From dichotomies to dialogues -
connecting discourses for a sustainable urbanism

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Designing reflexive spaces with human waste: Communities of resourcefulness in Brussels, Berlin, and Hong Kong

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Abstract: This paper compares three interventionist eco-sanitation cases by applying a structurally extended SWOT matrix for evaluating their transformative relations and capabilities in their respective urban settings of the global north. The enablers and barriers underlying these human waste cycling communities are assessed by combining qualitative-quantitative data collection and multiform analysis. By complementing the Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis with the emergent framework of Ideas-Arrangement-Effects (I-A-T), the study assesses the creative potential manifested in these cases. The eco-toilet communities address unsustainable food systems by acting in concert with people, places, and microbes in a profoundly self-implicating process that stems from an oscillation between actionable immersion and perspectival detachment. This dynamic creates a reflexive conduit for counter-intuitive doing and thinking that diversifies dominant and hegemonic perspectives. The three cases, sensible to their respective settings, demonstrate how cultivating a rich, interactive context on the physical, social and psychological level is conducive to the suspense and exchange of positions and a plurality of perspectives on the world, human and nonhuman. Community acceptance and individual satisfaction with urban eco-toilets stems then from balancing this unsettling repositioning with supportive involvement, whereas disrupting bathroom routines, group debates, and agroecological experimentation makes people act in better-attuned relations with unknowable otherness.

Keywords: Agroecological urban toilets, regenerative waste integration, Terra Preta fermentation, Structural SWOT, collectivized resourcefulness.

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1. Introduction

What does it mean to work with communities on ecological revitalization when designers abandon single-minded paradigms of efficiency and crisis response? What is implied in more-than-human collaboration when designers accept their complicity in the environmental and societal precarity that now prevails? Addressing this complexity, how can a wide range of positions be invited for manifesting unprecedented perspectives as premise for actionable creativity? These questions are considered by examining what spaces of reflexivity emerge when perspectives of humans and nonhumans are placed in direct dialogue whereas situations become multidimensional and open to change. This paper argues that attention oriented at material engagement with ordinary experience, including bodily defecation, expands the capabilities and collective action. Co-learning processes in profound exchange with the given eco-social context has been described as 'resourcefulness' (MacKinnon and Driscoll, 2013) and evolve from the reorientation of internal priorities in person and institution, expressed in localized value creation and social relations (Bendell, 2018). Collectivized resourcefulness is often neglected from reporting in urban design. Although previous research, particularly debates in 'infrastructuring,' have noted the importance of engaging the messiness of social entanglements (Pink, 2011; Agnew, 2011;

Mang and Reed, 2012; Karasti, Baker, and Millerand, 2010; Huybrechts et al. 2018), recognizing uncertainty and incompleteness as catalytic encounter and creative opportunity in communities are largely missing (Mosleh and Larsen, 2020; Said Moslef and Larsen, 2020; Akama and Light, 2020; DiSalvo, Clement, and Pipek, 2012).

This article focuses on experiential dimensions in participation to provoke reflection about the mental models underpinning reality formation since it can radically ground, liberate or hamper eco-social thriving. Discussion about the importance of iteratively examining the instructive relationships with the world is emerging in design (Luján Escalante, 2019; Smitheran and Joseph, 2020). The argument is that the mode of design needs to change—from the impartial, discipline-centric projecting onto the world towards becoming an 'equipment for social learning' (Bonnet et al. 2020) for how to live with the contingencies inside the damaged biosphere (Hennon and Monnin, 2020). It requires exploring practices aimed at generative inconsistencies for asking what such emotive accounts can contribute to discourses in design. For this, the article presents three eco-toilet cases of productive uncertainty, then evaluates related observations with a causal framework, and concludes with overarching implications.

2. Designing for collectivized resourcefulness

In the global south, design engages with productive uncertainty for restoring local food systems, reviving communitarian links in the city, and defending alternative ways of inhabiting the world. Arturo Escobar (2016) describes Indigenous Peoples' creative struggles in Latin America who reconstruct 'territories of life' by valuing diversity and approaching environmental interactions as circularity. 'Sentipensar con la tierra,' the *feel-thinking* with soils and land (Escobar, 2014), plays a fundamental role in indigenous communities since it embodies, enduring health, food sovereignty, relational situatedness, and intergenerational wisdom.

