‘Nai Waan’ (泥玩): designing working relationships with soil

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Abstract
This paper studies human effects of engagement with soil in the context of Nai Waan (Soil Trust), an experimental farm studio in Hong Kong. It was a research collaboration between a farmer, design school, and hotel. Its purpose was to upcycle food waste for regenerating local soil. The eco–social design undertaking prioritized collective work formats, intersectoral collaboration, and the reuse of locally available materials and logistics. From extensive field material, this paper analyzes how volunteers’ relationship to soil evolved including its organic, physical, and affinitive aspects. The paper contributes to emerging design discussions on soil health and other nonhuman forms of life.

Keywords
codesign – soil health – ethnography – composting – nonhuman life – hybridizing labor

1. Introduction: Design and Soil

Soil is a precondition of life. Specifically, the web of organisms in soil help reproduce water, feedstock, and fibers for all life on Earth including microbes which break down waste, replenish topsoil, remove contaminants, store carbon, release oxygen, and so on. What can designers do with soil? This paper describes a design undertaking that focused on regenerating soils from upcycled waste. Design here built a working alliance that created an appreciation of soil life that sustained it and that was sustained by it. The project Nai Waan (泥玩) – in English ‘Soil Trust’ – regenerated soil through localized fermentation, composting and horticulture inside an organic farm in rural Hong Kong from Summer 2022 to Spring 2023.

Interest in soil is growing among designers. Referring to Puig de la Bellacasa’s (2015) reminder that *only soil taken care of will care for us*, Liu et al. (2018, 2019) have studied ethnographically regenerative farming and human-fungi relationships in Taiwan. Lindström and Ståhl (2019) conducted participatory events in Sweden in a decommissioned glass industry setting that polluted soil with heavy metals. Interaction designers have experimented with creating speculative devices to create openings between people and animals (Jönsson and Lenskjold 2014; Smith et al. 2017). Wilde and Lenskjold (2023) have created speculative play-scapes for people with chronic gut problems. Tomico and colleagues' (2023) ethnographic work has illustrated human interactions with plants, Bardzell et al. (2021) have illuminated the politics of community gardens, and Wernli (2021) has described the imaginaries underpinning collective human waste upcycling, all touching soil indirectly. Soil has also turned into a productive matter in the development of soil biodegradable prototypes for thermodynamic packaging (Song et al. 2022) and circular menstrual hygiene (Søndergaard and Campo Woytuk 2023). Other studies have explored soil health monitoring to enhance urban agrifood systems (Odom 2010, Rosén et al. 2022) and human-environment interactions (Rosén et al. 2024, 2020). Ooms and colleagues' (2022) speculative probes explored bacterial activity in soil in alternative electricity generation, and Oktay et al. (2024) advanced principles of care by seeking inspiration from soil remediation with fungi.

Adjacent to design, research is shifting focus from 'working the soil to working *with* the soil' (Krzywoszynska 2020) for studying the material co-constitution of biospheric renewal across life forms. Harris (2024) has described the collaboration with horses to regenerate neglected soil, demonstrating interdependencies between herbivores, local communities, and planning priorities. Similar interdependencies have been mapped in studies of service design (Meroni 2007), showing how soil uses are dependent on social processes like acquiring land, setting legal structures, and creating organizations that function. There is also evidence of more imminent social processes, including touching, smelling, listening, tasting, noticing, and working on soil (Wernli and Chan 2023), and of reflective discussions about these experiences (Fletcher et al. 2020).

This paper contributes to this emerging debate on the relationship of soil and design from the perspective of codesigning social arrangements. It describes how the volunteers of Nai Waan learned to ferment food waste into soil and in the process reapproached it as a living substance and organizing directive across households and workplaces. The paper looks at the codesign of soil health as participatory undertaking with terrestrial nonhumans.

2. Soil Health as Social Undertaking

Nai Waan[1] (泥玩, Jyutping: nai4; waan2) was running in the Kam Tin agricultural area of Hong Kong's New Territories between 2022 to 2023. At the core of the nutrient cycling pilot was the attempt to change the way in which volunteers understood and engaged with soil. The project concentrated on a fallow, arable plot inside a production farm that made room for experimentation. The volunteers entered a relational configuration with plants, buffaloes, critters, compost, villagers, and participating businesses.

The purpose of the project was to encourage experimentation with farming techniques for reinstating often underutilized organic waste, frugal traditions, and rural periphery. It recovered clean, separated organic waste at homes for soil integration at the farm, salvaged used containers and secured space for ferment storage in the kitchen. Volunteers also invited relatives, friends, or coworkers into the soil care program to bolster support, fertilizer output, and help distribute the farm tasks—like transporting ferment containers from kitchens to the farm, adjusting the seasonal seedling planting schedule based on outcomes from the previous year and the changing climate (namely the ever-shorter winter season), and exploring ways of sharing vital farm updates with each other.

[1] Nai Waan's full name is 泥玩 : 集「棄」還田, which means 'come and play with the soil: collect the discarded for return to the field.' The character for 'discarded'「棄」is a Cantonese pun, matching pronunciation with「氣」(Jyutping: hei3; Mandarin: ch'i4), meaning 'vital energy.'

