Are We Repairing Soils and Each Other Here? Exploring Design Cosmotechnics in the Waste Age

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ABSTRACT: Design research increasingly turns to non-Western perspectives on repair to counteract the Waste Age and our climate crisis. We draw on the cosmotechnic vision by Yuk Hui (許煜) to explore agriculturists in Hong Kong who repair soil ecologies by recovering resources. They share many cosmotechnics commitments that subordinate human bodies, tools, and arrangements to balance their relations between Earth and cosmos. Our goal was to identify devices, practices, and characteristics that enact (in imperfect form) repair-led design from the place-based interworkings of technologies and environmental conditions. We encountered practitioners experimenting with organic waste, integration, climate farming, and community building. Turning these concerns into a socio-material-cosmological proposition of repair, we ask: What if we cultivated landscapes *and* each other? This research aims to advance design that no longer requires constant repair.

KEYWORDS: Asian cosmologies, Daoism, Yuk Hui, fermentation, agricultural innovation, soil care, multispecies ethnography, Hong Kong.

1. Introduction

Confronting our Waste Age (McGuirk 2022) starts with realizing that wastefulness is a learned propensity, thus, not inevitable. Already, ancestral Hakka (客家) farmers and Tanka (水上人) fisherfolk in Hong Kong brought the residual power of organic wastes to fruition on local lands and waterways. Such repair-led designing was underpinned by the lived continuity across lifeforms and awareness of the limitations of one's knowledge: it was conditioned by an underlying Daoist cosmology that demanded structural and distributive measures for prudently replenishing fields and fish.

Accepting our Waste Age implies that refuse is the condition of our current logic of economic 'growth' and technological 'progress.' Design tied to this productivity economy constitutes not a solution but the problem itself. Design is dissociated from any cosmic order, removing the *figure* (what is differentiated) from the *ground* (what is undifferentiated). The absence of an immediate relation to the environment leads to "design that has become a cosmology without a world" (Bonnet et al. 2019). What we experience in the Waste Age is not

mere brokenness of designed products but socioecological disruptions on a planetary scale. Thus, upholding the status quo with 'sustainability fixes' should be replaced with confronting complexity and exploring systemic, "futuring alternatives" (Fry 2020) for regrounding design as a caring discipline. It requires us to reposition the standing of repair by asking: How do repair situations co-constitute actors, materials, and technology (Sormani et al. 2019)? How can repair ethics nurture a community that is neither egotistic nor anthropocentric but is instead regenerative of coexistence with multiple others? How do repair communities cultivate intimate know-hows that are "hyperlocal" (Manzini 2019)? How do repair communities reshape social orders by embracing vibrancy and precarity (Jackson 2019)? Rather than subjecting the practice of repair to design, this chapter considers the potentiality of *repair-led* design. Repair-led design shifts the design rationale away from innovativeness toward equipment for social learning about what is mutually desirable in communities prioritising care.

Commonly, repair arrives *after* design. The designer speculates and innovates while the repairer fixes the broken parts of what is designed. Such a partial relationship between design and repair has been widely examined (Krebs and Weber 2021; Sennett 2012), particularly vis-à-vis socioecological disruption and demise (Nancy 2014) and "climatic regime" (Latour 2017). When current design practices contribute to carbon dioxide and microplastics that delineate our futures by breaching vital boundaries between nature and culture, designers must account for the centrality of waste.

This chapter evaluates the repair qualities of eco-farming experiments in Hong Kong to contemplate repair-led design. As design researchers, we share our interlocutors' commitment to enacting repair-led transformations that manifest futuring alternatives by simultaneously regenerating soils and multiple lifeforms. Drawing on Daoist cosmology (described in section below) and tangibly engaging with regenerative agriculture foregrounds enactments of repair-led design on the following four existential levels:

- Subject level (i): **'integratings,'** recognition for what is beyond human capacities;
- Process level (ii): **'doings,'** place-based and embodied practices;
- Situatedness level (iii): **'relatings,'** contingency with multiple lifeforms; and

- Engagement level (iv): **‘observings,’** paying heed to what is pre-existent.

Our work led us to a distinct biodynamic and material conception of repair practices. Here, human organisms become immersed alongside plant, animal, and microbial organisms in proximity, alliances, and confrontations that structure living practices from self-sustenance to repair-led designing. It prompted us to wonder, ‘Are we repairing soils and each other here’? This provocation captures what builds confidence in mutual flourishing (rather than survival) and entails eating wholesome food, finding mentors, reconnecting with nature, and accessing opportunities to grow.

The chapter focuses on the repair ethics of six agricultural experimenters in Hong Kong as part of a larger research program involving 24 respondent groups. The six cases were chosen for closer analysis since they showed a repair-led ethos. From this work, we established a framework that identifies the Daoist attributes of cosmotechnics in repair-led, alternative eco-farming. We see the concretisations of these attributes as a response to the external constraints of agriculture that, like design, require repairing intervention. Tied to social and ecological functioning, when agriculture fails, it leads to starvation and instability. Yet, its low barriers of entry are also amendable to grassroots experimentation, making it an arena of hope, discovery, and inventiveness. To make our findings accessible, in the next section, we correlate cosmotechnics to the coevolutionary ecologies of fermentation and traditional belief systems to propose a framework of characteristics that can guide repair-led designing. After applying an evaluative framework to cases of waste recovery, eco-farming, and community building, the chapter concludes with a fuller picture of repair-directed design cosmotechnics.

2. Background: Situating cosmotechnics in repair-led design

Cosmotechnics has been widely discussed in creative media studies as the experiential notion of technical variety, which can be ambiguous. In this section, we introduce cosmotechnics to the discourse of repair and design by situating it with socioecological re-conceptions of belief systems and bioremediation techniques shown to be integral to regenerative farming practices.