This passion for enacting social change in the face of an ever-deepening techno-economic mediation of the world also mobilizes communities in the global north (Lobenstine, Bailey, and Maruyama, 2021) to practice the 'autonomous design of themselves' (Escobar, 2018, p. 5). Communities here revolve around the environmental context they intend to transform while designing their capacity for a plurality of social life they truly want (Berglund and Kohtala, 2020). Increasingly, codesigning citizens wonder how future generations will grow sufficient food on a drastically smaller ecological footprint. Humus-rich, healthy soil ecologies are critical here since they provide vital storage capacities for water, nutrients, and carbon dioxide (Schneider and McMichael, 2010). This section introduces codesign cases in Brussels, Hong Kong, and Berlin where *feel-thinking* with the soil and disrupting deep-seated urban unsustainability implies that communities formed around bringing their excrements to fruition in the city.

2.1. Brussels: L'Usine du Trésor Noir

In the Belgian capital, human waste upcycling gravitates around architects and artists affiliated as Collective Disaster. The group formed in response to a call in 2014 by the Belgian Ministry of Environment to revitalize a derelict downtown park (Amaya 2016). In collaboration with two dozen neighbors, over the summer of 2015, Collective Disaster realized a community-run, ecological public toilet facility (Figure 1). Uniquely here, the respective composting processes dictated the spatial and organizational arrangement of the placemaking initiative. The onsite treatment of excrement as publicly accessible process triggered wondering what could be encountered, experienced, and learned. The community consolidated the insights gained into a comprehensive, open-source manual for all involved to carry out the maintenance involved.

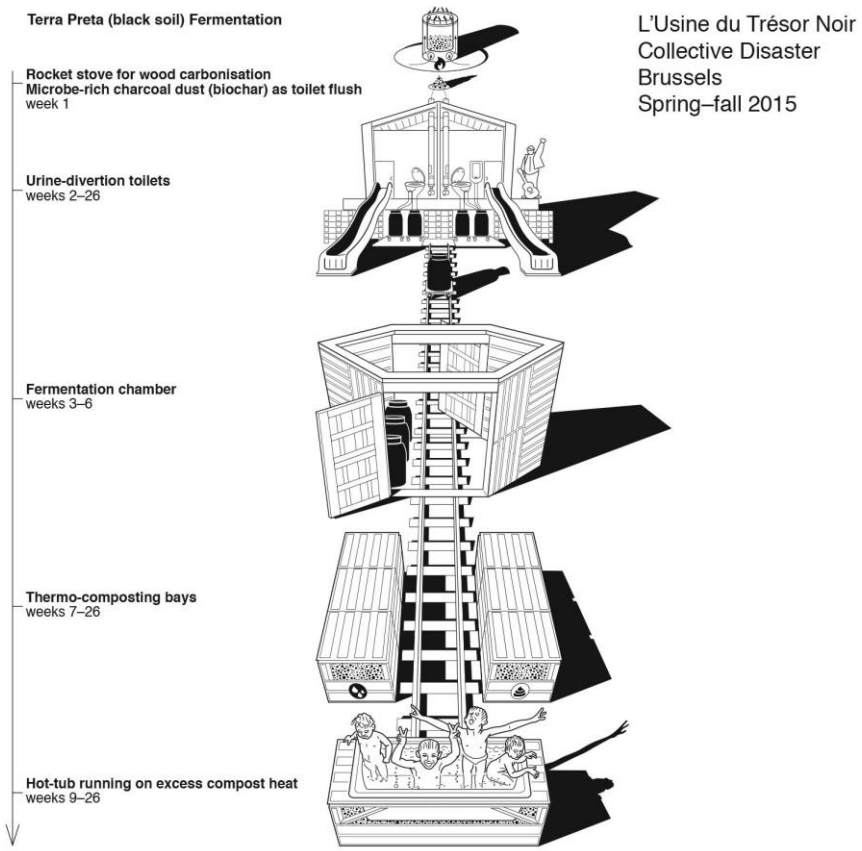

Figure 1. Architecturally arranged composting experience.