The main method of the project was brewing fruit peels into enzymes. At the farm volunteers concocted these enzymic cultures with traces of soil and rice bran into a microbial carrier delivered across kitchens for fermenting food waste inside containers. The fermented material was transferred monthly to the farm for composting and regenerating its soil. Produce grown in the soil was distributed to volunteers and families in need. The system is illustrated in Figure 1 and it has been detailed elsewhere (Wernli and Chan 2024).

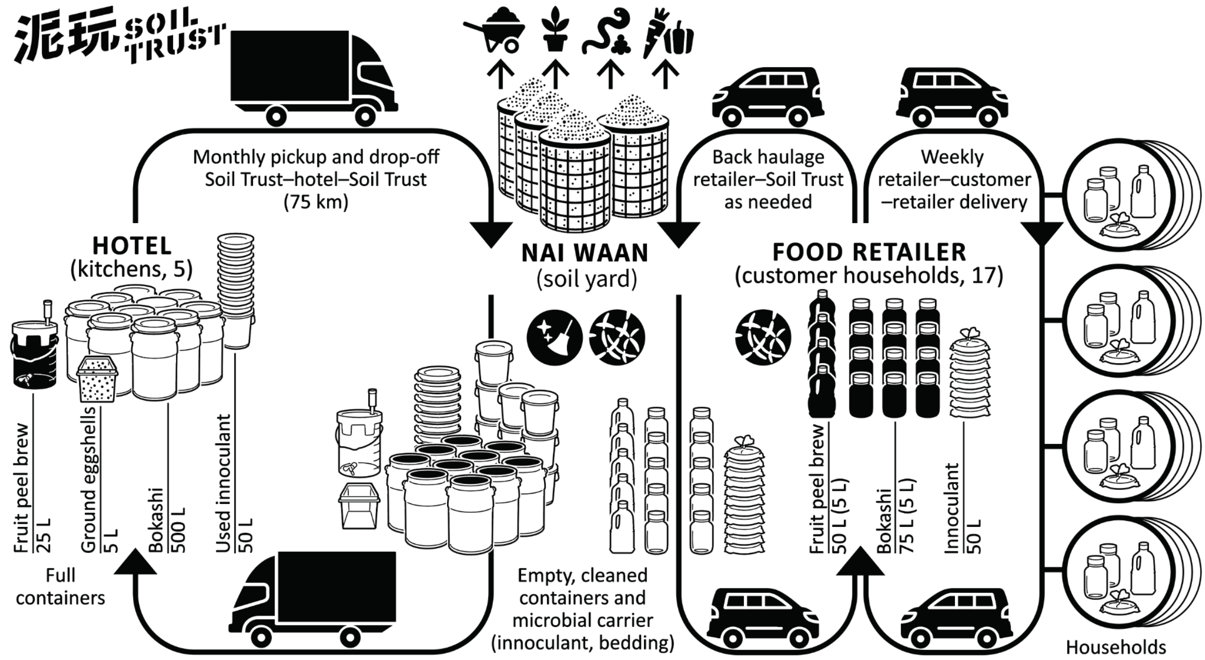

Figure 1. **Nai Waan (Soil Trust): a systemic overview**

Nai Waan brought people into contact with soil in many ways. Soil was the matrix for growing plants, but volunteers also found it under their fingernails, on clothes and tools, in washing vegetables at home, in composting and preparing compost, and in discussions on the farm and in WhatsApp. They also saw it in the context of plants, animals, microbes as well as the weather. These touchpoints fell into four main categories: knowledge from farm manager, farmers and researchers, media, social interaction, and first-hand experience, which is the main topic of this paper. Through these touchpoints, volunteers' understanding of soil shifted from a relatively undifferentiated to a complex, life-filled, and ever-changing concept.

Similar processes have been studied extensively in the context of user experience, where most models have built on pragmatism to capture moments in which experiences escalate into memorable experiences (Forlizzi and Ford 2000; McCarthy and Wright 2004). Following Blumer's symbolic interactionism (1969), Battarbee and Koskinen (2005) have given a sociological interpretation to user experience. Using multimedia messages, they showed how it consists of three elementary processes. First, people lift up experiences from the stream of events in everyday life and communicate them to others. For example, a person may describe something that has happened to them, evaluating it as meaningful enough to be told to others. Second, others may reciprocate these bits and modify them in interaction. In doing so, they show that the experience (as well as the person sharing it) is meaningful for them too. Third, they may reject and ignore experience by downgrading them through inaction, rejection, humor, teasing, and change of topics (Battarbee and Koskinen 2004: 8).

However, this framework was developed for understanding user experience rather than the non-human context of experience. In contrast, this paper analyses how these three processes work in the context of soil, whether organic (animals, insects, worms, plants, micro-organisms) or inorganic (physical and chemical aspects of experience). This framework opens an empirical way to study soil, how it became consequential for volunteers, and how their relationship to it shifted during the project.