Berkes (1999) has developed the Knowledge-Practice-Belief framework to identify the dimensions of repair-led social practices (Figure 1). It identifies four layers of traditional existential capabilities: (i) local knowledge of biota and landscape; (ii) environmental management systems that enable appropriate ecological practices; (iii) institutions, norms, and codes of social conduct; and (iv) worldview, including ethics, spirituality, and belief systems. These four layers correspond to the Daoist, repair-led dimensions outlined above. Each layer is conditioned by the other, always interlinked as a feedback web. Noteworthy is how ancestral knowledge systems are not restricted to utilitarian resource management but nurture a contingent figure/ground relationship: decision-making is both constrained and empowered by cosmological footing demanding continued ethical negotiation. In his conception of Asian "*cosmo*technics," philosopher Yuk Hui (許煜) illuminates this figure/ground dynamic (Hui 2016 p. 26–27) through the *Qi* (器 for: 'tool,' 'technics,' 'container') and the *Dao* (道 for: 'cosmic order') which are united and affirmed in *Ganying* (感應 for: 'resonance'). It invokes an ethical and sociopolitical sensibility simultaneously. *Qi,* as the technical object or system, is the affective containment of *Dao*, while the *Dao*, being formless and unmeasurable, necessitates the *Qi* to manifest itself.

Transitioning to repair-led design in the Waste Age parallels the shift from the groundless technics of modernity toward adept technological practices, conscious of their footing and embeddedness. Our research into waste-recovering agriculture and fermentation communities adopts Hui's paradigmatic conception of cosmotechnics. However, by discussing Asian cosmotechnics as an interpretative framework, this chapter does not propose a dualist opposition between Occident and Orient, global and local, technics and cosmotechnics. East Asia has already undergone numerous disruptive cultural transformations and an unprecedented acceleration of technological change, so a simple return to ancient cosmologies is no longer viable. Preferred over the construction of Orientalism, "dis-orientation" (Hui 2016 p. 190) points to the spatial disruptions and incompatible temporalities experienced in the Waste Age. Fry (2007; 2020) conducts a similar inquiry into the cultural traces of Daoism and Confucianism confronting Chinese modernity and their residual power for opening alternative possibilities of designing. Admittedly, the local nowadays is inseparable from the global, yet it should not

prevent us from exploring a locality capable of appropriating and transforming the global from *within* (Hui 2016 p. 223–224).

To cultivate discourse and practices of ecological repair, we situate Berkes' model of traditional knowledge in the contemporary Chinese context (Figure 2). The four corresponding layers in the adapted model are on the subject level (i) *Fengtu Renqing* (風土人情) affective knowledge of milieu and local customs; on the process level (ii) *Qi* (器) technics, technical skill, and practice—inadequate on their own, relying on *Dao* to seek refinement; on the situatedness level (iii) *Ganying* (感應) uniting *Qi* and *Dao* in resonance for connecting part and part, as well as part and whole; and on the engagement level (iv) *Dao* (道) the cosmic-ethical order which liberates *Qi* (praxis) from any calculative predetermination. We schematized Hui's insights (2016) into the figure/ground dynamics of (i) '*integratings,'* (ii) '*doings,'* (iii) '*relatings,'* and (iv) '*observings,'* resulting in our design cosmotechnics framework. The intensifying junction between these spheres marks the dynamic of repair-led designing. For analysing the ethnographic cases, we consolidated Daoist repair-led dimensions and figure/ground dynamics into the corresponding cosmotechnics attributes. They include on the subject level, (i) Humility (風土人情); on the process level, (ii) Attunement (器); on the situatedness level, (iii) Contingency (感應); and on the engagement level: (iv) Coevolution (道). For evaluating the groups of agriculturists encountered, we gauged these attributes with the following validation statements:

- (i) **Humility**: 'This group is aware that soils, microbes, plants, and animals are in control of successful harvests and human prospects overall—this respect is also enacted;'
- (ii) **Attunement**: 'This group practices sensible forms of ecological coexistence by putting their efforts into reclaiming resources, generosity, soil life, landscapes, and biodiversity;'
- (iii) **Contingency**: 'This group has invested themselves in tackling wastefulness without preliminary guarantees—they do not ask upfront for benefits or who is to blame but work closely with (nonhuman) others on countermeasures;'

- (iv) **Coevolution**: ‘This group experiments with alternative ways of living together to explore new relations pertaining to local traditions, knowledges, techniques, and social formats open to diverse futures.’

The enactment of repair, understood as the back-and-forth across all four existential layers, acquires a distinct sense. It is no longer a ‘fixing’ forced on to nature that opposes the human, as modernist naturalism presupposes (Descola 2013). Instead, it becomes a constant nourishment of vitality, a process emerging from the oscillation of *Ch’i* (氣), the ‘breath-energy’ that generates life when concentrated and dissolves life when dispersed (Jullien 2007). The movement of *Ch’i* resembles cosmic respiration, expressing *Dao* as the ultimate principle of life. While *Dao* is unconditioned, human life is always provisional. Thus, one should stay vigilant to the interworkings of *Dao* if one is to nourish life in oneself and others. For Sennett (2012), the most experimental and radical repair practice does not simply fix broken things but reconfigures broken social relations by renewing cooperation. To this, we add the idea of systemic reconfiguration that envisions communities of vitality, including human *and* soil health.

From the soil care practices witnessed in Hong Kong, we attempt to encapsulate the features of vitality as local manifestations of cosmotechnics and make them useful for a shared inquiry into repair. Our goals were (a) to survey the existing local practice and knowledge base, (b) to critically contemplate our future intervention in collectivized soil regeneration, and potentially (c) to liaise with collaborative partners.

