THINKING INSIDE the BOX

On Container Aquaculture and the Datafication of Life

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Abstract **Container aquaculture—a method that uses shipping boxes equipped with information technologies—is presented in China as an emblem of smart farming, and as a technological solution to the environmental degradation in natural water resources resulting from intensified aquacultural production. Container aquaculture aims at creating an orderly, self-contained ecosystem wherein the fish are managed in tandem with the water milieu via data governance. Its infrastructure operatively automates aquacultural practices into optimizable modules and programs biological and mechanical processes into interlocked components bearing distinctive functionalities within the artificial ecosystem. This article argues that the case of container aquaculture shows that algorithmically regulated and automated ecosystematic management does not always fulfill its promise; one still needs to navigate a dense web of interspecies associations filled with gaps and crossings between modes of being and values. Datafication is just one way to know and organize. An algorithmically controlled ecosystem cannot always accommodate the open-endedness of more-than-human ecologies. Drawing on works by Tsing, Stengers, and Satsuka, this article reappropriates what should be counted as the "smart" in farming by resituating it as a world-making practice in ecological collectives rather than in an abstract ecosystem, eschewing the fantasy of a singular criterion of evaluation and control.**

Keywords **smart farming, ecology, algorithm, infrastructure, multispecies justice, more-than-human**

On November 11, 2019, China's Central Television (CCTV) devoted twenty-two minutes of its prime-time broadcast programming to the explosion of blue algae in Yangcheng Lake, the home of mitten crabs. Yangcheng Lake, located in

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Suzhou, serves as the source of drinking water for the residents of the lower Yangtze River region. Aquaculture in this area mostly deploys offshore cultivation methods, involving floating net cages that are roughly one square kilometer in size. A massive amount of waste excreted by the crabs, along with unabsorbed antibiotics and fertilizers that are applied to increase productivity, are discharged into the lake. This gives rise to eutrophication—dense blooms of noxious, foul-smelling phytoplankton and algal growth—every autumn when the crabs mature.

Intensified freshwater aquacultural production has caused irreversible environmental degradation. Container aquaculture has gained traction in parts of China as a technological solution to the massive demand for fish protein. The method gained its name by using (often abandoned) shipping containers to raise fish, enabling maximum separation of aquacultural practice from natural water resources. In 2019 China's national aquacultural production reached 64.8 million tons, contributing a market value of 1,293.5 billion RMB (renminbi, China's national currency; China Fishery Law Enforcement 2020).

More than a method for environmental protection, container aquaculture is also an emblem of smart farming (智慧农业).[1] The containers are equipped with sensors and object-recognition cameras that continuously collect and analyze data on the condition of the fish, their movements, and their water environment, so that farmers can quickly respond to changes in either the behaviors of the fish or the environment with a fine degree of precision. Feeding, water purification, and fish harvesting can be automatically controlled. Farmers can examine various production metrics on personal computers and mobile interfaces in real time.

Container aquaculture is part of China's move toward algorithmic management and automation in farming. It is supported by the government's "Internet Plus" national agenda, which strives to upgrade traditional industries using information technologies (State Council 2015). Container aquaculture was listed among the "key demonstration technology projects" by China's agriculture ministry in 2019 (Godfrey 2020). Provincial agencies across China have funded multiyear programs promoting container aquaculture in rural villages as part of the government's environmental protection and poverty alleviation efforts (Godfrey 2020). In the 2020 Smart Farming Development Summit, Qiangde Liu, the deputy secretary general of China's Animal Agriculture Association, declared that datafication is the inevitable path for China's farming development. What lies at the core of datafication is its capacity to abstract farming operations into datasets that can be used for targeted preemptive intervention (Liu, quoted in Zhao, Guo, and Wu 2020). Datafication is about translating states and actions into quantitative expressions, enabling real-time tracking, pattern identification, and predictive analytics (Mayer-Schoenberger and Cukier 2013). It has been gradually normalized as a new paradigm in science and technology, legitimizing a widespread mythology: that extensive datasets can offer a higher form of intelligence with an unprecedented degree of accuracy (boyd and Crawford 2012).[2] In popular and scientific discourse, the datafication of aquaculture signifies a shift from an inefficient, unsustainable production style toward a precision-oriented, calculation-intensive mode of computerized subfield control (Antonucci and Costa 2020; Liao 2020).