The resurrection of excrements through materially performative structures and novel social constellations became known as L'Usine du Trésor Noir. To overcome resentment, the collective involved neighbors in planning, building, and operating facilities that incorporated spacious, urine-separating toilets and a heat-capturing compost system for powering public hot-tubs. This closed-circuit between waste and leisure in the open public was unprecedented and entailed unknown possibilities and risks. It required from all involved a healthy dose of trust and responsiveness to difference.

The pyramid-like toilet facilities operated over six months and were built on top of an elevated platform with spacious front stairs that doubled as a stage for performances. On the backside, visitors exited the toilets on slides, one for females, one for males. The platform's interior stored the sealed collection barrels to separate urine from solids and preprocess them with microbially activated charcoal dust. Using the Terra Preta method, the multi-stage fermentation process eliminates pathogens, retains nutrients, and makes human waste into veritable fertilizer within one year. From the collection chamber, narrow-gauge tracks connected to the adjoined composting site for swiftly transferring full barrels on trolleys for harnessing the excess heat. The park-enlivening public toilet garnered several awards and international acclaim. In its downtown setting, the Trésor Noir community exemplifies empathetic exploration of the possible and unknown based on imaginative and material repositioning of issues like public tolerance, land access, and urban resourcefulness. It brought together soil experts, authorities, and concern groups to reconceive, at least temporarily, operational infrastructures for sanitation, composting, and recreation, crossing divides between resource conservation and social capabilities.

2.2. Hong Kong: Anthroponix

The university-endorsed community of urine-upcycling citizens in Hong Kong responded to mounting food safety and environmental health concerns. The initiative instigated by the author was to enable urbanites deprived of balconies and land access to growing plants indoors (Figure 2). Following a public call in 2017, the organizers invited 22 households of diverse sociocultural backgrounds into this Urban Ecology Adventure to ferment their urine – with the addition of sauerkraut brine – into a fertilizer substrate to grow edible plants. The simple material relationship between participants' urine and the

environment constituted a provisional ecological proposition since the possibility of the fertilized plants was interlinked with the person feeding it.

