Citizen Science Platforms and the Reconfiguration of Urban Ecological Governance: Policy and Planning Implications from South Korea

The Case of the Uiwang Community Ecology Research Group's Use of NATURING

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Abstract

The proliferation of digital platforms is reshaping how citizen science is conducted. Yet empirical research remains limited on the conditions under which platform-based citizen science activities lead to public use within local communities and become connected to urban ecological governance. Focusing on the Uiwang Community Ecology Research Group's use of NATURING, this study explores ecological monitoring practices mediated by a citizen science platform, patterns of public utilization of platform-based citizen science data, and the conditions and limitations involved in connecting such data to urban ecological governance. For this purpose, participant observation was conducted for approximately six months from August 2025 to January 2026. Semi-structured interviews were then carried out with six participants, including members with experience using the platform and the group representative, followed by qualitative content analysis.

The findings show that the citizen science platform functioned as a socio-technical infrastructure that organized the repeated practices of observing, recording, identifying, and sharing, thereby transforming individual ecological experiences into accumulable data. In this case, data bias appeared not simply as an error but as a process through which species preferences, identifiability, educational utility, app proficiency, and interface design combined to structure priorities regarding what was considered worth recording. The accumulated data showed early signs of being used as a public resource at the community level through education, outreach, and archiving. However, its connection to institutionalized urban ecological governance remained limited because verification procedures, administrative feedback, and policy linkage structures were insufficient. This study interprets citizen science platforms as socio-technical devices that organize urban ecological participation and mediate the public utilization of platform-based citizen science data. It also highlights the need for institutional mechanisms, including verification, feedback, and utilization procedures, to connect citizen science data to policy and practice.

Keywords: citizen science platform; urban ecological governance; ecological monitoring; data-driven collaborative governance; data bias

1. Introduction

The recent proliferation of digital platforms is transforming the ways in which urban space and governance operate (Sadowski, 2020). Platforms function not merely as technical tools but as social infrastructures that organize participation, turn data into knowledge, and feed such knowledge back into policy and governance. In doing so, they reconfigure value creation and power relations within cities (Gillespie, 2010; Caprotti et al., 2022; Krisch, 2022; Robinson and Johnson, 2023). Against this backdrop, critical and theoretical debates on the roles and impacts of platforms in urban planning and the public sphere have become increasingly active (Gong, 2022; Kang, 2023).

This process of platformization is also evident in the field of citizen science. Citizen science has developed as a form of voluntary citizen participation in data collection and monitoring, through which data produced by citizens can be used in academia or policy after scientific validation (Park, J. H., 2018).

More recently, with the emergence of platforms such as NATURING, eBird, and iNaturalist, the production and sharing of knowledge about nature are being reorganized within digital environments. This shift raises the need to understand citizen science not simply as a participatory survey activity but as a socio-technical practice in which observational experiences are structured as data through platforms and shared with other participants.

NATURING, one of the representative citizen science platforms in Korea, is an online nature-activity sharing platform that has been operated since its incorporation in 2014 (Park, Y. B., 2018). It is designed so that citizens can record organisms observed with smartphones together with photographs, location, and time information; supplement species identification through interactions with other users when the name is unknown; and participate in "missions" centered on specific themes or places (Kim, 2018; Ko et al., 2019). NATURING is not the only citizen science platform in Korea, but it provides an important context for this study because it is both a large-scale platform, with approximately 60,000 members and more than 2.2 million accumulated observation records as of 2024 (Yun, 2025), and a representative platform that combines biodiversity observation with place-based ecological monitoring.

The characteristics of NATURING become clearer when compared with overseas citizen science platforms. Whereas eBird, which specializes in birdwatching, accumulates birdwatchers' checklists into a global bird observation database and manages data quality through a system of local expert reviewers (Sullivan et al., 2009), NATURING is more similar to iNaturalist in that it accumulates photo-based observation records of diverse taxa, including plants, animals, and fungi, without being limited to a single taxonomic group (Di Cecco et al., 2021). However, while iNaturalist is strongly connected to international biodiversity databases through identification by a global user community and links to the Global Biodiversity Information Facility (GBIF), NATURING is used in connection with neighborhood-based citizen science missions in Korea, including ecological education by domestic public agencies and local organizations, monitoring of climate-change indicator species, biodiversity surveys, and wild-bird collision surveys. In this sense, NATURING reveals the Korean context of citizen science practice. Accordingly, this study understands NATURING not merely as a recording app but as a socio-technical mediator that turns citizens' field observations into data and connects those data to community activities.

The significance of citizen science platforms, however, does not lie solely in the fact that large numbers of observation records are accumulated. The more important issue is how citizen science data produced through platforms are shared and used in local communities, and further, how they can be connected to the institutional circuits of urban environmental management and ecological governance. In this study, urban ecological governance is understood as a participatory coordination process in which citizens, experts, administrative actors, and local communities produce, share, and review urban ecological information and connect it to decision-making and field practices in urban planning and environmental management (Li et al., 2017). From this perspective, citizen science platforms should be understood not as devices that automatically create urban ecological governance, but as socio-technical mediators that transform citizens' observation experiences into data and make it possible to share those data with local communities, experts, and administrative actors.

Existing studies on citizen science have tended to focus on participants' motivations and data quality in offline ecological monitoring activities (Geldmann et al., 2016; Kosmala et al., 2016; Phillips et al., 2019; Day et al., 2022). However, empirical understanding remains limited regarding changes in the mode of data production mediated by digital platforms, the influence of platform functions on observation behavior and interaction, and the processes through which platform-based citizen science data are used as public resources in local communities or linked to administrative and policy processes. Korean studies have also presented types of citizen science and their policy potential (Ko et al., 2019; Ko and Ye, 2020), but they have not sufficiently explained how platforms organize place-based ecological monitoring practices or how they mediate the public utilization and institutional connection of citizen science data. This gap creates an important limitation in understanding the mechanisms through which citizen-participatory environmental data become connected to actual governance and policy processes.

This study aims to analyze ecological monitoring practices and interaction processes mediated by a citizen science platform, focusing on the Uiwang Community Ecology Research Group's use of NATURING. It also explores the conditions and limitations required for platform-based citizen science data to be used as public resources in local communities and connected to urban ecological governance. To this end, the

following research questions were established. First, how do citizen science participants produce ecological data? Second, how do citizen science participants use citizen science platforms, and how do interactions within the platform change their observation behavior and perceptions? Third, what patterns of public utilization do platform-based citizen science data show in the local community, and what conditions and limitations do they reveal for connecting to institutionalized urban ecological governance?

By analyzing the potential and limitations of the public utilization of data produced through citizen science platforms, this study is expected to provide practical implications for actors seeking to build urban ecological governance, including local governments and community activists.