3. Methods and Data

Nai Waan was a collaboration between a design school and a hotel. Hoteliers joint the research to engage with local agriculture and to inspire other businesses and authorities in coordinated waste recovery efforts. The task was to develop ways to reintegrate food waste through composting into fresh soil (Wernli and Chan 2024). In Hong Kong, farms are typically small, remote, family-owned, the farmers are aging, and there are chronic shortages of staff. Urbanization focused on housing and business districts has left the rural hinterlands of the territory with limited road access thus farms depend on small footpaths only passable by narrow-gauge hand trolleys. The project experimented with collective farming to learn how younger and diverse populations could be engaged. The research contract required the production of 50 liters of microbial catalyst every month for the hotel kitchen. The catalyst was used in fermentation containers to minimize odors in kitchens. The fermented material was taken to the farm to mature one cubic meter of new compost every month. The maturing process required observing and restacking the compost at least three times a week to avoid bacterial overheating and suffocation. The farm was in Hong Kong's New Territories about a 30-minute walk from the nearest train station. The hotel was located on Hong Kong Island about 40 km from the farm.

As a codesign project, the project was open-ended. People had considerable freedom to author their own actions and experiences (Kurvinen et al. 2008). The farm produced a community that developed behaviors and experiences that are explicated in this paper (Carroll and Kellogg 1989; Koskinen et al. 2011: Ch. 5).

Research team consisted of Author 1, three research assistants, and a mixed-gender cohort of an ethnically diverse team with 26 volunteers, 20 females and 11 males aged between 18 to 55 years. In exchange for working on the farm, they got farmland access, free harvest, new skills, and companionship. Volunteers consisted of immigrant mothers from a welfare center near the farm, subscribers of a local food retailer, design students in a Work–Integrated Learning program, and social media followers of Nai Waan's Instagram posts. About half of the volunteers lived within 15 kilometers of the farm. They were asked to join the farm at least one morning per week for three-hour sessions. Researchers introduced the volunteers to the villagers, the host farm and its irrigation system, regenerative farm principles, tool maintenance, and biodiversity markers. Volunteers had to fill an informed consent form, had to have access to a mobile phone, and had to enlist on the project's WhatsApp group.

Data consisted of instant messages, semi-structured and unstructured interviews, field notes including photographs, and documents of various sorts. These data are described in Table 1.

Analysis followed the principles of analytical induction (Koskinen 2003). The conceptual framework described in Section 2 above was a sensitizing device for observing and making sense of actions and events on the farm. The first stage of analysis consisted of unmotivated search for ways in which soil became a topic in attention among the volunteers. The second stage analyzed sequences in which soil was kept in focus over several message sequences. This analysis decomposed the topics into finer categories in a hermeneutic cycle (Fowler 1986). The final stage sought instances of how soil was dropped off from conversations. Eventually, a saturated picture emerged that described volunteers' understanding of soil.

The pilot followed the host university's research ethics rules. Researchers informed the volunteers about possible risks, how researchers minimize these risks, and how volunteers could minimize the risks. This paper uses pseudonyms, deletes details that could identify volunteers, and expects readers to respect the privacy of volunteers. By now, however, the farm has been converted to urban development. For this reason, we have not deleted information about its location.

Source of data	Description
Chat histories of two instant messaging groups	31 volunteers sent over 3000 messages comprising 60 video files, 1538 photographs, 1479 texts, plus emojis and animated stickers. Over 2500 messages were unique, with the rest being reposted. It amounted to 1.5 gigabytes of data, 34 minutes of video and a tabulated text document with 55 pages (DIN A4) and 28,743 words. Measured by word count, half the text volume was written and sent by the four researchers and the other half by the 26 volunteers.
Semi-structured interviews	Farm volunteers (N=19), food localization customers (N=24), and design students (N=19) that examined perspectival changes toward eco-social pilot concerning individuals, design, and regional development.
Unstructured interviews	A talk-aloud protocol with hotel staff (N=7) that examined perspectival changes toward eco-social pilot concerning individual experience, industry, regional development, and intersectoral research with observation and field notes.
Field notes and photographs by research team	Chronological description of events, observation notes, participant attendance record, meeting notes, and shared drive with 3500 photographs and 50 video clips.
Documentation	Planning documents, maps; Farm Logbook with compost inventory, biofertilizer application schedule, planting calendar, plant growth charts, yield records, crop blind-tasting profiles, citizen science data; participant photographs of animals, insects, fungi, crop disease; design works including sketches and props.

Table 1. **Data collection inventory**

4. Results

4.1 The start: lay, instrumental, conceptual definitions of soil

Nai Waan facilitated the Growers Without Borders (泥玩無國界) service learning program that attempted to change the way in which volunteers engaged with soil. The project first administered a questionnaire to the volunteers. Twelve responses were received, and although we should be cautious about extrapolating from these responses, the responses suggest that the volunteers had three main relationships to farming and through it to soil. It ranged from being oblivious to the role of soil (lay), seeing it as resource to extract from (instrumental), or approaching it as a scientific object removed from oneself (conceptual).