With its symbiotic culturing of people and microbes (Zilber 2019), the hyperlocal fermentation process can be understood as cosmotechnic manifestation. The hyperlocal is not only the local in terms of social geographies but also the intensifying field of possibilities and actions in relation to where someone stands. A ‘whiff’ of uncertainty pervades our microbial relationships to food and land since fermentation always implies a cosmo-politics of “living collaboration” (Maroney 2019) that refuses purity regimes and values the imperfect and the process of interdependent nourishment (DuPuis 2015). Framing the present chapter in terms of

design cosmotechnics, we explore how Earth-bound fermentation may help us repair – nourish, cultivate, and stipulate – communities in people and soils.

3. Methods: Advancing discourse using (multispecies) ethnography

Linking cosmotechnics to ancestral knowledge ecologies and repair in the above section highlights the importance of place-bound entanglements of technologies, diversity, and constraints. These are positioned as non-Western footings of the central concerns of this chapter – design for care, communities of repair, and environmental justice – with a focus on fielding repair insights. We examine cases of agricultural practices that, to various degrees, manifest the kind of human-technology-nature dispositions that advance a design ethos in which the impetus and agency of repair are implicit.

The cases presented are drawn from ethnographic field research conducted by the authors and a permaculture practitioner over the summer of 2021 in the New Territories (香港新界) of rural Hong Kong. We selected these cases to illuminate the rethinking of repair in relation to how the world might be assembled differently. The sampling of the cases reflects the interests of the researchers – agricultural innovation for reintegrating waste – while accepting that choosing agriculturists to be observed and interviewed depended partially on the serendipity of personal encounters and networking. However, we argue that agriculture and waste recovery in Hong Kong represents fertile ground for sociotechnical innovation because of the territory's intense combination of urban-ness and rurality, crucial position in global capitalism, complicated relationship with mainland China, and its colonial histories involving Europe and Japan.

Researching beyond human concerns: Our data collection methods explored how thinking and acting contribute practically to repair-led arrangements. To bring focus to restoring depleted soil ecologies in Hong Kong, we provided each respondent with a complimentary container of 'microbially supercharged' soil conditioner fermented by ourselves. Sourced from bamboo fungi (mycelium), rice mill residue (bran), and food scraps (nutrients), we questioned: how could this more-than-human repair proposition – which we named 'native Bokashi ferment' – be adopted in the operation at hand? As part of our "multispecies ethnography" (Gatto and McCardle 2019),

the material prompt was meant to direct the farmers' attention to the possibilities of enhancing healthy interactions in soils, plants, and animals, including humans. The farmers' responses assisted us in evaluating their readiness for future collaborative explorations and informed the findings of this research. By decentering humans and considering systems-level thriving, this approach invoked how repair-led design cannot just account for but must also stipulate the enactment of regenerative transformations. To record the simultaneous cultural exchanges in different places that typify the complexity behind wastefulness in Hong Kong, the researchers implemented a "multi-sited ethnography" (Marcus 1995) that involved 24 agricultural groups and 34 site visits with 38 interviews ranging from 45 to 180 minutes.

Including multiform data: Our research material includes fieldnotes, photographs, audio recordings, and document collection from concern groups and practitioners. Our interlocutors are production farmers, leisure gardeners, vegetable distributors, community organizers, and more. Interviews were held in English and Cantonese: these were translated by the authors, one of whom is a native Cantonese speaker. Multi-sited ethnography also entailed documenting the interlocutors' online presence – since Hong Kong agriculturists engage in social media – to learn how their activities unfold virtually and interface with others in the wider public.

The goal was neither to delineate the phenomena nor to predict the future; instead, envisioning a more cosmotechnical world that does not exist yet is worth uncovering. The four-fold cosmotechnics attributes of subject-practice-situation-engagement dispositions inspire reflections on repair-led design. In the following sections, we occasionally use imaginative language in our write-up to evoke our experience of encountering practitioners, places, and voices.

3.1. Encountering soil cultivators in Hong Kong

Our 'microbially supercharged' ethnography for exploring cosmotechnic affinities is situated in Hong Kong, a global transit hub of capital, goods, and people that epitomize the Waste Age. Almost half of the territory's solid waste consists of biomass discarded from food industries and

households that contribute to severe nutrient pollution in the waters of the Pearl River Delta and potent greenhouse gasses in the bursting full landfills (Fabian and Lou 2019). Conventional policy and technology interventions seem unable to curb the rampant increase of solid waste (worsened by the pandemic). Unlike other solid wastes, food byproducts, kitchen scraps, woody residues, and manures are *biodegradable*—meant to regenerate new life and proliferate our biophysical foundation. Thus, our research is motivated to study experimental agriculturists seeking 'repairful' alternatives. They come together to address the avoidable wasting of biomass as integral to pursuing resourceful, local food production.

Hong Kong maintained high food self-reliance until the 1970s, when food production was systematically outsourced abroad to make way for urban development (Chow 2019). However, on the margins and in fragments, city dwellers and professionals demonstrate a desire to live in more symbiotic kinds of human-land relationships. They address environmental detritus by experimenting with ecological farming techniques and seek to improve communal life.

To reflect on and contrast different approaches to soil care, we confronted industrialists and practitioners with the 'native Bokashi ferment'. The inquiry's goals were to discern (a) how ecological practices of resourcefulness can provide alternatives to farming, b) how to transfer such techniques to repair-led design, and (c) how these practices manifest or problematize notions and strategies advocated in cosmotechnic terms. Our inquiry, focusing on six cases, moves gradually from a descriptive to an interpretative account to establish a mutual understanding before developing our contribution.

