated through tags via the homepage or via this wayfinding page.



Figure 3: The Map wayfinding device spatially visualizes Atlas contributions from the Logbooks, Stories, and Radio. On clicking a location, a side panel opens that shows linked contributions. The map, currently only displaying forest land-cover to challenge traditional nation-based maps, can also be filtered through tags through the filter panel on the left.



**Figure 4: The Radio wayfinding device attends to sound as a mode of investigating digital technologies in forest environments. Contributors can add fieldwork recordings, interviews, and experimental sounds. The Radio can be played while exploring other pages through the built-in audio player on the bottom of the screen. The four wayfinding devices are also navigable from a drop-down menu in the header.**

## 5.4 Transforming Digital Infrastructures through Sustainable Data

Digital gardening platforms with multiple users who produce content simultaneously risk populating servers with large quantities of data that require more sustainable and less extractive forms of energy in loading, sharing, and maintaining web-content [35, 36]. We learned that encouraging data plurality also requires more explicit attention to the data ecologies that are created by the platform and the resources required to operate it. Contributors will be encouraged to remain mindful of the traces they leave behind by sharing already existing open datasets/APIs, store information on servers that source energy sustainably, and take content offline to minimize the creation of digital waste.

## 5.5 Cultivating Wayfinding through Unexpected Data

Instead of structuring content chronologically, through pre-defined hierarchies, or individually created links, the tag-system on the homepage and the four wayfinding devices offer diverse entry points with a less structured and more pluralistic relational approach to how data becomes visible. Through this less cultivated approach to digital gardening, we are experimenting with ways to link content relationally through a process where contributors can forge new pathways. These different entry points are meant to unearth surprising connections and create new links between content as the digital garden grows.

## 5.6 Moving to Praxis through Open Data

Data and reflections shared through open-data platforms have the potential to impact others. Attention to how open-data research

content actually travels and has effects in the world is needed. This also includes strategies to mobilize participation and building a diverse stakeholder network in iterative rather than determined ways. Digital gardens, in other words, can become lived worlds. To contribute to creating more liveable and just forest environments the cultivation of participatory and pluralistic data practices by overlooked or minoritized communities and entities is needed. Design researchers are working toward decolonial approaches that are less a set of universal design solutions and are more oriented toward ‘doing’ and ‘undoing’ to create engaged multiplicities [19, 39]. Users of the platform should be able to participate in this process with ongoing care for how content can connect to praxis by circulating further to raise concerns, informing policy, forming alliances, and growing future gardens and communities both online and offline.

## 6 CONCLUSIONS AND FUTURE DEVELOPMENTS

This paper details the design process of an open-data platform for the Smart Forests research project. This process included a design inquiry into open-data platforms and environmental atlases, critical reflections on digital gardening, and the practical design and development of the Atlas. Through this process the need to expand patterns of digital gardening emerged to align digital gardening practices with PD discourse able to build relational commons and further data plurality. This initial stage of the research project resulted in proposing six design qualities that inform the development of the Atlas. These qualities aim to transform practices of digital gardening towards open-data platforms where contributors, visitors, gardeners, and foragers can collectively generate knowledge. Due to its open and participatory nature, the contributions and source code of this platform have the potential

to travel beyond this research project and impact future forest environments, digital forest technologies, and forest governance. This brings up questions about further developments of participatory and pluralistic open-data platforms and digital gardening tools as they impact new configurations of worlds: How do diverse stakeholders end up making use of these platforms? How are their contributions mobilized by others? How can the Atlas ensure accessibility and acknowledge stakeholders' pluralities of backgrounds, forest engagements, and worldviews while recognizing that their negotiations are often rooted in epistemic differences and marginalization? And how do these contributions help to iterate the design of open-data platforms further? Besides further testing and iterating upon the Atlas to continue attending to how the design is experienced by different users, further practical research into digital methods on open-data platforms is needed to investigate limitations and risks of using such platforms to engage with digital technologies to work towards epistemological justice in forest environments.

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