For most volunteers, soil was a lay concept, meaning barely more than dirt in which plants grow. Three volunteers had grown herbs, flowers, or vegetables, but were without connection to farming. One example was a Pakistani volunteer who grew up in a farming village, but his experience had been limited to tending to vegetables. Another example was a Filipina from Manila whose mother had grown flowers at home. A volunteer from Nepal contrasted her previous experience of soil with what she learned during the project:

A: In my country, my parents and other villagers do not care much about soil, but at Growers Without Borders, I saw everyone loving the soil creatures, taking photos of toads, lizards, and earthworms—I find this amazing and want to learn all about soil.

In contrast, four volunteers had grown up on a farm or had farmers in the family and had an instrumental relation to soil. For them, it was means to an end, which is food production, and as such, a resource with little intrinsic value and also a substance to be controlled by eliminating biological and physical processes that intervene with the end. Soil was a matrix for growing edible plants like wheat, corn, peanuts, beans, tomatoes, or potatoes. The father of an Indonesian volunteer was a farmer, and another volunteer, raised in a village in Ukraine, still had former friends and family members who were farmers:

A: In my hometown, I planted crops like corn, sunflowers, potatoes or cabbage but it was part of industrial farm operations.
Q: Did you do any Bokashi [composting]?
A: My mother-in-law, she does it. She's not doing the fermentation bit, but she collects food and afterwards gives it to the government collection point.

A third group had a conceptual relationship to soil typical to city-raised volunteers. In this definition, the meaning of soil was seen through conceptual frameworks from society, science and art, and its value was determined by these frameworks. While the instrumental view stressed control for human ends, the conceptual perspective situated soil also to a human value context but without control. For example, a social worker saw farming as a tool to organize ethnic minorities, a dancer saw it in terms of communal art, and an environmental engineering student saw it in theoretical and relative terms, using terms like value chain, soil ecology, responsible branding, and soil health to describe it:

A: [Nai Waan] built many value chains for the soil for returning food waste from hotels, teaching people to facilitate the soil and do composting… On the commercial side, the hotel boosts its reputation. On the farming side, we collect resources to bring nutrients back to the soil and that obviously is good for soil health… so people become aware that Hong Kong still has soil, that there is food waste and… circular economy. Despite this, there is a lot of uncertainty because the government also plays an important role in allocating sufficient land to farming. No matter how much waste we recover, how much research on soil ecology we do, there's no use if the government isn't doing its part.

Despite differing starting points, Growers Without Borders connected volunteers with soil biological processes, fostering a deeper appreciation for the biostimulating cycles that reproduce them. Volunteers came to view soil health as a vital life matrix to be valued and engaged with.

4.2 How relationship to soil evolved

4.2.1 Soil becomes a living matter

As the first quote of the previous section suggests, the project enriched the concept of soil among the volunteers. They came to see soil as a matrix for plant life but also as a matrix for several types of creatures. They also learned to see excrements as signs of itinerant mammals like rodents and buffalos. After the project, the volunteers saw soil as a matrix that sustained many types of nonhuman life. It was not dirt anymore: it had become a living and breathing foundation for growing food and flowers, but also a substance full of animal, insect, and microbial life.

This change had its roots in contact with soil. Volunteers were tending to soil and crops most of the time on the farm and discussed soil mostly in WhatsApp. Often, soil was a scenic feature in the background. For instance, in Message 1, Anna sends a picture of a skink. She found it in a bucket, took a picture of it, and shared it with everyone in the chat. Soil is visible in the background, but it does not enter attention. In Message 2, soil gets a similar treatment in a warning to avoid eating a potentially toxic plant that looks like turmeric.

Message 1		**Anna** [7 Sep 2022, 16:04]**:** We found her in the bucket. **Meirong** to **Anna** [7 Sep 2022, 16:12]**:** Oh, is it still alive? **Anna** to **Meirong**, [7 Sep 2022, 16:14]: Yes, she ran away after posing 😄
Message 2		**Yeung** [16 Nov 2022, 16:37]: IMPORTANT! These past days, we excavated what looks like Tumeric but possibly is Yujin (鬱金), a close relative. We're still trying to properly identify it. Yujin promotes blood flow, is harmful during pregnancy, and may trigger miscarriages. If you've already consumed some, don't worry. Until we get exact identification, please refrain from eating any Tumeric. **Lexi, Kabani, Janitha, Tarala** to **Yeung:** 🙏🏼 👍🏽 👍🏽 🙏🏾

Soil was lifted out of the scenic status in three contexts, all related to composting: when obtaining enzyme cultures were needed to kick-start the compost; when monitoring its temperature and pH values; and when taking action to keep it working.

Most actions were instructions from farm manager Yeung, and discussions clarifying the instructions. In Message 3 below, he gives instructions for getting reliable temperature readings from the compost. In Message 4, a month later, Author 1 asks someone to measure the temperature: after getting the result, he associates the compost heat with bacterial activity. Message 5 discusses pH value of the compost, illustrates how these measurements were discussed.