2. Theoretical Background

2.1 Literature Review

Early research in citizen science focused on verifying the accuracy and reliability of data produced by citizens. This approach was intended to secure the scientific rigor required for academic research or policy use (Guerrini et al., 2020). Subsequent studies have shown that participation in citizen science affects participants' learning, identity formation, perceptions of nature, and willingness to continue participating (Phillips et al., 2019; Day et al., 2022). This stream of research has encouraged an understanding of citizen science not simply as a method of data collection but as a social process through which participants' knowledge, attitudes, and practices change.

More recently, discussions have emerged that understand citizen science as a governance process beyond data production. Göbel et al. (2019) interpreted citizen science as a site of socio-technical governance that contributes to the management of local environmental issues through participatory networks and technical infrastructures, even without formal policy or political actors. In the field of water resources management, citizen science has also been shown to be closely linked to polycentric governance, which entails distributed knowledge production and decision-making authority, by forming decentralized data-production and monitoring systems involving diverse actors (Buytaert et al., 2016). These discussions suggest that citizen science data are not merely supplementary data provided to scientists but can reconfigure relationships among actors in the process of defining and responding to local environmental problems.

In this regard, ecological governance understands environmental problems not simply as objects of government regulation or management, but as a process of coordinating social-ecological systems in which diverse social actors and ecological elements interact (Robertson and Choi, 2010; Wu et al., 2026). Urban ecological governance focuses on how ecological governance operates in the spatial context of the city. It can be understood as an integrated process in which urbanization, urban ecosystems, urban planning, policy implementation, and cooperative structures among actors are combined (Li et al., 2017). The core of urban ecological governance, therefore, does not lie in the production of ecological information itself, but in whether an institutional circuit is formed in which the ecological information produced is reviewed in urban planning and environmental management, shared between administrative actors and local communities, and fed back into field observation and practice.

Within such circuits, citizen science participants can move beyond the role of simple data providers. They can produce local ecological information, raise issues, and at times function as boundary spanners who connect administrative actors and local communities. Boundary spanners do not refer to a specific occupation or fixed institutional status. Rather, they are actors who connect science and decision-making and translate knowledge into action. They connect data producers and data users, mediate interests, and facilitate mutual understanding by presenting various alternatives rather than imposing a particular position (Safford et al., 2017; Goodrich et al., 2020). Recent studies of place-based citizen science show that participants can produce knowledge and education based on place-based experience and mediate communication between administrative actors and local communities (O'Connor et al., 2025). Studies have also emphasized that local knowledge, trust from residents, face-to-face relationships, and long-term participation are important for becoming successful boundary spanners in ecological governance at the local level (Stephens et al., 2024).

At the same time, the proliferation of digital platforms is changing the ways in which citizen science is conducted and the structures through which participants interact. Existing platform studies have examined how platforms reshape urban space and social relations (Gong, 2022; Hong and Baek, 2022; Kang, 2023), revealing mechanisms through which data and algorithms mediate the reconfiguration of urban economic and social structures (Barns, 2020; Krisch, 2022; Robinson and Johnson, 2023). However, these discussions have largely focused on private-company-based platforms and have not sufficiently addressed the social relations and governance effects created by citizen science platforms grounded in publicness and voluntariness. Meanwhile, studies of platform-based citizen science have analyzed participants' motivations and learning effects (Curtis, 2015), as well as the effects of gamification elements within platforms in encouraging sustained participation (Fu et al., 2025). Nevertheless, few studies have analyzed citizen science platforms as socio-technical mediators that go beyond tools for recording, sharing, and verifying observational data, and that structure what participants judge to be worth recording, how they interact with others, and how accumulated data are understood as shared resources. In particular, empirical research remains insufficient on the processes through which interactions within platforms are combined with offline community activities and extended into local governance.

Previous studies on citizen science in Korea show that citizen science has developed across various domains, including ecological and environmental monitoring, the resolution of everyday environmental problems, climate-change adaptation, and disaster safety. Park (J. H., 2018) classified Korean citizen science cases into scientist-led contributory, collaborative, community-led, and public-agency-led types, and presented the Suwon tree frog survey group, the Earth-Loving Exploration Team, the Baek In-cheon project, the Saemangeum Citizens' Ecological Survey Group, citizen monitoring of marine protected areas, K-BON, and the Seoul Swallow SOS project as major cases. These studies show that in Korea, citizens record species distributions, climate-change indicator species, and local ecosystem changes, and that some data can be used for academic research or conservation activities. At the same time, limitations have been noted: citizen science in Korea remains concentrated on ecological and environmental monitoring, and participation often remains at the level of data collection or educational activity (Kim, 2018; Park, J. H., 2018). Nature survey activities led by civic organizations have been accumulated over a long period, but there have been limitations in connecting them to scientific research or environmental policy due to insufficient expert collaboration, data verification, open-data systems, and policy-use pathways (Park, J. H., 2018; Ko and Ye, 2020). Public-agency-led cases are meaningful in that they institutionalized citizen participation, but problems have also been identified, including participation centered on semi-experts or environmental activists and one-off survey activities (Ko et al., 2019).

Therefore, existing studies have contributed to explaining data quality, participation experiences, and policy potential in citizen science, but they have not sufficiently explained how digital platforms organize place-based ecological monitoring practices, or how citizen science data accumulated on platforms are used as public resources within local communities or connected to institutional decision-making. In particular, Korean studies lack empirical analyses of how platforms such as NATURING mediate citizens' observation, identification, sharing, and learning, and what verification, feedback, and utilization procedures are required for platform-based data to function as reference resources for urban ecological governance. Addressing this gap, this study conceptualizes citizen science platforms as socio-technical infrastructures and analyzes platform-mediated practices and the conditions for connection to urban ecological governance through the case of the Uiwang Community Ecology Research Group's use of NATURING.

2.2 Conceptual Framework

This study understands citizen science platforms not simply as tools for data collection but as socio-technical mediators that structure citizens' ecological observation experiences as data and connect those data to social interaction and public utilization at the community level. From this perspective, the conceptual framework of this study consists of three analytical dimensions: (1) citizen science practice, (2) platform mediation, and (3) public utilization and conditions for connection to urban ecological governance.

First, the dimension of citizen science practice consists of the data production process of observation, recording, identification, and sharing. Citizen science participants observe nature in the field, record it

through photographs and notes, and generate data through species identification and supplementation of information. In this process, recording operates not merely as an output but as both a purpose of activity and a practice that encourages sustained participation. The accumulation of data transforms one-off activities into long-term monitoring. However, data may become biased toward particular species or places due to citizens' preferences, the observability of targets, and preferred species (Dickinson et al., 2010; Gonsamo and D'Odorico, 2014; Geldmann et al., 2016; Millar et al., 2019).