3.2 Growing with soil or without

Located at the border to Shenzhen, the *Mapopo Community Farm* (馬寶寶社區農場) was founded in the early 2000s by Becky Au and Cho Kai-kai, who quit their economics studies and office jobs to protect their native farming village Ma Shi Po (馬屎埔) from encroaching urban development. Learning to cultivate vegetables from veteran farmers, Becky and Kai-kai seek contingency between the rural and urban. Insightful suspicion about unquestioned urban

wastefulness prompted the farm to convert food waste into organic fertilizer. The farm collects veggie scraps from wet markets, fruit pulp, tofu residue, and mushroom substrate from the local food industry and enlivens their soils through practices of mulching (Figure 3), composting, and 'enzyming': the fermentation of fruit peels cultured in a mixture of water and cane sugar. Becky and Kai-kai explain how their soil care with compost propagates a microbial wealth that relates directly to the healthiness of crops. Growing in the rich, coevolutionary soils of *Mapopo*, the plants develop stronger immune systems for withstanding insect attacks, pests, and weather extremes.

Ten kilometers southeast of *Mapopo* in the alluvial plain of Kam Tin (錦田鄉), we find *Sangwoodgoon* (生活館) *Living Pavillion* farm, formed in 2009 by anthropologist Chow Sze-chung who took up farming in opposition to the Express Rail Link construction that upended dozens of farm villages. Sze-chung and his wife make a living by growing heirloom rice and 30 crops with minimal human and mechanical intervention. *Living Pavillion* seeks coevolutionary potential with feral soybeans and weeds that are companion species to the rice: they protect the soil, retain its moisture, shelter a diverse range of critters (including paddy frogs, mole crickets, and eels), and through photosynthesis, nourish the soil's microorganisms. That is a lot of 'ecosystem services' that Sze-chung has delivered by untidy companion species rather than himself. Inadvertently, such bounty attracts predators that can be humiliating. Days before our visit, a wild boar had plowed through the farm and feasted on the potatoes, in its wake depositing fecund manure.

Contrary to mutually attuning "mixings of insides and outsides" (Tsing et al. 2019 p. S189) at Becky's and Sze-chung's farms, many conventional farmers associate agriculture with the geometry of tilt-leveled soils, monocrops, neat rows, and irrigation circles. The modular simplification of monocropping eliminates the number of life forms to one type for concentrating labor and resources on productivity. Urban planner Gordon Tam, co-founder of the aquaculture investment group *Farm66* (綠芝園), is shifting agriculture from the geometric into the parametric. In a quest for efficient use of vacant warehouses, control yield, and growth on-

demand, Gordon formulated the ‘clean-room farm concept’ inside a manufacturing building. Carps stacked in five layers of fish tanks are nibbling on imported feed pellets. Their excrements fertilize the crops above growing in LED exposure: fine-calibrated to improve leaf coloring, nutritional value, and taste. The soil-free mustard greens we sampled were indeed delectable. The system is replicable elsewhere through predictive datafication: the ‘smart cloud farm’ already links to Gordon’s subsidiary aquaculture facilities in Macao and Dubai, whereby machine learning responds to data points between fish and plants.

One may imagine the story told from the perspective of the carp fish subjected to the clean-room datafication, contrasted by the paddy eel embedded in an assemblage of to-and-fro relationality among insects, plants, people, and landscapes. Likewise, the wild boar, discovering a land of tasty abundance, could not resist. This kind of cosmotechnical accounting for interspecies, generative assemblages weaved into land and soil denote fermentation and repair as patterning of many contingent lineages. We now turn to such coevolutionary biographies that give rise to multiple futures.

3.3 The stuff of life, intimately shared

Encountering food growers with our live-cultured bokashi was more than instigating soil care. It was an exploration into intimacy. It reaches beyond the contingencies of nonhumans living in rice paddies, clean-rooms, veggie patches, or bokashi bins—from paddy frogs, earthworms, bamboo mycelium to chemical fertilizers, microplastics, and other forms of toxicity. Cosmotechnic intimacy is the recognition of being caught up in self-attuning, shared materiality, constituting with another “the flesh of the world” (Merleau-Ponty 1968 p. 248). Pursuing such people-embedding biophysical exchanges is the life purpose of Ho-ying Mak and Nicole Lam, owners, and vegetable packers at *TinYeah* (田嘢) food localisation platform. With no fixed product list, Ho-ying and Nicole prepare weekly veggie deliveries for their 130 subscribed families – whom they call ‘members’ – based on what the seven associated farms are harvesting in the morning. Should a typhoon inundate the fields, there are humiliating weeks without harvest; should drought and insects cause sprinkles and deformations to produce, the

imperfections will show. Ho-ying and Nicole maintain the social infrastructure to navigate these contingencies while creating livelihoods throughout.

Visiting *TinYeah*'s headquarters inside an industrial building, we walk into a homey room with veggie crates, wood shelves, packing table, and simple kitchen. The distributor's commitment to environmentalism is self-evident. The packing table stacks a colorful range of perpetually reused carrier bags with handwritten name tags for deliveries (Figure 4). As Nicole prepares a veggie bag, she messages the recipients to announce today's choice of produce to match their preferences: customer care as attunement practice.

Back in 2014, Ho-ying and Nicole started working closely with local farmers and chefs to revive Hong Kong's abandoned soy sauce brewing for bringing back the flavours of the land. While extreme weather compromised the outcome, relationships built in the process led them to found *TinYeah,* which translates into 'Field Stuff.' Ever since, the platform championed food localisation to counter what is widely considered a failing sector, neither viable nor desirable to work in. Yet, eco-farming is vital for the community to secure local sustenance and regenerate soils. Ho-ying and Nicole help remake conventional family farm structures by experimenting with socially open formats that attune younger people to working *with* the land.

Inspired by *TinYeah*'s work, media professionals Olive Chu and Ann Lee extend human/Earth alliances into their densely populated public housing estate in Kowloon Bay (九龍灣). To prevent incineration of their food scraps inside electric composters, the duo launched the *Present Living* (日常豐作) health food store that doubles as a food waste collection point. Here, two dozen soil-minded households collect kitchen scraps and reimburse Olive and Ann to have it shuttled to a startup farm, where composted it renews the *stuff of life,* including molecules, bacteria, and fungi.