<table>
<tr><td>Message 3</td><td colspan="3">Yeung [7 Jan 2023, 10:56]: I think we still need to turn today as the temperature yesterday was 61°C. The temperature is decreasing and won't come back up these two days. You can check a few more spots in the pile to get more readings for locating the highest temperature. But I suggest turning the pile today, so it won't cool off and affect microbial activity. 🙏🏼</td></tr>
<tr><td>Message 4</td><td>Author 1 [8 Feb 2023, 9:58]: Yes, Abis, this is the compost stack, can you please measure its temperature?</td><td>Abis [8 Feb 2023, 9:58]:

</td><td>Author 1 [8 Feb 2023, 9:59]: The compost bacteria are still working hard and want some air for breathing 😃

Abis [8 Feb 2023, 10:01]:
👍🏽</td></tr>
<tr><td>Message 5</td><td colspan="3">Jasmine [8 April 2023, 15:33]: Over the past weeks, we've been tracking our bean growing trial with different bio-fertilizing methods (control, traditional-organic, regenerative). Our citizen science testing shows that the regenerative farming approach has the slowest growth, shortest plant height and smallest leaf size. Ranked by growth, 1st is traditional-organic, 2nd is control, and 3rd is regenerative. The result is unexpected. We suspect that our rather acidic compost inhibits the growth in the regenerative approach, as soil pH is lower than in the other two fertilizers.</td></tr>
</table>

These interactions had an accumulative impact on volunteers. An example is the ceramicist Barbara who said, reflecting on her experience: "soil [is] supposed to be the most important thing to take care of," and elaborated by adding how her experience in using decomposing materials like cardboard and forest leaves to protect the soil made her realize not just that soil needs nurturing, but it also made her think about "more eco-friendly ways of farming" instead of using non-degradable inputs. Several other volunteers similarly said how the project led them to advocate soil care by rethinking the use of artificial or toxic substances.

4.2.2 Developing a sensory relationship with soil

The volunteers also developed new ways to understand and analyze soil. They acquired new skills to study the soil using their senses, including sight, touch, smell, and taste, but also proprioception and thermoception.

A particularly important new sensory relationship was touch, as a cue to microbial processes. The volunteers learned to touch soil to validate moisture content in soil, compost, and Bokashi bedding. One method was pressing the material into a ball to see whether the bedding had enough enzyme saturation at the time of inoculation. Fingers were particularly important. In the following example, farm manager Yeung instructed volunteers not to water the plants after heavy rains even if the next days were sunny. In response to a query about how to know when the soil is too wet, he gave instructions for how to evaluate wetness in soil with fingers (Message 6).

Message 6		**Yeung** [11 Nov 2022, 14:23]: One more thing: please no watering for the whole field even if it's sunny tomorrow as the soil is still very damp after last week's rains. **Yeung** [11 Nov 2022, 16:20]: You can spot-sample the field and put your finger 1–2 inches deep to feel the soil moisture.

Nai Waan also engaged the senses of smell and taste. For example, fermentation bedding was generated from rice bran – milling residue from polishing brown into white rice – and fruit peel enzyme. Bran is rich in linoleic oils and minerals. In contact with the enzymes the bran acquires a distinctly soothing touch and balsamic smell. Also, when kitchen scraps were interlaid with the enzymic bedding to accelerate their decomposition, they generated a pleasant pickle scent that became an indication of microbial and chemical processes in fermentation. Similarly, the volunteers learned to track the presence of calcium – a crucial component in soil clay, walls of plant cells, and exoskeletons – by tasting a wide range of sweet, sour, or bitter components in vegetables as traces of micronutrients that are often lacking in crops grown conventionally on petrochemical inputs.

After pandemic distancing measures were lifted, the volunteers came together to mix and compress microbial carrier material into fermentation containers. As a student explained, balancing one's body weight atop the Bokashi container, and performing a circular dance was the most effective way of feeling and removing air pockets. Feeling the soil through proprioception and taste (Figure 2) were crucial facilities.