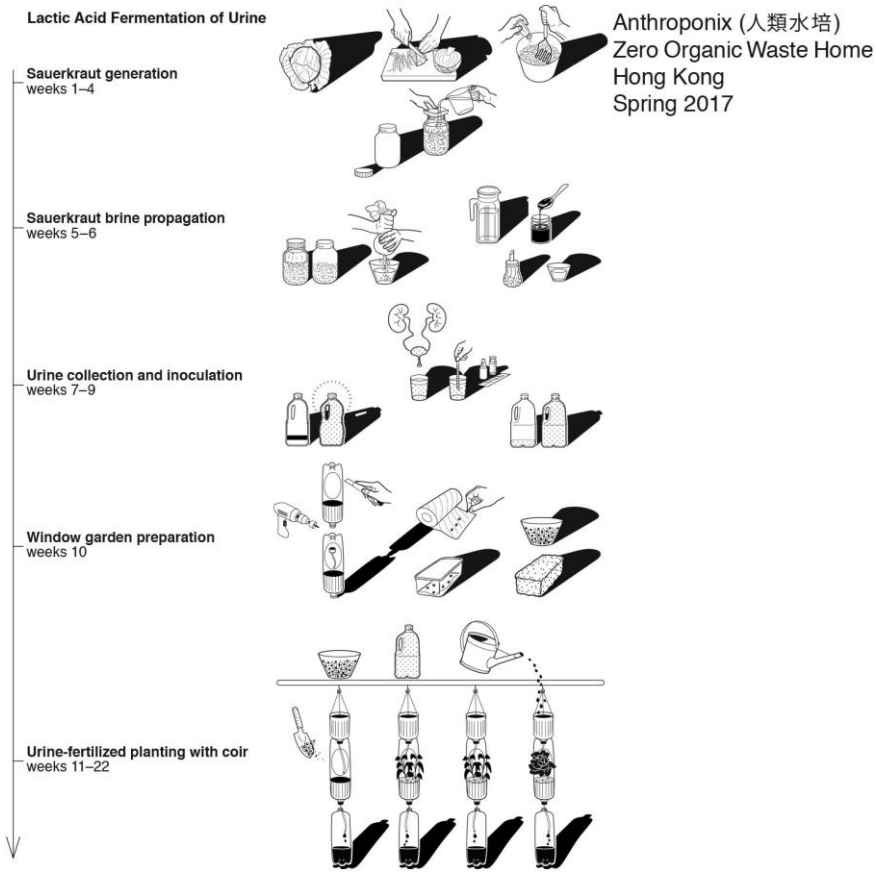

Figure 2. Fermenting urine inside collective food pedagogy.

Each fermenting urine specimen became part of an annotated self-examination passage that involved medical dipstick testers, diet monitoring, and botanical tracking. Participants consolidated all data into an intricate Mutual Thrivability journal. The community spearheaded an untested closed-loop resource system that required participants to jointly overcome technical and affective ambiguities. The imperfect technical setup invited tinkering, instructive failing, and social curiosity—all forms of excitement stemming from responding to unsettling relationships that ignited unifying purpose, social engagement, thus captivating participants' inventiveness for over three months. The empathetic exploration led many to continue their fermentation experiments or join garden groups long after the project ended.

The agroecological experiment reframed human waste as a responsibility-triggering agent (Wernli, 2019). It countered visions of the urban as an inevitable nutrients' sink, instead reimagined the household as a resource hub between human and environmental circulations.

2.3. Berlin: DYCLE (Obst aus Babywindeln)

Responding to severe soil degradation and water shortages in the German capital region, an artist-led human waste reuse program has evolved in recent years. Under the name DYCLE, the communal start-up pioneers the eco-friendly transformation of baby nappies into fertile soil for fruit orchards since 2014 (Figure 3). The proposition is to cultivate fruit tree orchards along the city's outskirts led by diaper-upcycling families. Building on revenue from tree adoptions rather than the sale of diapers, the DYCLE enterprise entails custom production of biodegradable diaper inlays and communal composting into Terra Preta black soils, to grow heirloom fruit trees. The engaged families meet weekly at a central processing point to exchange soiled inlays with fresh ones (Debatty and Matsuzaka, 2019).