Second, the dimension of platform mediation reorganizes citizen science practice through data structuring, interaction, and participation-inducing functions. Platforms convert observational experiences into standardized data formats, attach metadata, and increase the potential usability of data. They also facilitate interaction and learning among participants through functions such as "please identify this," comments, and "likes." In addition, devices such as rankings, challenges, and individual cumulative performance indicators strengthen the continuity of participation (Greenhill et al., 2016; Spitz et al., 2018; Sajan and Sapkota, 2025). These processes function as mechanisms that transform citizen science activities from personal hobbies into forms of participation that enable social learning and verification (Phillips et al., 2019; Day et al., 2022). At the same time, platform interfaces and rules set the direction of data production and structure recordability (Robinson and Johnson, 2023; Arazy et al., 2024).

Third, the dimension of public utilization and conditions for connection to urban ecological governance focuses on how citizen science data accumulated through platforms can be used as public resources at the community level beyond personal records. Such data are used in education, outreach, and local events, and can function as mediators of evidence-based communication in cooperation with local governments (Ko and Ye, 2020). Citizen science participants can be positioned as potential boundary spanners who raise local issues based on accumulated data and connect experts, administrative actors, and local communities (McGreavy et al., 2016). However, for citizen science data to be used in policy processes, data reliability, institutional utilization procedures, and administrative feedback systems are necessary (Bonney et al., 2014). When such foundations are lacking, public utilization may remain limited, and especially the connection to formal urban ecological governance may remain weak.

Accordingly, the conceptual framework of this study structures three research questions centered on the citizen science platform. First, it analyzes through what practical processes citizen science participants produce field observations as ecological data. Second, it examines how the data-structuring, interaction, and participation-inducing functions of the platform are combined with offline community activities to mediate participants' observation behavior and ecological perceptions. Third, it examines what conditions and limitations are revealed when accumulated platform-based citizen science data are used for community-level public purposes such as education, outreach, and archiving, and how they may be connected to institutionalized urban ecological governance. In particular, this study does not assume that citizen science data are immediately reflected in formal decision-making. Rather, it analyzes the conditional relationship in which citizen science data can function as reference resources for urban ecological governance when data-verification systems, administrative feedback channels, and policy-utilization procedures are in place.

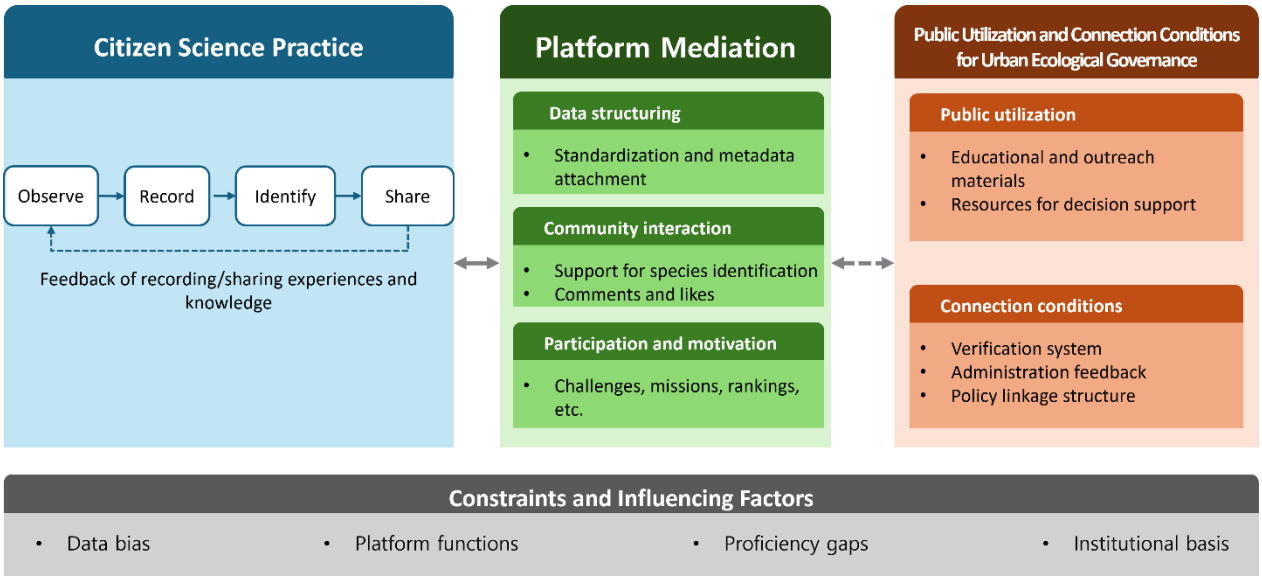

Figure 1. Conceptual framework. Source: Authors.

3. Methodology

This study adopted a case-study approach in order to understand in depth the processes of data production, interaction among members, and governance connection mediated by a citizen science platform. By using participant observation, which has been insufficiently employed in prior studies of Korean citizen science platforms, this study sought to analyze the embedded practices and meanings of platform-based citizen science activities that are difficult to identify over a short period.

The case selected for this study is the Uiwang Community Ecology Research Group, which operates in Uiwang City, Gyeonggi Province. The Uiwang Community Ecology Research Group is a place-based private organization that records the villages and ecology of Uiwang City and shares them with citizens (Uiwang Community Ecology Research Group, n.d.). This organization was selected as a case for the following reasons. First, the Uiwang Community Ecology Research Group is an ecological monitoring organization that has worked for a long period in Uiwang City and has operated various local programs and publicly funded projects, such as Uiwang Village Park Exploration, interpretation at the Uiwang Bird Ecology Science Museum, and village-park forest play. Second, because the organization has formed cooperative relationships with local governance organizations such as the Uiwang Council for Sustainable Development and the Uiwang Volunteer Center, it is suitable for analyzing the relationships in which citizen science activities are conducted with administrative actors and intermediary support organizations. Third, the organization's ecological monitoring activities take place not in protected areas but in everyday urban spaces such as streams, walking trails, and parks near residential areas. It is therefore suitable for analyzing how citizens' ecological perceptions and observation practices are formed within the urban environment. At the same time, the Uiwang Community Ecology Research Group is closely connected to ecological education, and approximately 70 percent of its members were working as ecological education instructors. Accordingly, this case should be understood not as a form of platform-based citizen science in which ordinary citizens participate loosely, but as a case in which local residents with experience in ecological education use NATURING for ecological monitoring.

Data were collected through participant observation and in-depth interviews. Participant observation was conducted by taking part in the regular ecological monitoring activities of the Uiwang Community Ecology Research Group. The researcher joined the group as a member and participated in activities twice a month for approximately six months, from August 2025 to January 2026. During this period, the researcher observed and recorded the observation process, data recording and platform uploading, and interaction and feedback among participants. In addition to regular monitoring activities, the researcher attended workshops and meetings, participated in the group's citizen science platform missions, and interacted with members both online and offline from the position of a participant.