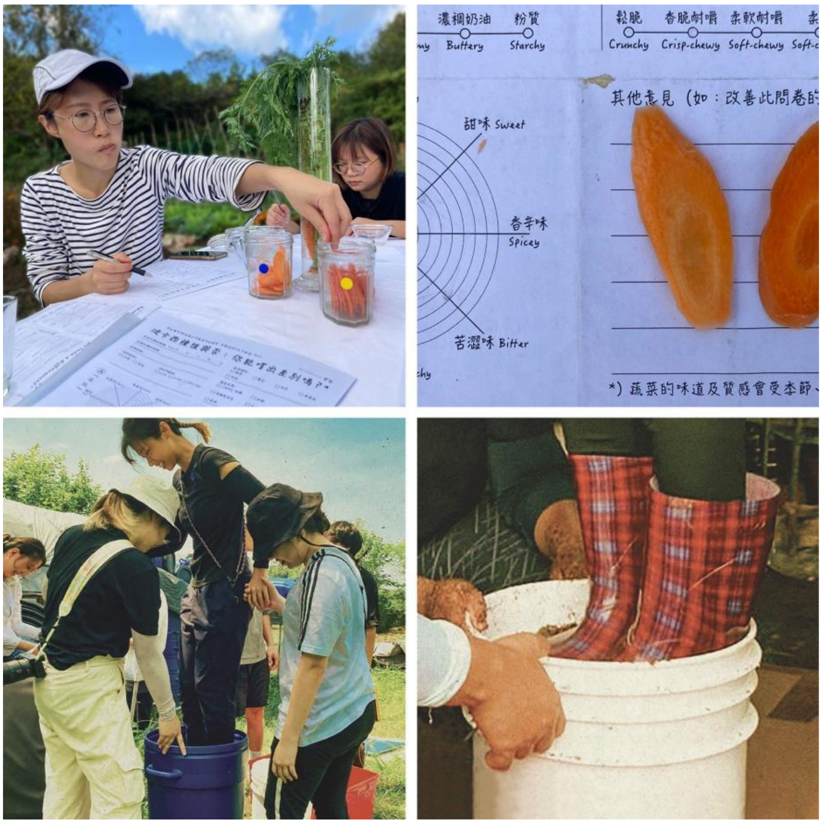

Figure 2. **Volunteers feeling soil through tasting the emergence of trace minerals at comparative blind tastings of the harvest and removing air pockets during Bokashi bedding preparation with proprioception.**

In reflecting about the aspect of new learning, the co-founder of the participating food localization retailer summarized the outcome of engaging multiple senses in soil care:

A: By fermenting kitchen scraps together, we approached soil as an ally in an extended gut environment—it is bacteria, fungi, plants, and animals that make healthy food web interactions possible. We learned to differentiate what healthy enzymes, healthy vegetables, or healthy soil smell and feel like.

Similarly, a mother and customer of the farm told how the Bokashi soil care experience had interlinked her to her fermentation mates. Referring to Covid-19 restrictions, she noted that the volunteers remained "physically separated for more than a year," but how through recirculating starter cultures "stayed connected metabolically and sensorially with the farm plot and each other." Peer solidarity could affirm the role of soil as passive enabler. Yet for volunteers working on the farm over time, solidarities extended to soil as a partner in the process of continued and shared livability.

4.2.3 Soil becomes a fellow laborer

In rebuilding soil, the volunteers encounter many life forms and must learn to work with and nurture them. This was most evident in fermentation. It was a bio-stimulating practice for returning organic matter at the point of food loss back into the soil. Following East Asian natural farming traditions, volunteers learned to see it in symbiotic and collaborative terms. Nutrients and minerals withdrawn from harvested crops, they saw, could be naturally replaced by infusing the soil with microbial activity that nourished plant roots and critters to make them resilient to weather extremes. The farm manager, who was also one of the instructors, noted this deliberate working *with* the soil as follows:

A: With Bokashi fermentation, you forgo chemicals and electricity, you suppress bad smells and greenhouse gases, you store nutrients for years, and you create feedstock for soils and critters, not just crops.

To avoid reliance on factory-cultured microorganisms, Nai Waan generated microbial catalysts from fruit peels, leaf mold and other organic byproducts. The volunteers interlaid kitchen scraps with microbial bedding (Bokashi), which required coordination between the homes, the hotel, and the farm. To speed up material decomposition, fruit peels need shredding and kitchen scraps mushing before being interlayered with microbial bedding and packed into airtight containers for maturation. To make trace minerals biologically accessible, food scraps and eggshells needed grinding, oyster shells crushing, and seaweed blending before they were fermented, diluted, and applied to the soil via irrigation water.

Another class of tools protected the soil. The bacterially invigorated soil had to be shielded from sunlight and erosion either with cardboard sheets, wood mulch, or a vegetation blanket (cover crops) that accumulate sugars and trace minerals essential in growing nutrient-dense produce. To avoid the use of heavy machinery that compacts soil and hampers microbial life, volunteers sheet-layered soil with mulch and cardboard to shield it from weather extremes, to suppress weeds, and to retain moisture. Creating microbially charged mulch necessary for protecting seeds and baby plants, volunteers chopped, stacked, compressed, and restacked old roots, dead plants, bastes, and leaves after harvest for reintegrating them into soil (Message 7).

Message 7		**Yeung** [8 Feb 2023, 9:25]**:** Please help to chop down these brown materials, including twigs and straw so that they can be easily decomposed. Also, the latest pile with the white aeration pipe needs turning today. I will return, once I finish the hotel food waste delivery

For soil to thrive and collaborate it foremost requires to breath. Nai Waan paid particular attention to the respiration needs in soil, Bokashi containers, and compost stack. Volunteers built several tools for this purpose. The project relied on shallow raking to integrate fertilizer with the soil instead of tilling or ploughing. One was “broadfork,” a no-till soil aeration rake. Another was a Bokashi compressor created from scavenged wood to squeeze out excess air in the fermentation bin. Other tools were a penetrable compost stack built with aeration pile and chicken wire, and a shading hut made from burlap, clay, and bamboo depicted in Figure 3.

Figure 3. **Tools that support soil respiration: Sheet-mulch cardboards to enhance soil climate, Bokashi compressor to control airflow in fermentation, broadfork rake to infuse oxygen, and chicken wire enclosure with aeration pipe for breathing compost.**

The purpose of these tools was apparent on several occasions, and perhaps best when it was raining. In Messages 8 to 9, the farm manager reports a torrential downpour in the area and shows pictures of how the soil was protected.