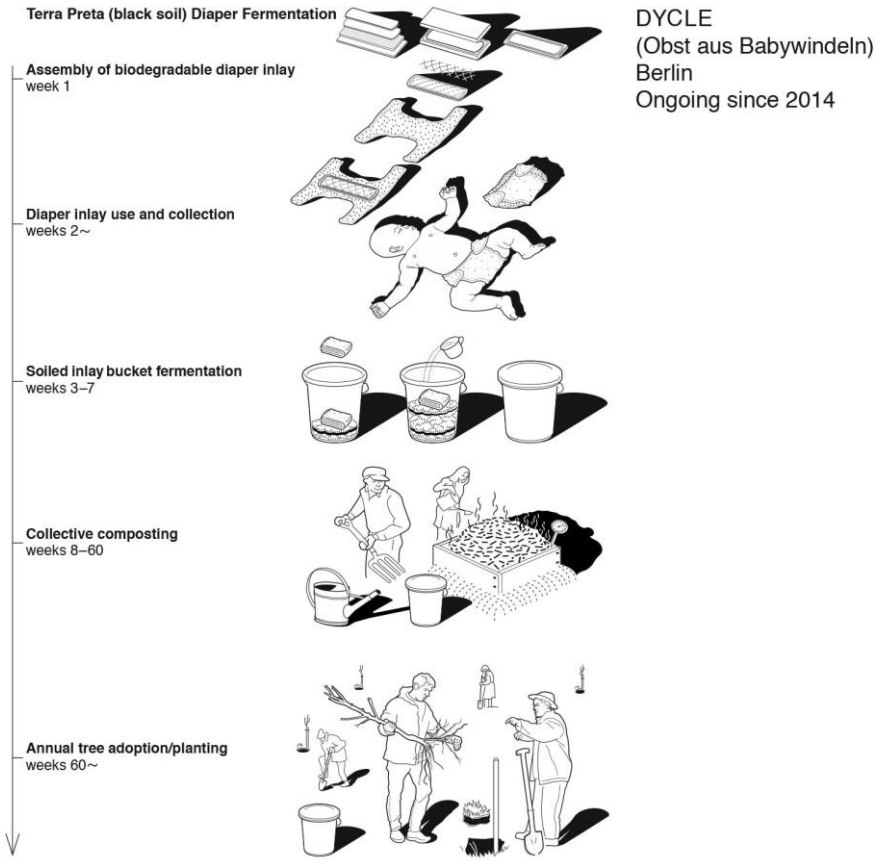

Figure 3. Tree adoptions supports the social enterprise.

DYCLE established a value-creating local economy that spans community, soil care, food forests, and employment. Advancing this biosocial proposition required that all elements and procedures be custom-configured to serve the larger purpose. It took the DYCLE team six years of trial and error to develop diaper inlays that would satisfy both the needs of the baby and the soil. Several hackathons and maker occasions provided gradual breakthroughs for incorporating local plant fibers into appropriate diaper inlays. While the community around DYCLE's core team fluctuates, its empathetic exploration inspires communities increasingly beyond Berlin to adopt the diaper-to-orchard economy. Generations growing up with diaper-fertilized orchards help normalize the agroecological use of human waste and affirm humanity's role in Earth's shared metabolism.

All three excrement upcycling communities demonstrate, in their respective context, how advancing commitment, practices, and capabilities prompted curiosity about the human function in replenishing the biophysical foundation. With this disposition, the author wished to probe further the value of productive uncertainty in communal experimentation by diverse citizens inside their daily lives. The following section introduces how the research was conducted with these actors.

3. Methods and analysis

This research presents three urban eco-toilet communities to evaluate the enablers and barriers to collaboration under uncertainty. The research responds to the need to justify urban eco-toilet experiments, find ways to sustain them, and tailor follow-up interventions. The author wanted to examine the characteristic features and frames of reference in communities that equip communities with agency to self-manage place-bound arrangements.

3.1. Gathering research material

The study integrated participant observation, document review, and interviews into a multiform analysis. Based in Hong Kong, the author knew the organizers of the cases in Brussels and Berlin from eco-sanitation networks but was neither involved in planning

these projects nor implementing them. The research material was collected by the organizers of each case and compiled by the author. In the Hong Kong case, 54 interviews ranging from 45 to 120 minutes were conducted. All field notes highlighted the position, role, and possible influence of the respective note-taking organizers. In Hong Kong, drafts of the manuscript were subjected to validation of respondents.

3.2. Analyzing creative productivity under uncertainty

To evaluate the data, the author adopted SWOT analysis, whereby the internal Strengths and Weaknesses of an organization are correlated to the external Opportunities and Threats for determining fruitful future directions. However, design innovation studies indicate how SWOP analysis is limited to account for novelty since it takes existing organizations and contexts as point of reference (Dorst, 2005, p. 145). Also, the terms ascribed to Strengths, Weaknesses, Opportunities, and Threats predefine assumptions that delineate the examination. To evaluate the precedence-setting eco-toilet cases, each of the four SWOP terms were correlated with the three dimensions of the Idea-Arrangement-Effect (I-A-E) framework used in systems design (Lobenstine, Bailey and Maruyama, 2021). For assessing the Strengths and Weaknesses, participants of the eco-toilet interventions walk themselves through the given Arrangements (A) at play then relate them to the Ideas (I) embedded in those Arrangements to be able to contextualize the systemic Effects (E) thereof. The subsequent Structural SWOP analysis thus focuses on reflecting upon the arrangements of one's reality to change it in more sensible ways (Borda, 1979).