Researchers have begun to pay attention to the datafication of farming.

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Kelly Bronson and Irena Knezevic (2016: 2) declare that farming "is undergoing a digital revolution," which can reproduce long-standing, unequal relations among food production players. In farmers' daily operations, they unwittingly produce data for technology providers. However, farmers are often denied ownership of the datasets and their values (Fraser 2019). Michael Carolan (2017) explores how access to data should be understood as an issue of justice, political ontology, and claim making. Other scholars have examined how trustworthiness works in the platformization of food distribution (Zhang 2022), the issue of market concentration (Livingstone and Knezevic 2020), and the consequences wrought by uneven developments of agricultural technologies across the globe (Murray 2018). Few researchers have theorized the politics and epistemology of data-driven farming practices through the lens of media studies, except for Christopher Miles's (2019: 3) study, which sees the discourse on precision agriculture as performing a kind of "persuasive, imaginary-shaping work" that "enacts a form of algorithmic normativity." For Miles, even though the datafication process reorganizes production on quantitative, rule-based grounds, precision agriculture is essentially an intensification of conventional agriculture (2).

This article seeks to show that container aquaculture is more than an intensification of conventional aquacultural methods. It will show that container aquaculture is a special kind of smart farming, in its adoption of a biodesign approach. It is a type of farming that grounds itself on ecological relations and the self-sufficient circularity of the biosphere. To construct an artificial ecosystem where water can be circulated within the container, microbial metabolic processes are mobilized to biologically exhaust nutrient loadings, maintain oxygenation and nitrification stability in the water, and improve the digestibility of fish species. Container aquaculture demonstrates a mode of ecosystematic management in which the fish, the biological processes, and mechanical operations in the container are managed in tandem with data governance.

I have examined corporate marketing materials, news reports, design diagrams, patent documents, and relevant television programs related to container aquaculture. The article thus contributes to the critical literature on smart farming and data governance in two ways. First, it explicates the operational logics and implications of data-driven ecosystematic management. Second, it explores what more-than-human perspectives can tell us about the epistemological grounding and limits of algorithmic methods relating to the practices of farming and world making. *More-than-human approach* refers to a rubric of ethnographic research that takes seriously the agencies of more-than-human beings and the interconnectedness of humans and other life-forms (Kirksey and Helmreich 2010; Ogden, Hall, and Kimiko 2013). To redirect us from economic concepts (e.g., rationalization) and anthropocentric epistemology in which the more-than-human is subordinated to human ends, Anna N. Tsing (2015: 21) points out how life-forms (e.g., matsutake mushrooms) make worlds in ways that confound modern scientific interpretations.[3] A scientific understanding of ecosystems in farming implies boundedness and formalization, but the ecological world(s) stitched together by life-forms are "open-ended gatherings" rather than a coherent, teleological "system" or "logic" (23).

Here, I argue, container aquaculture shows that algorithmically regulated and

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automated ecosystematic management does not always fulfill its promise; one still needs to navigate a dense web of interspecies associations filled with gaps and crossings between modes of being and values that coexist. Put differently, farming takes place in ecology, and ecology does not equate with a model ecosystem. Ecology does not work like a machine. Datafication is just one way to know and organize. Drawing on works by Tsing (2015), Isabelle Stengers (2011), and Shiho Satsuka (2018), this article reappropriates what should be considered the "smart" in farming by resituating farming as a world-making practice in an ecological collective rather than in an abstract ecosystem, eschewing the fantasy of a singular criterion of evaluation and control.

In the following sections, I discuss (a) how container aquaculture aims to construct an orderly, self-contained artificial ecosystem; (b) how data-driven ecosystematic management is operationalized and its implications; and (c) how out-of-tune biological processes testify to the need to rethink farming as a world-making practice, a process that always involves livable collaborations and working across difference. The article ends by reflecting on the politics of smart farming, and how the case of container aquaculture invites us to (re)consider how "smartness" should manifest in food production within a multispecies world.