The in-depth interviews were conducted in a semi-structured format. The questions presented in Table 1 served as the basis, but they were adjusted flexibly depending on the participants' responses. Semi-structured interviews are considered an appropriate method for exploring participants' experiences and perceptions in depth (Seo, 2023). The in-depth interviewees summarized in Table 2 consisted of members of the Uiwang Community Ecology Research Group who had used a citizen science platform, namely NATURING, for at least six months, as well as the group representative.

Data analysis was conducted based on qualitative content analysis. Participant observation notes and interview data were transcribed using Naver Clova Note and then reviewed repeatedly. The transcribed texts were open-coded in ATLAS.ti to derive units of meaning, and similar codes were grouped into categories. Axial coding was then used to derive relationships among categories, and major themes explaining the use of the citizen science platform and the interactions around it were identified. This analytical process was conducted inductively, centered on the meanings that emerged from the data. To enhance the credibility of the analysis, the first author prepared and coded the participant observation notes and interview data in the first round. The co-author then reviewed them, and disagreements were discussed and adjusted.

Because the first author joined the organization as a member and conducted participant observation, she was not a complete external observer but occupied the position of a participant-observer. This positionality contributed to an in-depth understanding of the contexts and interactions of platform-based citizen science activities, but it also involved the limitation that the analysis could become close to an insider perspective. To compensate for this, the participant observation notes and interview data were repeatedly cross-checked, and the co-author, who had not conducted participant observation, participated in the interpretation of the data. Meanwhile, because the Uiwang Community Ecology Research Group is already a publicly active local organization and because identifying the case was judged necessary to explain the platform-use practices and local activity context, the name of the organization is disclosed in the title and the body of this study. However, individual participants could be identifiable within the organization, so their names and detailed personal information were anonymized, and interview quotations were limited to the extent necessary for explanation in the text. Before conducting participant observation, the research purpose and method of data use were explained to the group representative, and cooperation was requested. Before each interview, the research purpose, whether the interview would be recorded and transcribed, the method of data storage, and the anonymization policy were explained, and individual consent was obtained.

Table 1. In-depth interview questions

Category	In-depth interview questions for members
Starting point and background	When and through what occasion did you start using a citizen science platform? How did you come to know the platform, and what was your purpose in using it?
Mode of activity and user experience	Which citizen science platform do you mainly use? How often and in what ways do you use it?
Changes in perception and behavior	Have your observation habits or perceptions and attitudes toward nature changed while using the platform? Has it affected outdoor activities such as walking or photography? Please describe specific experiences or examples.
Platform interface	What do you think about functions provided by the platform, such as challenges, rankings, and comments? How do these elements affect ecological observation activities?

Category	In-depth interview questions for members
Perception of contribution	What meaning do you think the data you recorded have in terms of scientific research or social contribution? Have you experienced your data being used in academic or local-government research?
Perception of governance	Have the data you recorded been used in group activities, education, local events, or administrative consultations? Have you received feedback from local governments, experts, or platform users regarding the accuracy of records or location information?

Category	In-depth interview questions for the representative
Background of group establishment	What was the background behind establishing the Uiwang Community Ecology Research Group?
Group activities	What kinds of ecological monitoring activities does the Uiwang Community Ecology Research Group currently conduct?
Citizen science platform	What led the group to use a citizen science platform for the first time? How did platform-based records change the activities, including the mode of activity and changes among members?
Vision and mission	What direction does the Uiwang Community Ecology Research Group aim to pursue?
Perception of ecological conservation	How do you think ecological conservation should be approached? Are there differences from environmental movement organizations in the way the group works?
Perception of governance	Are there cases in which data accumulated on NATURING have actually been used by local governments, schools, local institutions, citizen education programs, or publicly funded projects? What conditions do you think are necessary for citizen science data to be used in policy or administration?

Table 2. List of interview participants

Name	Age	Gender	Period of activity	Residential area
A	50s	Female	5 years	Uiwang City
B (rep.)	40s	Female	5-6 years	Uiwang City
C	60s	Female	5-6 years	Uiwang City
D	50s	Female	5-6 years	Uiwang City
E	40s	Female	3-4 years	Uiwang City
F	50s	Female	3 years	Uiwang City

Note: Before the interviews, the research purpose was explained and consent was obtained. Participants were anonymized to protect personal information. All interview data were recorded, transcribed, and stored.

4. Findings

4.1 A Data Production Loop Formed Through the Repetition of Observation, Recording, Identification, and Sharing

The conceptual framework of this study conceptualizes citizen science practice as a data production loop consisting of observation, recording, identification, and sharing.[1] The analysis shows that the citizen science activities of the Uiwang Community Ecology Research Group were indeed organized as practices with this loop structure. Participants repeatedly observed organisms in the field, recorded them with photographs and notes, identified the species, and uploaded the results to the platform. These practices operated as a core mechanism through which personal experiences were transformed into accumulable data. In particular, "recording" functioned not simply as an output but as a cognitive device that deepened observation. Participant B stated that "when you take a photograph of something you might otherwise just pass by, and then try to record it, you end up looking up what it is." This indicates that the act of recording becomes an occasion for further inquiry and learning.

> As we keep recording like this, the first thing, actually, is that members start looking more closely. You might just pass by something, but if you take a picture of it, you become really curious about it that day. (…) If you want to record what it is, you have to look it up. (Interview participant B)

> I think I came to know things more deeply [than before I started recording]. About a plant, about a tree… Before, if a bird passed by, I would just think, "a bird is passing by." But now I think once more, "What bird is that?" Things like that. (Interview participant A)

In practice, members of the Uiwang Community Ecology Research Group generally had nature-friendly hobbies even before joining the organization, but their repeated observation and recording began with their use of the citizen science platform. They stated that before learning about the citizen science platform, they did not keep records in any particular way, or they kept only personal records on blogs. One member said, "When NATURING first appeared, people who had been observing plants separately, one by one, finally had a place where they could all gather, and that was good. On NATURING, it feels like skilled players are always standing by" (participant observation note, August 4, 2025). In this way, the citizen science platform provided a community where more people could gather and share information, and it functioned as a tool that enabled people to steadily accumulate records.

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[1] In this study, the term "loop" refers not simply to repetition, but to a cyclical process that includes a feedback structure in which experiences and knowledge accumulated through recording and sharing again influence subsequent modes of observation and objects of attention.

Data production was also carried out not at the individual level alone but within a collective practice structure. Through regular monitoring activities, participants moved together, observed together, and then repeatedly shared and uploaded the results in an indoor space afterward. In this process, species identification relied not only on individual knowledge but also on peer interaction and external searches. This shows that data production was organized as a collaborative learning process rather than as an individual act.

This repetitive data production loop also induced changes in participants' perceptions and behaviors. Participants came to pay closer attention to species characteristics and ecological contexts beyond simple observation. Through the continuous accumulation of records, they recognized their own growth and strengthened their intrinsic motivation for the activity. In fact, participant A said, "It is not just the records; I myself have changed. (…) There is also pride in having grown on my own." This shows that data accumulation is connected to changes in individual perception.