3.3. Coding and Structural SWOP analysis

Research materials were summarized in text descriptions and analyzed inductively using open coding to give voice to the diverse actors and permit themes to emerge. The Structural SWOP analysis was used to render connections among (non)human actors, material practices, emergent perspectives, and symbolic discourses. Guided by criteria from the Idea-Arrangement-Effect (I-A-E) framework, the following questions assessed Ideas (I), Arrangement of value creation (A1), Arrangement of practices (A2), and systemic Effects (E) in regard to the cases Strengths (S-):

- (S-I) what collective vision work well in pursuing the initiative?
- (S-A1) what is unique about the community's self-validation?
- (S-A2) what is specific to the community's practices?
- (S-E) what are benefits for (nonhuman) actors stemming from the initiative?

Regarding Weaknesses (W-), the questions were:

- (W-I) what conventions hamper the progress?
- (W-A1) what forms of validation are underperforming and why?
- (W-A2) what practices (tasks) are detractive and why?
- (W-E) what resources could improve contributions to overall thriving?

Regarding Opportunities (O-), the questions were:

- (O-I) what are future ambitions?
- (O-A1) where are offering gaps of contributions?
- (O-A2) what synergies can be accessed to address weaknesses?
- (O-E) how do proliferating effects create synergies?

Regarding Threats (T-), the questions were:

- (T-I) what trends of thought are on the horizon?
- (T-A1) what techno-economic counterforces are outperforming the initiative?
- (T-A2) what are the behavioral barriers to change?
- (T-E) what macro-level changes are cause for concern?

The following section discusses the results by correlating the pluralization of perspectives generated from dialogue with Structural SWOP with subjecting ordinary experience to what initially might have been unthinkable.

4. Results: Productive uncertainty of urban eco-toilets

The following chart (Table 1) summarizes the Structural SWOT analysis of the research material. In this analysis, the Strengths, Weaknesses, Opportunities, and Threats components are specified with narratives (vision), value creation (economic arrange-

ments), practices (work arrangements), and systems' functioning (effects) to better account for the enablers and barriers underlying them. Comparing the eco-toilet communities, side by side, allows acknowledging the overall propensities, as listed in the Enablers/Barriers on right column.

Table 1. Structural SWOT of urban eco-toilet cases to identify their enablers and barriers.

	BERLIN	BRUSSELS	HONG KONG	*Enablers/Barriers*
Strengths				
(S-I) Collective vision	Intergenerational resource sovereignty (joint enterprise)	Regenerative placemaking (joint purpose)	Human/plant health interactions (joint discovery)	*Collective imaginary*
(S-A1) Arrangement: Value creation	Periurban resourceful economy	Neighborhood resourceful economy	Peer-to-peer resourceful economy	*Collaborative economies*
(S-A2) Arrangement: Practice	Self-implication in food forest cultivation	Self-implication in urban park revitalization	Self-implication in interspecies alliance	*Distributed responsibilities*
(S-E) Effects: Functioning	Fulfillment from intergenerational links and cross-sector technology innovation	Fulfillment from coevolution with biophysical foundation	Fulfillment from failure-tolerant learning and cohesion	*Environmental citizenship and convivial technology development*
Weaknesses				
(W-I) Collective vision	Elimination-driven focus	Confrontational, activist design	One-off research cycle	*Single-minded framing of dichotomies*
(W-A1) Arrangement: Value creation	Prohibitive property rights (inaccessible land use rights)	Weak institutional and legal framework	Expertise silos	*Challenge to divert resources away from vested interests*
(W-A2) Arrangement: Practice	Reliance on volunteer labor (competitions)	Reliance on migrant workers (inequality)	Reliance on goodwill (tokenism)	*Challenge to engage commitment over time*
(W-E) Effects: Functioning	Active policy engagement	Cross-sector compensation and funding	Scientific priority and educational credit-bearing	*Social recognition leading to the food-enabled city*
Opportunities				
(O-I) Collective vision	Pan-urban resource proliferation	Public/private coevolution	Mutualist caregiver	*Coproducing food sovereignty*
(O-A1) Arrangement: Value creation	Local resourcefulness hubs (convivial conservation)	Upcycle waste with waste (not pristine resources)	Consumer/producer tie-ups (urine to fodder production)	*Resourcefulness*
(O-A2) Arrangement: Practice	Eco-regenerative industry (localization)	Eco-entrepreneurial provider (infrastructuring)	Eco-literate household network (platforming)	*Multiplying local efforts planetwide (scaling-out)*
(O-E) Effects: Functioning	Convivial afforestation and conservation program (eco-city development)	Provision of eco-regenerative toilets in urban margins (participatory urban metabolism)	Community-supported resource recovery (right to reintegrate human waste)	*Radically participative food systems*
Threats				
(T-I) Collective vision	Reclusive 'nature' conservation	Perfectionism (purity ideals)	Immunity from decay (mortality fear)	*Hegemony and defensiveness*
(T-A1) Arrangement: Value creation	Market substitutions (underpriced external resources)	Convenience standards	Dehumanization of work	*Singular path dependencies (lack of resourcefulness)*
(T-A2) Arrangement: Practice	Routine use of disposable diapers	Routine use of flush toilets	Routine use of external fertilizer	*Inertia to change*
(T-E) Effects: Functioning	Ecological breakdown (extreme events)	Social distancing (labor shortage)	Biophobia (Nature Deficiency Disorder)	*Breaching tipping points*