Message 8	**Yeung** [30 Sep 2022, 11:19]: There is a downpour in Kam Tin now and if tomorrow is like that, we can do nothing at the farm since our shed is not big enough to hold 20 to 30 people. We will make a final decision at 7:30 tomorrow morning if farm activity will be postponed.
Message 9	**Yeung** [30 Sep 2022, 16:08]: See the devastation to soil life in neighboring plots due to lack of surface cover. Hopefully the weather will be good tomorrow so you can come and compare yourself. **Yeung** [30 Sep 2022, 16:09]: Rain became lighter, and drainages cleared out. These are the photos at this moment: our plot [third image] is holding up well.
	  

A respectful relationship to soil led to a change in understanding farming equipment that were built from readily available materials. One volunteer reflected on the collaborative integration of human and nonhuman labor that these practices involve, and another reflected on the value of these practices:

A: Obviously, removing the tapes from the cardboards and cutting them up for sheet-mulching requires a lot of human labor. Not everyone is willing to invest that time, so most farmers use plastic sheeting to protect the soil [...]. At [Nai Waan], I realized, oh, there’s another way where we also collaborate with nonhuman labor that naturally breaks down the cardboard over time.

A: I think veggie farming on soil is worth much more than meat production if we consider all those skills and the labor involved. Through working at [Nai Waan], I started to wonder why vegetables in the market are sold so cheaply.

With all those skills and labor, the volunteer expresses soil’s essential role in veggie raising, which emphases the collectivized, interspecies effort involved. As these quotes suggest, the project also changed the volunteers’ approach to tools. A design student noted how the project changed his approach to design. For him, the project taught that “tools and methods should fit nature, be carefully upcycled, re-input and kept as simple and natural as possible,” so that they support the purpose of the farm. Another student noted a shift in her design approach from sketching and rendering to intuition and mockups because “we only found wood boards and sticks.” She found the use of “recycled materials for something functional” formative. Furthermore, the idea that tools themselves contain nutrients that can be recirculated locally and synergistically to work *alongside* soil, counterintuitive to traditional design education, was a revelation.

For design students, relating to soil as a fellow laborer raised questions about who counts as worker, and about appropriate social relations of compensation, restitution, care and value: they also experienced how they are always assisted by or subjected to insects, worms and microbes in soil. They learned to question a rational relationship to labor that sees scientists or agrologists as authoritative sources of knowledge. Rather, they learned to see relational value that derives from the recognition of being alive together with the biology of soil and working with it instead of finding ways to control it for human utility.

5. Discussion

Soil enables biospheric life and some designers have recently shown interest in pushing design beyond an instrumental relationship to it (for example, Wernli and Chan 2024; Liu et al. 2018, 2019 on fungi and regenerative agriculture; Lindström and Ståhl 2019 on contaminated soil; Smith et al. 2017 on theory; Tomico et al. 2023 on plants; and Oktay et al. 2024 on care narratives). Many of these projects, recognize soil as medium or enabler of these activities. In extension, the Nai Waan pilot foregrounded soil explicitly in human interactions to study how the volunteers' relationship to soil changes when they are exposed to the living properties of soil. As the paper has shown, the volunteers' initial concept of soil became much richer during the project. The volunteers realized that human prospects are intricately bound up in a reciprocal relationship with soil. Their expanded vocabulary remained tied to things they saw, could name, and learned to name during the project; it remained within lay understanding and experience rather than built on elements of science, religion, or any other elaborate theory of soil.

These changes of interpretation impacted activities and those frameworks through which the volunteers related to soil also indirectly—for example, through tools. In the broadest sense, this study showed how a community of people moved from an undifferentiated concept of soil to a deeper concept that is aware of the needs of many types of life forms and does not see them as opponents, is active, and also teaches people how to see themselves in the context of soil as sensitive and sensorial creatures that can without fear interact with the rich complexity around them. The appreciation of soil life assisted by social media has also supported researchers to maintain the long tail of this study for several years after the active phase of research has finished. The long tail of research as discussed by Júdice (2014, 282–294) for Nai Waan entailed that the researchers remained connected with volunteers long after the farm had closed and together realized a book (Yu and Wernli 2024) and exhibitions that deepen the soil health enterprise over time.

This paper has shown how the change in volunteers' relationship to soil was deeply social: they discovered life in it and discussed it with others, learned to use their senses with others, adopting cues from them, and learned techniques for working with it. The enrolment of soil biota as shared labor of human and nonhumans collapsed the distinction between who is producing, consuming, or benefiting. If we follow Krzywoszynska (2020), we can argue that laboring with soil stipulates the need to redefine the ways in which designers account for the biosphere in design curricula, in the workplaces, and in business.

Nai Waan was an interpretive study in the context of a codesign process (Koskinen 2023). It was not designed to test a hypothesis about how interaction at the farm would change how people relate to soil. This would have required a very different approach that would probably have been beyond the capabilities of design researchers. However, this research design has also intrinsic value: it is design-led and leads to design outcomes, but also provides undeniable evidence about the importance of the experience at the farm and its effect on how the volunteers learned to see soil and reposition themselves in relation to it.