At the same time, this data production was not a completely neutral process but included certain forms of selectivity and bias. Participant observation showed that although members did not generally display strong likes or dislikes toward species overall, individual preferences and familiarity influenced the selection of observation targets. For example, participant A said that she did not particularly like insects, including larvae, while participant E stated that she liked trees more and observed birds less because she did not know birds well and found them difficult to identify.

Furthermore, in the process of uploading ecological monitoring data to NATURING, members of the Uiwang Community Ecology Research Group tended to upload many repeated records of plants with distinctive names or clear features, such as *Persicaria perfoliata* and kudzu. Given NATURING's emphasis on the accuracy of identification, among the many plants and animals observed on a given day, those with names or external features that were relatively easy to identify were uploaded more frequently (participant observation note, January 5, 2026). Participant observation also confirmed that some members showed relatively less preference for plantation trees or very common ornamental plants, such as royal azalea, as targets of observation and recording (participant observation note, September 1, 2025).

In addition, interactions with other users within the citizen science platform and experiences related to ecological education influenced the selection of observation and recording targets. For example, approximately 70 percent of members of the Uiwang Community Ecology Research Group were working as ecological education instructors. The fact that mushrooms are used less often in educational settings due to the dangers of poisonous mushrooms was reflected in monitoring activities as well. As a result, members showed less interest in mushrooms compared with other taxa, and conversations related to mushrooms were relatively infrequent. One member had experienced uploading a mushroom identification result to NATURING and receiving negative feedback from other users because of misidentification. This experience led her to perceive mushrooms as "difficult" and as something one should not upload carelessly. During an actual monitoring activity, when asked to identify a particular mushroom, she replied, "Mushrooms are difficult, so I don't really upload them to NATURING" (participant observation note, September 8, 2025).

Differences in proficiency in using the NATURING app and the interface of the app itself also partly affected the accuracy of data production. Members did not show a strong tendency to prefer particular places (interview participants A, D, E, and F). However, due to characteristics of the NATURING interface, there were cases in which the uploaded observation location differed somewhat from the actual location. If GPS is turned on in the photo settings before using NATURING, the location is automatically saved. If it has not been set in advance, however, the user must manually enter a search term on the map to designate the location. When locations were entered manually in this way, the data were uploaded only at the administrative-dong level rather than with precise GPS coordinates, thereby reducing the spatial resolution of the data (participant observation notes, August 4, 2025; August 18, 2025).

In sum, citizen science practice appeared not as a simple observation activity but as a process of transforming personal experiences into accumulable data through a repetitive and socially organized data production loop. These findings suggest that the citizen science platform functions as an important mediator that organizes and stabilizes this data production loop in a sustained and accumulable form.

4.2 Platform Mediation Supporting Data Structuring and Mutual Learning

The citizen science platform functioned not merely as a tool for storing data but as a mediator that reorganized the data production process itself. The analysis shows that platform mediation transformed citizen science practice largely through data structuring, interaction-based learning, and mechanisms that encouraged participation.

First, the citizen science platform structured observational experiences as standardized data. When participants uploaded photographs, the platform's functions automatically displayed observation location, time, weather, and elevation. In addition to photographs, users could also upload sound, video, and notes on the observation. Interview participant A especially emphasized the platform's datafication function, explaining that "once you take a photo, the location and time are all shown, so you just need to know the name." However, this automation was not complete. Technical constraints remained, such as the need to enter location information manually when using a DSLR camera.

Second, the platform formed a structure in which learning and verification occurred through interaction. Functions such as "please identify this," comments, and viewing other users' records provided an environment in which participants could share their observation results with others and exchange feedback. In the process of species identification, participants received help from other users, including both members of the Uiwang Community Ecology Research Group and other NATURING users, or corrected their own errors by comparing various observation cases. Participant A explained this interaction-based learning structure by saying, "Even if you don't know the name, if you upload it, someone will teach you." The platform's "mission" function also connected diverse observational data around specific themes or places, encouraging participants to access ecological information beyond the group's internal activities. In this process, observation targets and areas of interest tended to expand beyond personal experience through information flows within the platform. Participants E and F stated that they were able to check how species they had observed appeared in other seasons or places, read diverse opinions on identification, and correct knowledge they had previously misunderstood. Participant B also described becoming interested in birds in the Ganghwa tidal flat area, outside Uiwang City, while participating in various NATURING missions.

> The NATURING app is really convenient. First of all, when you take a picture, the location and time all appear. I only need to know the name. But if I don't know the name, I can just upload it without knowing, and someone will tell me. (Interview participant A)

Third, the platform functioned as a motivational device that adjusted the continuity and behavior of participation. Functions such as "likes" or hearts, comments, counts of individual observations and species, rankings, and challenges[2] provided participants with social feedback and experiences of achievement. Some participants responded that these elements gave them a sense of competition or enjoyment and helped them continue observation activities. For example, in written responses before the interview, participant A stated that "challenges and rankings create a little bit of competitiveness, and this actually helps me continue observation activities in an enjoyable way." At the same time, this motivation was strengthened in combination with the offline community. Encouragement to upload and sharing of activities within the Uiwang Community Ecology Research Group served as important factors that promoted platform participation. This shows that the platform's gamification elements do not operate on their own but become effective within a social context combined with the offline community.

Meanwhile, the citizen science platform also partially influenced the direction of data production. Interface features that indicate endangered species or indicator species strengthened awareness of protected species and reorganized priorities in recording. In addition, the function for hiding locations enabled recording practices that considered the protection of endangered species. Participant B stated that when uploading observation records of endangered species, she actively used the location-hiding function because she was concerned that visitors might concentrate in that place if the record were made public.

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[2] A function that assigns tasks on a specific theme for a given period.

This suggests that data production can be practiced not simply as recording but in combination with ethical judgment.

Overall, the citizen science platform operated as a socio-technical infrastructure that reorganized citizen science practice by shaping and mediating the form of data, modes of interaction, and motivations for participation, rather than simply as a technical tool that supports data production. This means that the data production loop identified in the previous section was transformed through the platform into an interactive and expanded system of data production.

4.3 The Public-Resource Formation of Platform Data and the Bottleneck of Institutional Connection

The analysis showed early signs that data produced through the citizen science platform were expanding beyond personal records into public resources used within the local community. However, these practices were occurring in a state disconnected from institutional verification and policy linkage structures. At the same time, at the level of some actors, an orientation toward data-driven collaborative governance was identified. Therefore, this section does not assume that platform data were immediately institutionalized as urban ecological governance. Instead, it analyzes three aspects separately: first, how the data were used as public resources within the local community; second, the bottlenecks that prevented connection to administrative and policy systems; and third, the conditions necessary for future expansion into institutional use.