4.1. Strengths

Propelled by Terra Preta movement, municipal revitalisation, and pro-environmental university backing, the eco-toilet initiatives in all three cases were successful in building 'commanding presence' (Borgman, 1995) and establishing vibrant followings responding

to their urban context. The interventions sparked a collective imaginary spanning intergenerational enterprise, regenerative placemaking, and human/plant health interactions for transcending stigmas associated with human waste. This shared narrative translated in the social arena into prototypical collaborative economies that stimulate value chains between city and countryside, neighbors and visitors, or peers and mentors. It means that conventionally segregated roles (like consumers and producers) could be fluidly exchanged, thus use-values questioned and redefined. Such 'collaborative contamination (Tsing, 2015, p. 27) required participants to negotiate material responsibilities. Experientially embedded, the self-implication 'what else/how else' mode of thinking triggers multiple perspective-taking essential to social creativity (Glăveanu, 2020). In effect, these more-than-human alliances candidly suspended the prerogatives of domination (Borda, 2006, p: 27) between humans and nonhumans. 'Defamiliarization as social activity' (Cohen, 2000, p: 97) of what is commonly relegated to 'sanitation' made for fulfilling experiences through intergenerational purpose, biophysical linkage, or cohesion in a failure-tolerant group of learners. Such community mobilisation spurs cross-sector technology development and environmental citizenship as manifested in inventive appropriations of organic resource reintegration tailored to the site-specific needs on the level of landscape, neighborhood, and household.

4.2. Weaknesses

The eco-toilet initiatives face societal obstacles that hamper their advancement. Regarding conventions, the eco-toilet communities find themselves working against unhelpful dichotomies that make it challenging to break new ground. Long-standing urban sanitation regimes reduce (human) waste to a matter of efficient elimination forgoing its regeneration potential (Waltner-Toews, 2013). Hampering conventions are also self-imposed, like in the Brussels case when overambition on the organizers' side posits a confrontational activist proposition or, in the Hong Kong case, a one-off, short-cycle research project that impedes longer-term prospects. Regenerative eco-toilets demand receptive soils, negotiable frameworks, and evolutionary thinking before they come to fruition. Property privileges make nutrients-deprived lands inaccessible, legal frameworks mandate eco-toilets to be connected to the resource-wasting sewer, and there is a lack of willingness to interlock waste management with resource proliferation. All three cases stipulated 'biosocial protocols' (Galloway, 2004) that proposed a renewed purpose for human waste that is both demanding as well as self-disclosing. Rather than approaching earthworms, urine, or peers as mysteries to crack, it is a call to rediscover and never completely know these subjects so that their possibility of future change remains viable (Kearns, 2015, p. 99). Operating eco-toilets demand temporal resources of caregiving labor. The cases rely on hackathons, migrants' employment programs, service learning schemes, and goodwill—that can be short-lived. The self-perpetuating cause behind these weaknesses is the absence of social recognition for the 'food-disenabled city' (Tornaghi, 2017) unfit to reintegrate organic resources, including human waste. Thus, the cases need to go past awareness and perceive themselves as alternative models for addressing the food-energy-water nexus.