This paper is a design case, and its results are meant to be valid only within the case. But would the results apply in other similar cases? In the lack of design studies about soil, we cannot say for sure, but we believe volunteers in similar design studies would certainly make sense of soil and would probably discuss soil in increasing richness and intensity, though perhaps not similar to Nai Waan's terms towards the end of the project. The details of the study would probably be different, especially if the flora and fauna were different. Hong Kong has a subtropical climate with high heat load and humidity, accentuated precipitation, and a typhoon season. Another possible argument against generalizing the findings is cultural and says that since the volunteers were mostly from Southeast Asia, the results may not apply in Western countries for reasons ranging from the nature of industrial agriculture in the West, ownership of land, and a cultural setting that favors rational approaches to nature. We believe that this is not the case, however: European volunteers did not differ significantly from the others during the study. Just as their Asian peers, they have vocabularies that prioritize symbiosis with nature over control. Still, we cannot say what we would see if the project were replicated in Europe or the Americas.

Elaborating a framework introduced by Battarbee and Koskinen (2005), this paper has tracked three changes in the relationship to soil. During the project, the volunteers moved from seeing it as dirt to seeing it as living matter, relating to it sensorially, and seeing it as something to be worked with. These, however, were only some of the most important changes among the volunteers, and we want to point out three of these. First, the project also raised questions about how society relates to soil. Most importantly, it brought the volunteers in contact with economic and political interests in land care. The project connected the volunteers to soil, microbes, and mammals, making the permeating symbiosis between the body and the environment tangible. Such intimate soil engagement contrasts the dysbiosis of industrialized food systems that disrupt soil-human connections and approach indigenous microbial processes as deviations from farming norms. Second, another dysbiosis took place slightly later. Nai Waan's farm plot was sold to a property developer. Consequently, the plot was covered with construction waste as a means of contaminating and making it unfit for agricultural use to justify later rezoning it to residential use. Third, on the positive side, the project also showed that society can be turned to work with soil. Hotel managers believed that Nai Waan could be a showcase for waste reduction, and the project became a vehicle for presenting the anonymous women, volunteers, and their work in mainstream TV broadcasts, higher education, social media, and public talks. However, this paper focused on knowledge co-production from first-hand experience rather than social interaction, public recognition, and expert research. These extended societal connections have to be left to other papers.

Finally, Nai Waan led us to broader questions about how designers can relate to nature, and we would like to conclude this paper with some pointers to the future. First, we need to network and build synergies across private and industrial households to become responsive to the needs of soil without complicated technologies that often come with hidden costs. Second, we need to learn to be directed by ecologies. This means stepping inside the field of food production and wastefulness and to durationally engage with the system. Third, we need to learn to work closely with unknowable, non-human entities to attune to the cycles of growth, decay, and afterlife that do not fit into human conceptions of speed, efficiency, and instant gratification. Fourth, we also need to learn to integrate design decisions with the anticipation of non-human elements, as in the case of using cardboard for mulching soil to enable rain penetration, mycological communication, and earthworm digestion. Finally, we need to learn humility. Working with soil means uncertainty, requires patience, and leads to frustration, but also lead to delightful surprises, as in the failing bean trial experiment in

Message 5. Nature surprises us: Nai Waan taught us that designing with soil requires continuous experimentation, multidimensional reflection, and an open mind to soil and living otherness.

Finally, healthy soil also merits attention for its intrinsic value. Increasingly, many researchers in design argue that proliferating life is essential even when it may not have instrumental human value (Wakkary 2021). Intergenerational biodiversity is a good example: soil is immensely rich in terms of life forms, whereby previous, entangled genealogies are shaping the conditions of future terrains. Some life forms are microscopic and some visible, but regardless of their visibility, they deserve outright human respect as cohabitants of the planet and as our fellow coworkers who make the planet habitable.

6. Conclusion

This empirical study accounts for codesign with experientially activated soil ecologies. It is grounding discussions on participatory design involving nonhuman life forms through concrete practices and also has traction beyond well-intended criticism (Liu et al. 2019). We believe that the absence of design studies with an explicit focus on soil warrants attention from designers on a planet that is dramatically altered by human activity.

Soil is a matrix of life and a necessary condition for reproducing food, biosphere, and society. It has geophysical, biological, remedial, and medical value, and the fact that many of these values may never be fully known makes nourishing it even more pertinent. It also serves as the largest natural filter and terrestrial carbon pool (as Scharlemann et al. 2010 argue). Nai Waan showed the public how to transform food waste with enzymes and regenerate soil instead of discarding it in landfills or biodigesters that would create detrimental methane emissions. Soil holds intrinsic value on its own terms for its continued capacity function as a living and life-giving ecosystem that renews bacteria, plants, animals, humans, and atmospheres. Soil deserves human respect as a cohabitant essential to planetary cohabitability.

The paper shows how codesign can be made with a community of diverse participants with divergent interests. In this, the paper continues in the footsteps of codesign reflective of its participation. The fate of the farm that turned into a construction site illustrates well how codesign is dependent on forces that are sometimes beyond its control. This, however, has to be left to other papers in the interest of space. For us, the novelty here is seeing how the community has learned to approach nonhuman nature as a part of the codesign process to a point where it started to discern plants, animals, insects, and soil-microbial life as codesigners on equal footing to humans.

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