A hilly ride away from the bustle of Kowloon, we return to the New Territories, where we find Ho Man-chi on her soil health research farm. Man-chi, a former social worker disillusioned by NGO culture and the wastefulness of urban life, co-founded *The Mushroom*

Initiative (菇菌圓). Here farmers, bioscientists, and functionaries devoted to agricultural innovation come together to explore soil care, carbon-storing farming, and crowd-sourced sensors. Inspired by the mycorrhizal networks of soil fungi, The Mushroom Initiative builds collective constellations with private and public sectors to repair metabolic rifts and circumvent widespread inertia. To interlock soil health with human flourishing, Man-chi currently uses open-access technology and develops with agroecologists, nutritionists, and product designers an inexpensive, handheld spectrometer device (Figure 5) for monitoring the nutrient density of crops—thus rendering visible agri-cultural contingencies.

The ethnographies denote cosmotechnic configurations in which all lifeforms – on their respective terms and abilities – enact a sense of collocation through closely attuning to each other's back-and-forth movements. It is paralleled by Ho-ying and Nicole's work that binds together varied farmers, locavores, toad-filled paddies, weedy farms, and hungry wild boars. For *TinYeah, Living Presence,* and *The Mushroom Initiative,* livelihood is crucial but not the essence: the cosmotechnic question is whether we are repairing soils and each other.

4. Findings: Cosmotechnic characteristics to advance design

Through cosmotechnic validation of multiform ethnographies, this section gauges repair qualities of soil-interacting groups in Hong Kong. By prompting our interlocutors with 'native Bokashi ferment', we sought to identify concrete traits, practices, artifacts, and strategies that constitute social transformations and place-based, ecological knowledge.

Assessing cosmotechnics criteria implies that the whole ethos behind human-technology relations needs to change to counter the Waste Age and achieve diversified futures. It is the logic behind designing that requires redesigning. Cosmotechnics criteria can help contemplate and implement a whole-system change that comprises outlook, lived practice, place, and worldview. Emergent cosmotechnics discourse (Hui 2016; Mitchel 2018) and our ethnographies put forward the criteria of (i) Humility, (ii) Attunement, (iii) Contingency, and (iv) Coevolution. In unison they became a compass to evaluate the readiness among respondents to enact design modes that regenerate flourishing, communal capacities, and a place worth living. Also, cosmotechnic

criteria helped researchers identify groups willing to experiment on successive research with organic waste.

In Hong Kong, where farmers' voices are vastly absent, we consulted with our permaculture advisor to define the criteria's validation statements for reviewing conversations and observations from respondents. The research team evaluated how the respondents' expressions approximated each criterion on a four-point scale of 0 for 'not present,' 1 for 'weak,' 2 for 'medium,' and 3 for 'strong.' This account does neither propose to be sufficient nor objective. The purpose of icosmotechnic criteria, as shown in **Table 1,** is only to foreground the importance of beliefs, techniques, impetus, and experimentation when designing for soil repair.

From this cosmotechnics evaluation, we derive four characteristics that help prioritise repair-led design, indicating that (i) *undesigning waste is provoked by insightful doubts* (Humility) since it takes concrete acts of learning to recover resources; (ii) *soil care practices are forms of self-cultivation* (Attunement) since they put humans in direct disposition with their environment; (iii) *mutations in nature and society are reconfiguring the terms of living* (Contingency) as processes of internal reorientation, and (iv) *people and situations come together* (Coevolution) to recover resources as follows:

- (i) **Undesigning waste is provoked by insightful doubts** (風土人情): nutrient-cycling cases arise from the realization that un-wasting is a technique to be acquired (since wasting has been learned too), how one's knowledge and social arrangements are insufficient, and one is surrounded by initially unknowable possibility;
- (ii) **Soil care practices are forms of self-cultivation** (器): nutrient-cycling cases show a strong uptake of cosmotechnics criteria, indicating how practitioners find themselves in the creative tension between balancing technical activity with ethical demands of the environment, thus improving human adeptness;
- (iii) **Mutations in nature and society reconfigure the terms of living** (感應): practitioners in nutrient-cycling cases demonstrate courage to reprioritize their processes, enterprises, and biographies to the ecological terms encountered through material responsibilities that remain responsive to unknowable otherness;

- (iv) **People and situations come together in resource recovery** (道): nutrient-cycling cases coproduced infra-structures of empathetic exploration whereby resources are pooled, positions can be exchanged, risk-taking is safe, and the experience is mutually energizing.

The practical implications of these four cosmotechnic characteristics are further reflected in the next section through correlating observations with design discourses. This cosmotechnically guided fieldwork enabled the researchers to forge relationships with organic farmers, food distributors, and households toward launching a bokashi-powered social pilot in late 2021. This way, excess foods, idle transport logistics, and fallow farmlands were reconfigured and brought soils and people into mutually balancing place-based exchanges (Wernli and Chan 2023).

5. Discussion: Enablers of cosmotechnics

Using the agriculturist cases, we employed cosmotechnics to prioritize how humility, attunement, contingency, and coevolution from mutual interrelatedness configure reparative practices. We now consider four enabling factors emerging from this validation that can support efforts to shift design away from Waste Age perpetuation toward a discipline of situated care. The four enablers include (i) *know-how subordinated to biosocial alliances*, (ii) *insistence to coinhabit the here-and-now*, (iii) *trust renewal to embrace the unknown*, and (iv) *prototyping communities of flourishing*. With these ideas, we do not imply that cosmotechnics is the comprehensive answer for repair-led design. Instead, we wish to stir curiosity in the reader about more cosmotechnic living and remaking *with* the world.