4.3. Opportunities

All three cases create multiform opportunities in their respective urban settings, ranging from landscape proliferation, employment prospects, material development, and pro-environmental subjectivities. As manifestations of an alternative urban narrative city dwellers experience themselves as part of a long-range urban/rural exchange, participative park revitalization, or human/plant cultivation, whereas conventional roles a blurred for unexpected, ever-emergent capabilities to spring up. Opportunities arise when eco-toilets in the global north are not just considered gap-fill approaches but models to be scaled-out elsewhere. Diaper upcycling aimed at convivial conservation manifests a node in a network of resourcefulness, eco-toilets harnessing multiform energies, and the consumer/producer tie-ups fostered in these metabolic economies create use-value in direct alignment with the biophysical foundation. Perceived beyond arborist diapers, jacuzzi-heating toilets, and urine ferment, the cases represent applied strategies of bringing ecologically regenerative literacy to practices of localized industries, entrepreneurship, and households. The life-proliferating productivity of bio-energy, regenerative greening, carbon-sequestering, and synergetic world-participation of circular humanure systems cannot be emphasized enough especially vis-à-vis tightening government budgets. In a rapidly destabilizing world where all life forms inescapably coexist because they feed on each other, eco-toilet routines become part of the 'provisional proposition' (Glăveanu, 2020) of

more-than-human public health that is opportunity and effect of concurrent human/environment interactions.

4.4. Threats

In the face of accelerating climatic disruption, resource depletion, 'sixth extinction,' and rampant social inequality, the impulse for command-and-control 'solutions' is on the rise, cementing the complete faith in human domination and capitalist markets. In this narrative, what is considered 'human development' and 'natural environment' ought to be further detached as to 'protect' them from each other. What is considered 'nature' thus is securely placed into sanctuaries to eliminate the frictions between conservation efforts and capitalist production (Büscher and Fletcher, 2019). The very economics of market and state substitutions, in effect, defer the environmental costs of external inputs like fuels, feeds, and fertilizers to future generations, which undermine entirely the regenerative value of locally recovered biomass (Tornaghi, 2017). Clinging to narrow purity ideals that stigmatize decay, mortality and dirt-expelling bodies is detrimental for reconciling the impure otherness inside humans that enables them to live (Caslav Cavino, 2004). However, the eco-toilet cases do not trade purity for messy existence. They incorporate both by aligning the needs of humans and nonhumans towards regenerative and just landscapes. Eco-toilet designers find themselves in the paradox of being challenged as well as affirmed by ecological functioning and dysfunctions of our times. Weather extremes may potentially nullify the diaper-fertilized afforestation efforts, while ensuing migration streams will increasingly demand ambulant eco-toilet approaches. Pandemic fears may discourage urbanites from fermenting and composting while this probiotic work may have valuable answers to sedentary, dirt-averse lifestyles of the global north (Louv, 2005).

5. Conclusion

Assessing three cases of urban eco-toilets in Brussels, Berlin, and Hong Kong highlights the following:

1. Collectivized urban eco-toilets become increasingly essential as complementary approach for responding to resource shortages, fluctuating sanitation needs and city dwellers' disconnect to their biophysical foundation;
2. Thriving urban eco-toilet communities balance unsettling bathroom routines, group debates, and agroecological experimentation with a rich interactive context to embrace the unknowable;
3. The applied Structural SWOP analysis can better account for the inventive potential of precedent-setting eco-toilets through its focus on system functioning.

The social creativity in the three cases stems from the fact that human waste can be reimagined and used in multiple ways, as health indicator, worm food, soil conditioner, intergenerational arc, or civic resistance. The task then for designers is not only to include the perspectives of (unwanted) otherness but also problematize the lack of recognition for the diminished creative potential of such marginalized, human or nonhuman—that ultimately hampers the advancement of humanity overall.

Contributor statement

Conceptualization, Methodology, Validation, and Writing by the author.

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