Ecosystematic Management

In China, container aquaculture is seen as an indicator of "the third epoch of aquacultural industry," an "aquacultural ecosystem driven by a precision-oriented, visualizable, automated, and condensed yet environmentally friendly management style" (Dajiang Fishery 2021; Yang 2020). Container aquaculture minimizes the threat of pathogens from the outside, which can also significantly reduce the use of antibiotics for the benefit of production and the larger ecology (China Fishery Law Enforcement 2018). An article in a Chinese magazine specializing in aquaculture praised the container system for possessing the advantages of reducing biosecurity risks, cutting down antibiotic exposure, decreasing the percentage of fat in fish's flesh via controlling water streams, and alleviating the influence of natural disasters (Zhu, Shu, and Xie 2019). Similarly, Nongxin's (2018) report celebrated container aquaculture as an innovative method that could bring about a positive outcome of "four savings": land resource, water, human labor, and feed consumption.

Agriculture and Farming, a CCTV-7 show that focuses on introducing novel agricultural technologies, featured a container aquaculture episode (Ren 2018). It showed fish cultivated in computerized containers, which were created by repurposing standard shipping containers. These "smart" tanks had hatch lids and automatic devices fitted on the top for feeding activities. The containers were coated with a three-layer insulation shield for temperature control. The bottom featured a manufactured slope with a controllable, smooth-surface hole and stainless-steel slide in one corner where fish could be automatically harvested when the slide was deployed. A local farmer explained that this design significantly saved human labor, allowing him to "harvest 4.5 kilograms of fish in just 10 minutes" (Peng, quoted in Ren 2018). He showed the reporter how biomediation and mechanical filtration techniques separated waste from wastewater, reducing waste dispersion; the fish's excrement was then used as organic fertilizer for planting. The program represented container aquaculture as a

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"smart" solution to the massive demand for "white meat" in China. It adopted algorithmic technologies to execute precision-oriented management, solved food safety issues, and answered the government's call for returning an uncontaminated environment to the people.[4]

Container aquaculture demonstrates how the dilemma posed by the environmental impacts of intensified production is reconstituted into a concern about infrastructure: the creation of an insulated technological "bubble," a fetishization of enhanced sensor capability, and faith in data analytics. Technically, the container system comprises:

- a perception layer—underwater cameras, radio frequency identification, and wireless sensor networks, for real-time monitoring and life cycle assessment;
- an Internet of Things (IoT)–based network layer of communication nodes and gateways, whereby collected data are forwarded to the data infrastructure for storage and analysis; and
- the application/end-user layer, through which data are synthesized and presented (often on the farmer's smartphone).

The container system can thus be seen as a form of data infrastructure, demonstrating what Shannon Mattern (2015: 98) called "infrastructural capacities"—it coordinates signal traffic via multilayered "communication and communion," enabling the system's interconnectedness and interoperable data transmission. Vertically integrated sensing devices afford the datafication of multifaceted biological and environmental dimensions inside the container into quantifiable variables (e.g., temperature, movement level of the fish, water current speed, oxygen dissolving level, and feed conversion ratio), which can give early indications of potential welfare problems. Supported by front- and backstage data work, the fish are managed as at-risk living entities whose growth conditions can be continuously monitored to ensure that they are being kept in an optimal condition.

However, what makes container aquaculture unique lies in its holistic, ecosystematic approach to control. Data-driven ecosystematic management, in this case, is not simply about datafication but also the construction of a self-contained model ecosystem par excellence. In the scientific community, *ecosystematic management* refers to using "scientific knowledge of ecological relationships within a complex sociopolitical and values framework" to sustain the long-term ecological resiliency of a given domain (Grumbine 1994: 31). For container aquaculture, ecological resiliency is translated into the equilibrium of the artificial container ecosystem. In other words, container aquaculture adopts a kind of data-driven ecosystematic management strategy wherein living entities are managed in tandem with environmental and mechanical processes. In the container, aquatic organisms are readily "involved" in each other's lives. The maintenance of water quality is seen as synonymous with the maintenance of the well-being of the fish. The fish are not managed as discreet entities; instead, they are cultivated as transcorporeal subjects (Alaimo 2012) interconnected with the flows of substances and agencies of the water milieu.