(i) **Know-how subordinated to biosocial alliances** (風土人情): Agriculturists with cosmotechnic characteristics in Hong Kong restructured their social and design arrangements, as revealed by Ho Man-chi's soil care laboratory. Her radical career transformation from social worker to agrarian innovator applies engineering skills and soil science in attunement with community development to ensure overall continuity (coevolution). Assembling expertise from many parties, she developed horticultural systems to support an integrative knowledge of

microbial processes, soil health, and conditional changes. She relies on open-source methods to establish and replicate these systems and their outcomes for local farmers. While her toolkit of sensors augments human intelligence, she never prioritizes the efficiency of these engineering efforts as an end in itself. She subordinates her engineering abilities to coregulation with her environment rather than to control it.

Biosystems prefer heterogeneous interactions. Hence, Man-chi uses her socially enacted, technical training to endorse the flourishing of such ecosystems. Returning to the dilemma of design, can a field that perpetuates the Waste Age through functionalist "earthlessness and worldlessness" (Fry and Willis 2017) give rise to planet-wide transformation toward proliferating life? We posit that Man-chi's career path demonstrates such cosmotechnic possibility. Her sample responds to environmental crises by moving forward rather than withdraw to a romanticized past (that never was). Cosmotechnics design is about reconsidering where we exert our efforts to rethink what we design. Man-chi's biography indicates that any of us can realign our 'doings' and 'relatings' beyond domineering paradigms (Light 2019).

We also can approach Man-chi's 'farm hack lab' from a historical lens. Design evolved from supporting individuals (human-machine interactions) to collaborative systems (workplace organization) and entire human life sphere (Internet of Things). Man-chi's methodology expands to include human-nature-technology systems that endorse ecological functioning with dynamic biomonitoring. It means repair-led design is about shifting from linear systems of today to the emergence of biotechnical alliances of tomorrow.

(ii) **Insistence to coinhabit the here-and-now** (器): Soil-invested collectives are productive because they generate local food and knowledge. Yet, this is not what constitutes their cosmotechnic qualities. Instead, belief systems, economic imaginary, interconnected practices, and social cohesion in unison enact a sense of colocation. What matters to the soil caregivers we encountered is the desire to live *here* in togetherness. In contrast, agrotechnical revolutions aim at replicable productivity across the globe, even outer space: the here-and-now, with its degraded soils, pandemics, wastefulness, and climate crisis, is simply not engaged. With the cosmotechnic

bokashi proposition, we do not suggest returning to preindustrial days, yet we recognize in grassroots agriculturists the self-enablement of living *with* the land.

If design is to transform toward care cultivation, if it is to search beyond the effectiveness of human/artifact interactions toward respect grounded in concrete, equitable relationships, then designers no longer ask: Is it economical? Instead, the bottom line becomes: Are we cultivating the biophysical foundation and each other here? Cultivating ourselves in situ entails enacting mutualistic relations woven into the land, described as "emplacement" (Gray 2014). This constitution instantiates sensation, reasoning, and intention. The question permits us to debate *who* the 'we' and 'each other' may be—all of humankind or all of life. Emplacement as a technically varied making of place through the proximity of enduring relations among all partaking in the landscape becomes a design strategy for committing to biodiversification, local governance, and continued relation-building.

(iii) **Trust renewal to embrace the unknown** (感應): Livelihoods remain essential in the cosmotechnic relationship between humans and world. Most agriculturists in Hong Kong engage in supplementary employment and the market economy. Cosmotechnics design does not have a viable financing mechanism for regenerative agriculture. Instead, the cases demonstrate differentiated economic sensibilities, whereas forms of mutual care are embedded in structures of producing and distributing that cushion risks and support life. It entails access to local markets, sharing logistics, support throughout growing cycles, and internal substitutions to sustain 'unprofitable' waste recovery. Such alternative economies are not about rejecting government subsidies, leases, or insurance. Instead, these transactions are complemented and reconfigured with emergent "relational assets" (Light and Miskelly 2015) deriving from local collaborations and the manifestation of trust renewal: the formulation of processes, initiatives, and tools for pooling resources within a given setting.

The *Present Living* residents and *TinYeah* platform enact formalized and goodwill exchanges that promote a virtuous spiral of agency and social values. These arrangements recognize the rights and needs of members and newcomers, not predicated on reciprocity but connective prospects. For example, during pandemic restrictions Ho-ying and Nicole opened

their distribution network to external farmers who lost market access—which also prevented crops from going to waste. Economic arrangements can be a wellspring for community life and not the other way around. Such trust renewal emphasizes place and land use, often absent or abstracted in system thinking and platform design (Escobar 2018). This connective tissue naturally extends to nonhuman actors (Puig de la Bellacasa 2016) that design anthropology is applying to communities of interest and communities of practice. To those communities, the cosmotechnics lens proposes the addition of *communities of flourishing*.

(iv) **Prototyping communities of flourishing** (道): Our encounter with Olive and Ann saw a resident group struggling to return their food scraps to the soil to avert incineration or landfill. Still, the concerned citizens keep prototyping "urban resourcefulness" (MacKinnon and Derickson 2012), an exploration that, in this case, has not yet come to fruition. Other prototypes, like their local veggie distribution point, were more successful. Experimenting with alternative ways of living must be tried, failed, reinvented, and tried again. These prototypes are not put in place by individuals but by a collective that has come together to restructure itself to enable such experimentation. Restructuring entails the practical, spatial, intellectual, and economical, which, in concert, hold such prototypes in place. The rich interrelation of practitioners, critters, soils, and companionship forms a "provisional proposition" (Wernli 2021) that make trialing rewarding. Cosmotechnics experiments are prototypical because they never reach a final version or conclusion since the constellation of their place is in constant flux. Thus, cosmotechnical prototypes cannot be scaled-out or scaled-up. Instead, their ideas, stance, and courage can be proliferated across distances from shared learning of how to live in ecologically integrative ways.