4.3.1 Citizen Science Data Converted into Education, Outreach, and Archives

Citizen science data accumulated through the platform were found to be converted into public resources used in the local community beyond individual observation records. This conversion appeared in concrete practices such as education, outreach, and group operation within the local community context, before institutional policy use. Here, public-resource formation does not mean that an administrative agency officially adopted the data or reflected them in policy decisions. Rather, it refers to the process through which observation information scattered across individuals' smartphones or private records becomes accumulated, searchable, and shareable through the platform, and is then reused as supporting material for community education, outreach, and group activities.

First, the data were directly used as educational materials in place-based ecological education and citizen programs. Participants used photographs and records accumulated on the platform to conduct ecological education for children or to explain seasonal changes and characteristics of particular species. This shows that citizen science data functioned as resources that mediate knowledge transmission and learning within the local community beyond simple records. In this case, the use of data as educational materials was not an incidental side effect. Rather, it emerged in combination with the organizational characteristic that a large share of the group's members were connected to ecological education activities. Through NATURING records, participants did not merely store the fact that a particular organism had been present in a particular place. They selectively accumulated photographs useful for later explanation in educational settings, records that clearly showed seasonal changes, and biological information that was easy to show to children and citizens. In this respect, platform data were reorganized not simply as biological occurrence records but as visual and explanatory resources for local ecological education.

The accumulated data also contributed to raising citizen awareness by being used in the production of plant information boards in local parks or reorganized as visual content for local festivals and events. For example, photographs accumulated on NATURING and data on the locations where plants were found were used to produce information boards about plants in Wangsong Lake Park. As another example, Wangsong Lake ecological monitoring data were displayed in the form of annual observation results or reorganized into quiz and educational content. In this process, platform data were converted into photographs, species lists, seasonal observation results, and quiz content that local residents could easily understand. In other words, the public-resource formation of citizen science data first appeared as the creation of community communication materials before becoming policy materials.

Furthermore, the citizen science platform functioned as an archive that supported the continuity and legitimacy of the group's activities. The Uiwang Community Ecology Research Group holds an annual presentation based on data accumulated on the citizen science platform and accumulates these data as internal learning materials. This archiving process facilitated the accumulation of the group's ecological knowledge and collective learning among members.

In addition, the data accumulated on the citizen science platform were used as evidence to explain and promote the group's activities externally. The continuous accumulation of records functioned as proof that the group was actually conducting local ecological monitoring, and it provided a basis for building trust in relationships with the local community and related institutions. According to participant B, for instance, awareness of citizen science within the local government, namely city hall, was insufficient in the early stages, but the data accumulated on NATURING helped responsible officials recognize the value of citizen science activities. These findings suggest that even when citizen science data are not directly used in institutional policy, an early stage is forming in which they are converted into public resources at the community level. Although the data were shared and used within the local community, no procedure was identified through which they were regularly adopted as materials for administrative decision-making, such as official ecological maps, urban planning data, environmental impact reviews, or park and river management plans. Therefore, the public-resource formation identified in this case should be interpreted not as "institutionalized public data" but as an early stage in which citizen-produced ecological information accumulated by a local organization acquires public meaning through education and outreach.

4.3.2 The Absence of Administrative Feedback and Verification Systems

However, this public-resource formation had not been sufficiently extended into connection with institutional governance. The analysis found that no structure had been formed through which citizen science data were systematically integrated into administrative or policy processes. First, systems for data verification and administrative feedback were highly insufficient. For example, participant A mentioned an experience of communication with the local government, saying that after receiving a request from an Uiwang City Hall official to confirm the observation location, she became more attentive to data accuracy than before. However, this remained a one-off interaction and did not lead to a regular and institutionalized feedback system. This case shows the possibility that feedback can serve as an opportunity to improve the quality of data production, while also indicating that such a structure is not currently formed in a stable way.

The important point in this case is that the absence of administrative feedback is not simply a matter of the administration showing no interest. Rather, there is no institutional circuit specifying through what procedures citizen science data should be reviewed, who should verify them, and how the review results should be communicated back to participants. When citizens entered an observation location or species name incorrectly, guidance for correcting it was limited. Even when a local government referred to a specific record, there was no system to inform participants how that record had been used. As a result, participants found it difficult to confirm what meaning their records had for local environmental management or policy judgment. Local governments, in turn, found it difficult to use citizen science data as reliable policy materials.

Participants also tended not to clearly recognize whether or through what pathways the data they produced were used in policy. Interview participants A through F all vaguely recognized that the data could be used for academic research or policy, but they either did not know actual cases or concrete mechanisms of use, or they did not pay much attention to them.

In particular, perceptions of the scientific contribution of the data were also limited. For example, participant A evaluated the data she had collected by saying, "In a sense, it is not yet at the level of publishing a detailed paper or anything like that." In this way, participants regarded their activities as highly meaningful at educational and personal levels, but they did not perceive them as directly contributing to academic research or policy decisions.

These results show that although citizen science data have potential as public resources, the verification systems, utilization procedures, and administrative feedback structures that connect them to institutional

decision-making have not been sufficiently established. In other words, the third stage of the framework has been partially formed, but it has not reached the level of institutional integration.

This does not mean that citizen science data have low value. Rather, it means that the value of the data has not been clearly translated either to participants or to administrative actors. NATURING records include basic elements that could be used as policy materials, such as photographs, location, time, and species names. However, for policy use, additional information is needed, including verification grades, location accuracy, standards for protecting sensitive species, standardization of survey methods, whether observations are repeated, and whether experts have confirmed the records. In this case, such information was not systematically classified and reviewed, which limited the conversion of accumulated data into reference materials for administrative judgment.

When compared with other cases of NATURING use, this limitation can be understood not as a limitation of the NATURING platform itself but as a matter of the conditions under which platform data are converted into institutional use. For example, the National Institute of Biological Resources introduced the Korean Biodiversity Observation Network (K-BON) in 2012 and expanded citizen participation by changing it into a NATURING-based project in 2015. Led by a public institution, this project established expert networks, provided standardized training related to data collection, and produced academic achievements such as research on predicting areas vulnerable to biodiversity changes caused by climate change (Park, J. H., 2018). However, because the project centered on environmental organizations and experts, it had limitations in sustaining the participation of ordinary citizens (Ko and Ye, 2020). In another case, citizens continuously recorded wild-bird collision cases through a mission on bird-window collisions created by the National Institute of Ecology. As these records attracted social attention, the law was amended to require the installation of bird-collision prevention stickers on public buildings and sound barriers (Lee, 2025). Whereas the preceding cases were planned and led by public institutions, in the case of bird monitoring at the Gongneungcheon Estuary, teenage birdwatchers voluntarily accumulated bird habitat information on NATURING that had not been sufficiently reflected in an environmental impact assessment during a local development project, and they raised it as a local environmental issue (Yoo, 2022). Thus, in public-institution projects, detailed design is needed to substantively increase citizen participation, including outreach, app improvements, survey preparation activities, and financial support. Evaluation systems and institutional foundations are also needed to enable scientists to participate in citizen science (Park, J. H., 2018). In addition, open-data policies and data standardization guidelines are needed so that biodiversity data accumulated by civic organizations can be used in environmental policy and related domains (Park, J. H., 2018).