Our interlocutors are putting themselves into a position – ontologically, intellectually, economically – to *prototype*. In their respective roles, they show how rethinking land and resource usage supports the integrity of behaviors, attitudes, social norms, nonhuman life, and knowledge acquisition for prototyping alternative modes of living with and for the land. While nonhuman considerations are increasingly enlisted to design research and practice, cosmotechnics heightens attention to land use and how it impacts human-cultural-technical relations.

At a moment when networked virtual platforms are superseding informal economies and accelerating unsustainable 'progress' – from place-bound toward place-neglecting services (Subrahmanian, Reich, and Krishnan 2020) – the commitment to here-and-now is a matter of context, mutualistic care, specified scale and essentially about *synergetic survivability*. It demands repair-led design to contemplate how diversification is integral to strategy, how resource governance remains accessible, and how people keep prototyping as part of their everyday lives. All are part of the cosmotechnic ability to flourish that the hegemonic design structures tend to eliminate.

6. Conclusion

We opened this chapter wondering how a repair-led discipline departing from waste inside human-technology-nature relations might contribute to the radical transformations needed to address the planetary predicament. We did so by framing the climate crisis as a manifestation of wastefulness driven by blind faith in ever-increasing productivity that relegates repair to an afterthought. Repositioning a field complicit in economic growth agendas (while fixing rather than repairing) requires changing the design ethos. It demands a deeper commitment to human-land interdependencies based on coevolutionary, hence limit-imposing cosmologies.

Drawing on Daoism, Yuk Hui's proposal for *cosmo*technics describes the intimate interplay of technologies and social circumstances that situate humans between cosmos and Earth. Thereby, they become natural combinations of both. In these terms, humans with bodies and tools cultivate aesthetic, ritual, and attunement for balancing their relations with the world. Accordingly, we outlined a cosmotechnic framework where (i) humans live embedded in place, (ii) resonate in their doings, (iii) find assertion in coregulation, and (iv) yield to nature. Repair-led designing integrates these four spheres, as explored in this chapter and summarised in **Table 2**. We understand fermentation and soil care techniques as cosmotechnics proposition since they engage the actuality of body, place, and world while manifesting self-cultivation, integrating humans with never fully knowable, wondrous bacterial transformation.

Paying heed to cosmotechnics demands us designers to change *ourselves*, whereby our designs, lifestyles, and economies are subordinated to the salient question: What if we cultivated

landscapes and each other? With this vision, we investigated cases of waste-recovering agriculturists in Hong Kong to trace social formats of arranging places where biomass is fermented, food is locally grown, and interspecies contingencies are nourished. Attending to cosmotechnics revealed how localised responses to local needs are not scalable. When we accept that standardised, definite solutions are diminishing rather than opening futures, constant prototyping of sociotechnical constellations becomes imperative. It also entails restructuring one's career to live personally and contextually in attuned ways. We saw applied science subordinated to natural processes and entrepreneurship in the service of communities in places worth living.

If the cases and cosmotechnics framework inspire alternative futures, then the design discipline also requires such restructuring. It would entail refusing the division of the artificial and natural, halting the production and use of what is toxic, and questioning modular reductions ranging from assembly lines to monocrops. Such repair-led designing enlivened people and ecosystems rather than extracting from them, revolved around nonhuman agents rather than substituting them, adhered to place (particularly to soils), and upheld the diversity of life rather than chasing tech-driven salvation. All this would force questions about how neglected cultures and ways of knowing might support the agenda of technology attuned to coevolution: systematic arts of caregiving that no longer require constant repair.

Acknowledgments

The authors are grateful to Lin-cheung Yuen from Hong Miu Regenerative Farm (康苗有機農場), Greenfield Organic (田嘢) food localisation platform, Growers Without Borders (泥玩無國界) ethnic minority gardeners, Shing Wai Ng, Joshua Wolper, Sheren Ngan, Jonathan Yu, Sin Ting Lam, Michelle Man-yi Tang, and Justin Sacks from #commonize studio for their ongoing support. This research journey was funded by The Hong Kong Polytechnic University's School of Design and Zero Foodprint Asia in Hong Kong.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Indexed terms

Table 1

24 agriculturist groups listed according to their cosmotechnic characteristics.

CASE	*SECTOR*	**Humility**	**Attunement**	**Contingency**	**Coevolution**
TinYeah co-purchase platform	Food distribution	3	3	3	3
The Mushroom Initiative soil research	Concern group	3	3	3	3
Mapopo farmers	Food production	2	3	3	3
Sangwoodgoon family farm	Food production	3	3	3	2
Foodcycle+ social enterprise	Waste processing	3	3	3	2
HoManTin informal slope garden	Home gardening	3	3	3	2
Present Living eco-living group	Concern group	3	3	3	2
Yitian Shequ Shejii garden	Countryside garden	3	2	2	2
Huangtu (Ground Zero) family garden	Countryside garden	3	3	2	2
KwongPanTin villagers	Home garden	3	3	3	2
Daily Practices With Nature lawn garden	Home garden	2	2	3	2
Grow Something B2C landscapers	Service provider	3	2	1	3
Greener's Action environmental NPO	Concern group	2	3	2	1
MeiFoo Farmers Market facilitators	Food distribution	1	2	2	2
Garden Estate allotment garden	Home garden	2	2	2	1
Busy Urban Gardeners society	Home garden	2	2	1	1
Johnny's family farm	Food production	1	2	1	1
E-Farm biotech startup	Waste processing	0	1	2	2
Xinxing Nongchang garden collective	Countryside garden	0	1	2	1
Bicui Youji Gengzhong coaching farm	Service provider	0	1	1	1
TaiPo Farmers Market facilitators	Food distribution	0	1	1	0
Shiduopi Liyuan orchard restaurateur	Service provider	0	0	2	0
Rooftop Republic B2B landscapers	Service provider	0	0	1	0
Farn66 aquaculture investors	Food production	0	0	1	0

Table 2

Summary of cosmotechnics conceptualisation presented across chapter sections

	Background: **Principles**	Methods and Findings: **Criteria**	Discussion: **Enablers**
(i) Subject level	Affective knowledge: *Fengtu Renqing* (風土人情) *'integratings'*	Humility: Undesigning waste is provoked by insightful doubts	Know-how subordinated to biosocial continuity
(ii) Process level	Vital nourishment: *Qi* (器) *'doings'*	Attunement: Soil care practices are forms of self-cultivation	Insistence to coinhabit the here and now
(iii) Situatedness level	Relationality: *Ganying* (感應) *'relatings'*	Contingency: Mutations in nature and society are reconfiguring terms of living	Trust renewal to embrace the unknown
(iv) Engagement level	Cosmic order: *Dao* (道) *'observings'*	Coevolution: People and situations come together	Prototyping communities of flourishing

Figure 1

Knowledge-practice-belief framework with figure/ground mutuality, adopted from Berkes (1999).

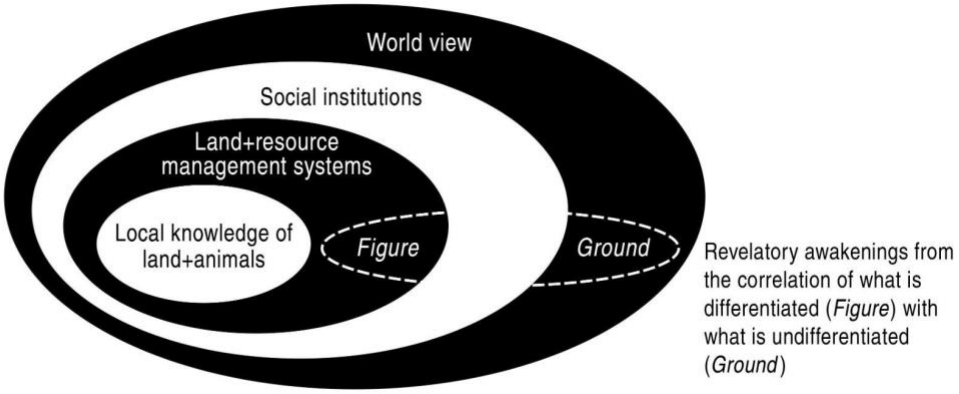

Figure 2
Design cosmotechnics framework with generative dynamic underlying repair-directed design (illustration by the authors).

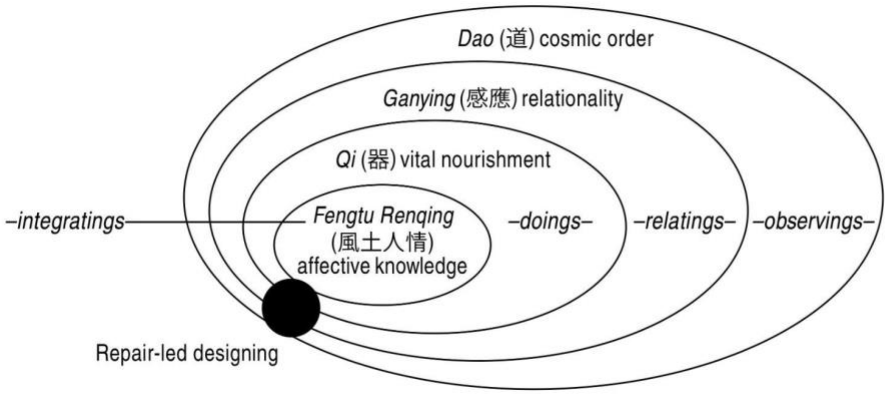

Figure 3
Becky layering tofu residue, citrus peels, and spent mushroom substrate onto the soil.

Figure 4
Ho-ying reusing carrier bags for weekly vegetable deliveries (photograph: Markus Wernli).

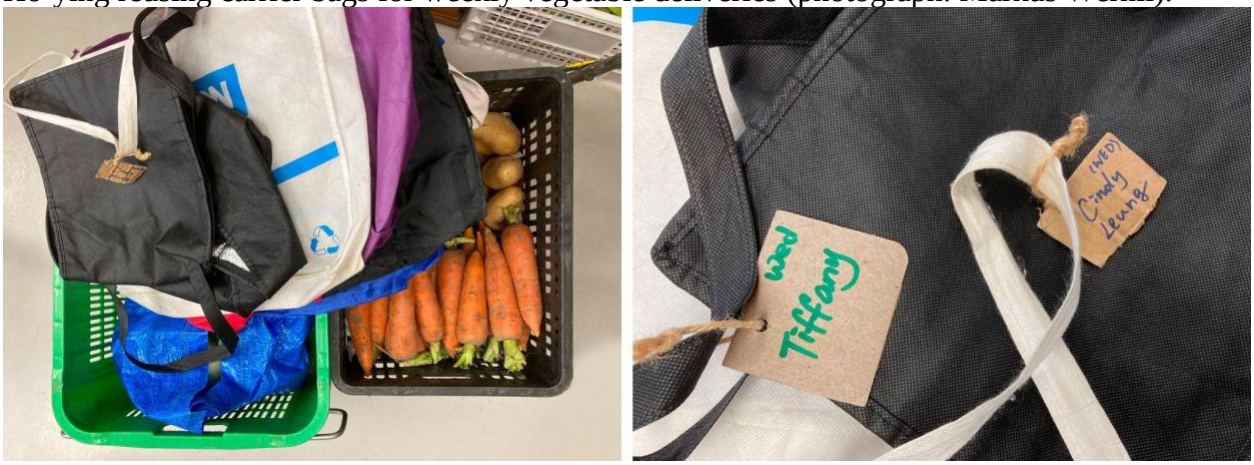

Figure 5
Man-chi overseeing the development of nutrients-density scanner (photograph: Markus Wernli).