4.3.3 Possibilities and Limitations as Boundary Spanners

As discussed in the previous section, this case did not reveal any instances in which citizen science data were connected to formal administrative procedures or policy decisions. Nevertheless, the statements of group representative B showed a relatively clear awareness of the need to cooperate with administrative actors based on citizen science data. Therefore, the possibility of boundary spanning discussed in this section should be understood not as a practice generalized across the entire group but as a limited and early-stage orientation identified mainly around representative B.

Participant B recognized the need for a citizen science organization to function not as an actor that engages in one-sided opposition or struggle over environmental issues, but as a “mediator” or “partner” that communicates with administrative actors based on data. This is connected to an understanding that accumulated data are not merely records but can be used as a basis for discussion in conflicts between development and conservation. In fact, regarding local development issues, the representative believed that explanation and communication based on data, rather than emotional responses, were necessary.

> I think we need to be somewhat of a partner with the city administration. I think we should become a partner, not people who fight. The reason is that it would be good to become people who can talk and change things together. (…) A mediating role? We continue to record steadily and help citizens recognize that this is such a good place. (…) (Interview participant B)

An awareness was also identified that data accumulated over the long term could be used as evidence in policy processes. For example, in development conflicts concerning the presence of particular species, the

expectation was raised that continuously accumulated citizen science data could be used as materials to demonstrate the ecological characteristics of the area. This shows a potential pathway through which citizen science data can intervene in institutional decision-making through temporal accumulation.

> When protected species are discovered, there need to be things that can stop development and so on there. (…) What we have to do is leave records of those things, accumulate data, and make it possible for anyone who looks at them to know that these things actually existed here. I think that is our role. (…) (Interview participant B)

These statements show that at least representative B understood citizen science activities as a kind of boundary-spanning activity that helps communication between the local community and administrative actors. Here, boundary spanners do not refer to administrative actors with legal authority, but to actors who mediate communication among civil society, experts, and administrative actors based on field-based place knowledge and data accumulated on the platform. In this sense, the roles of "mediator" and "partner" described by B show the possibility that citizen science participants can function as boundary spanners. However, this was closer to the representative's self-understanding and future orientation than to a currently institutionalized role.

This orientation toward data-driven collaborative governance, however, mainly appeared at the level of the group representative and a small number of participants (participant observation notes, August 18, 2025; January 23, 2026), and it had not spread to the majority of participants. No case was identified in which this orientation had been concretized into an actual institutional cooperation structure. This shows that citizen science platforms do not automatically turn citizens into governance actors. Rather, their governance role can be strengthened only when data are connected to administrative and expert review systems, local agenda-setting processes, and formal participation procedures.

In sum, the data formed through the citizen science platform showed early signs of being used as public resources for education, outreach, and archiving at the community level. An awareness of the possibility of cooperation with administrative actors was also identified, especially around representative B. However, for these possibilities to expand into actual policy linkage and institutional governance, additional institutional foundations are required, such as data verification, utilization procedures, and administrative feedback systems. Therefore, this case should be interpreted not as a completed case of boundary spanner formation, but as a case showing what procedures and conditions are needed for platform-based citizen science data to move beyond public utilization within the local community and become reference materials for institutional decision-making.

5. Conclusion and Discussion

5.1 Discussion

This study explored how a citizen science platform organizes ecological monitoring practices and what possibilities and limitations citizen science data accumulated through the platform reveal in the process of public utilization at the community level and connection to urban ecological governance. The analysis showed that the citizen science platform functioned as a socio-technical infrastructure that organized the repetitive practices of observation, recording, identification, and sharing; transformed individual ecological experiences into accumulable data; and mediated interaction among users and community-level utilization. However, the governance connection identified in this case should be understood not as the completion of an institutionalized cooperative structure but as an early pattern in which citizen science data are used as public resources within the local community, as well as an indication of the conditions required for these data to be connected to urban ecological governance.

The discussion of this study can be summarized in three points. First, the citizen science platform functioned as a socio-technical infrastructure that went beyond a data collection tool by organizing the repeated practices of observation, recording, identification, and sharing, and by coordinating the norms and motivations of participation. This resonates with Cardullo and Kitchin's (2025) argument that platforms form different kinds of participation and governance depending on how they are configured and

operated, and it shows that citizen science platforms are also infrastructures that organize citizen-participatory ecological activities. This interpretation is connected to previous studies that view citizen science as a site where civic identity and participation are formed (Strasser et al., 2019; Vikström et al., 2025). At the same time, through a case of citizen science combined with a place-based offline organization, this study concretizes Baudry et al.'s (2022) discussion that the ways in which citizen science platforms turn crowds into knowledge-producing communities depend on interfaces and operational contexts.

However, the platform effects observed in this case cannot be explained solely by the functions of the digital platform NATURING. NATURING structured observation experiences as data and enabled interaction among users through functions such as photographs, location, time, species names, comments, "please identify this," missions, and rankings. Yet the actual continuity of participation and activation of uploading were strengthened when combined with encouragement from the group representative, learning among members, regular monitoring activities, and offline networks. Thus, this case shows that citizen science platforms do not create participation on their own. Rather, when they operate within the activity goals and relational networks of place-based communities, they stabilize and expand citizen science practices. This reconfirms Arazy et al.'s (2024) finding that platform effects are strengthened when combined with offline community contexts, and it suggests that platform-mediated effects and organizational effects need to be analytically distinguished.

Second, the data bias identified in this study should be understood not merely as a limitation of citizen science data, but as a process through which the platform and participants jointly structure what is worth recording. The fact that recording behavior was shaped by preferences for particular species, identifiability, convenience of photographing and uploading, proficiency in app functions, preferences for rarity, and learning needs is similar to the findings of Arazy et al. (2024). In this case, however, community-level environmental agendas did not organize the records. Instead, practical criteria such as educational utility, ease of identification, and the enjoyment of observation formed priorities. This suggests that in citizen science conducted in everyday urban spaces, data bias may be formed less by politicized agendas and more by the combination of observability and platform interface.

Nevertheless, these findings should be interpreted as a result combined with the case-specific characteristics of the Uiwang Community Ecology Research Group rather than as universal effects of citizen science platforms. The fact that approximately 70 percent of the group's members are ecological education instructors is not merely background information. It is an important condition that shaped the result itself, namely the way educational utility structured recording priorities. The fact that all six interview participants were women in their 40s to 60s living in Uiwang City also limits the scope of interpretation. They were participants who engaged in ecological activities centered on their local living sphere and were accustomed to using records in ecological education and community programs. If organizations including men, younger people, and members from more diverse places were examined, recording priorities might be structured by different criteria.

Third, data accumulated through the citizen science platform were being used at the community level as resources for education, outreach, and group legitimation, thereby entering an early stage of public-resource formation. However, they had not yet been sufficiently connected to institutionalized governance. This is consistent with Vikström et al.'s (2025) analysis that even when citizen science platforms facilitate interaction among users, they do not automatically create shared understandings. As previous studies have pointed out, several structural factors explain why citizen science is not easily connected to formal governance structures. These include limitations in institutional capacity, such as shortages of personnel, budgets, and expertise (O'Connor et al., 2025); low awareness among policymakers; the non-standardized status of citizen science; insufficient policy-citizen science linkage structures; lack of participant diversity (Hölscher et al., 2025); and insufficient recognition systems for scientists' citizen science activities (Von Gönner et al., 2023). Accordingly, the delay in institutionalization identified in this case can be interpreted not as a result of the low social value of citizen science data, but as a result of the insufficient institutional circuits needed to translate that value into administrative judgment and policy processes. According to previous research, translating citizen science data into policy and related domains requires participants' long-term commitment, the construction of maps, models, apps, and databases for effective communication, and the assignment of shared responsibility to diverse actors (Safford et al., 2017).

In this context, the data-based collaborative partnership proposed by the representative of the Uiwang Community Ecology Research Group suggests the possibility of the "boundary spanner" described by O'Connor et al. (2025). However, it is more appropriate to interpret the case in this study as an early sign rather than as a completed form. In the case examined here, functions of knowledge production and education were identified, but no case was found in which citizen science data performed an institutional role that substantively supported administrative monitoring, regulatory judgment, or permit review. Rather, the more important point is that such place-based citizen science platform activities can form situated expertise based on accumulated place-based experiences in a particular area and can become a foundation for future collaborative co-creation among policymakers, scientists, and citizens (O'Connor et al., 2025; Hölscher et al., 2025). Ultimately, the task of urban ecological governance is not limited to collecting more data through citizen science platforms. It lies in creating institutional mechanisms that connect already accumulated place-based data to circuits of verification, feedback, and co-design, thereby positioning citizen science participants not merely as data providers but as public partners capable of collaboration.

5.2 Conclusion

This study is significant in that it analyzed citizen science platforms not simply as data collection tools but as socio-technical devices that structure citizens' ecological observation experiences as data and connect them to mutual learning and public utilization at the community level. Whereas previous citizen science studies have mainly focused on verifying data accuracy, participants' learning effects, and motivations and continuity of citizen participation, this study analyzed how the platform NATURING organizes the repeated activities of observation, recording, identification, and sharing within place-based ecological monitoring practices, and how accumulated citizen science data are used as public resources within the local community through education, outreach, and archiving.

However, the connection to urban ecological governance identified in this study should be understood not as a completed institutional cooperative structure but as an exploratory finding that shows the conditions and bottlenecks required for platform-based citizen science data to move through public utilization and become connected to institutional decision-making. In the case of the Uiwang Community Ecology Research Group, NATURING data moved beyond personal records and showed early signs of public-resource formation by being used as the group's educational materials, evidence for outreach, and activity archives. However, no institutional circuit was identified through which these data were stably connected to official administrative review, policy judgment, or urban ecosystem management systems. Thus, the core contribution of this study does not lie in proving that urban ecological governance has already been formed. Rather, it lies in revealing how citizen science platforms accumulate and share place-based ecological data and in demonstrating the importance of verification, feedback, and utilization procedures required for these data to be connected to institutionalized urban ecological governance.

This study nevertheless has several limitations. First, because it is based on the analysis of a single case, the Uiwang Community Ecology Research Group, there are limits to the generalizability of the findings. In particular, all interview participants in this study were women in their 40s to 60s living in Uiwang City, and the case organization is a place-based group characterized by a high proportion of ecological education instructors. Therefore, the recording priorities centered on educational utility and the activation of participation based on the offline community identified in this study should be interpreted as results combined with the characteristics of an instructor-centered local organization, rather than as universal effects of citizen science platforms in general.

Second, this study could not completely separate the mediating effects of the NATURING platform from the organizational effects of the offline community, the Uiwang Community Ecology Research Group. In this case, the continuity of participation, activation of uploading, and educational use of records were not explained by platform functions alone. Rather, they appeared in combination with offline contexts, including encouragement from the group representative, learning among members, regular monitoring activities, and ecological education activities. Therefore, the findings of this study need to be interpreted not as the independent effects of the platform but as the effects of socio-technical practices that combine the platform with a place-based community.

Third, this study could not quantitatively analyze the scientific accuracy of citizen science data or the effects of platform algorithmic structures on participation behavior and data bias. Through participant observation and interviews, this study qualitatively analyzed what organisms participants judged to be worth recording and how such judgments were combined with educational utility, identifiability, convenience of photographing, and app proficiency. However, it did not combine platform logs or the full set of observation records to analyze species-level, spatial, and temporal biases in actual uploaded data, the accuracy of identification, or user activity patterns.

Fourth, this study has a limitation in that it could not trace in depth specific cases in which citizen science data were actually reflected in policy decision-making processes. This study identified the ways in which NATURING data were used within the local community for education, outreach, and archiving. However, it did not sufficiently conduct a multi-actor analysis of how Uiwang City administration, intermediary support organizations, expert groups, and policy officers perceive and use citizen science data. Therefore, the conditions for connection to urban ecological governance proposed in this study are not an empirically complete analysis, but rather tasks that should be examined more concretely in future research by including administrative, expert, and community actors.

Future research should address the following tasks. First, it is necessary to compare and analyze cases across diverse regions and platforms. Second, research is needed to trace the pathways through which citizen science data are used in actual policy processes, such as environmental impact assessments and ecological map production. Third, it is necessary to understand the structure of citizen science data production more systematically by analyzing the relationship between platform design elements and participation behavior through mixed-methods approaches.

In sum, the citizen science platform identified in the case of the Uiwang Community Ecology Research Group is not a completed institutional model. Rather, it demonstrates an early structure of public-resource formation in which place-based citizen science practices accumulate and share ecological data through platform mediation and use those data in education and local community activities. This study has shown that citizen science platforms do not automatically form urban ecological governance. Instead, they are socio-technical mediators that reveal the conditions needed for citizen science data to acquire public meaning and move toward institutional use. For citizen science to function as a reference resource for urban ecological governance beyond everyday observation and recording, the quantitative accumulation of data alone is insufficient. Verification systems that can review the quality of citizen science data, systems through which administrative actors formally review citizen science data and feed the results back to participants, and policy-utilization procedures connected to ecological education, environmental management, and urban planning processes must be established together. When such institutional mechanisms are built, citizen science participants will be able to position themselves not merely as auxiliary data providers but as potential boundary spanners who produce and share local ecological information and cooperate in solving urban ecological problems.

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