The emphasis on data-driven ecosystematic management was a descendant of the broader trend in post–Cold War natural and social sciences in which cybernetics, systems thinking, signals, and feedback loops became the foundational vocabularies. The rationalist, managerial ideals of the self-contained ecosystem for space research programs later served

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as the model for sustaining life on earth (Anker 2005: 240).[5] Container aquaculture expresses an attempt to transform ecology into an orderly functioning ecosystem placed within a defined domain. Fish can be raised within an artificial container ecosystem, which reorganizes production and water environment maintenance based on calculative rationality, something of which present-day computers are capable.[6]

Automating an Ecosystem

To operationalize ecosystematic management and water resource circulation, container aquaculture adopts a key aspect of platform design strategy: modularity. Modularity entails the structural compartmentalization of web contents by dividing them into reusable modules bearing distinct functions (McKelvey 2011), which eases the coordination of distributed operations (Benkler 2006). Anne Helmond (2015: 1) has theorized platforms as "pouring data systems" consisting of interoperable modular channels through which external web contents/applications can be easily added and made compatible to the core platform framework. Each modular component can work independently while contributing to the platform ecosystem's overall data work (Nieborg and Helmond 2018).

The construction of an artificial ecosystem does not in itself make container aquaculture an instantiation of smart farming. In fact, its "smartness" lies in its (promised) infrastructural ability. Biotic processes (e.g., breaking down wastewater biosolids via anaerobic digestion) and abiotic processes (processes that are not derived from living organisms, like controlling water currents) are broken down into modules of an artificial ecosystem. On a holistic level, the technology promises uniform expansion, as the container itself is built as a standardized, replicable device. For internal operations, the container infrastructure compartmentalizes complex aquacultural practices (e.g., feeding, mechanically filtering wastewater) into a series of modular prototypes for integrated control.

Taking water purification and recirculation as an example (itself a modular component of the overall container system), there are two main types of container infrastructure. The semi-enclosed type (陆基推水式) requires connection to artificial "ecological ponds" where water is filtered and biologically purified. The other type features a fully enclosed biocycling design (一拖二式), consisting of two fish-cultivation units and one water-treatment unit to complete a self-contained water-circulation feedback loop (Yao, Xie, and Lin 2019).

For the semi-enclosed type, according to a documentary broadcast on CCTV-17 (2021), the wastewater first goes through a mechanical filter that screens large solid substances. The finer particles, along with dissolved compounds, are subsequently processed in "ecological ponds," which comprise four sequential segments:

- A 4.5-meter-deep pond that uses gravity for initial sedimentation
- A one-meter-deep pond that uses biofloc technology—using aggregates of algae, bacteria, or protozoa held together in a matrix along with aquatic plants—to consume nutrient loadings, elevate water respiration rates, and sustain nitrification stability
- A pond with herbivorous fishes introduced in an appropriate proportion. The multi-trophic method—incorporating species from different nutritional levels in the system so that the by-products (e.g., waste) of one species are recaptured as source of energy for another—is implemented to avert algae bloom.

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- A thermal-control pond that keeps the purified water at an optimal temperature before it is sourced back to the fish-cultivation module. Computational sensors are installed in each module to harness real-time environmental parameters (CCTV-17 2021).[7]

The fully enclosed biocycling model integrates six modular components: water quality monitoring, excretion collection, water body purification, thermal and oxygen level control, fish-algae symbiosis, and a platform-based decision-support system (NFTEC 2018). The water purification module comprises a microfiltering machine, Roots-type blower, air pump and flow control lever, ozone generator, biochemical tank, and a central control system that collects and assesses various environmental parameters (e.g., pH level). Fifteen tons of water circulate throughout the modules per hour (L. Wang 2018). Pressurized water circulation forces the fish to swim in a certain direction, to accurately direct their excrement to the purification modules and to burn off fat. Nutrient-rich wastewater is processed via the mechanical-filtering and fish-algae symbiosis modules (to remove detritus excreted by the fish, and to maintain oxygenation and nitrification stability), and then fed back to the fish tank, constituting a self-contained, resource-circulation feedback loop (Liao and Luo 2019).

Container aquaculture deals with complex material exchanges and interspecies attachments in a condensed environment. The risk of water quality degradation is normalized into a sense of "permanent precariousness" (Puig de la Bellacasa 2015: 694) that needs to be constantly acted on. The vertically integrated sensor system makes environmental sensing a highly distributed event. Each sensor (or group of sensors) provides a perspectival view of the overall ecosystem. For example, biofiltration efficiency depends primarily on:

- water temperature;
- an acceptable nitrification rate, reached by the proliferation of nitrifying bacteria, converting the toxic ammonia first into nitrite and finally into nitrate; and
- a stable pH level in the system, which is primarily affected by the production of carbon dioxide from the fish and biological processes of the biofilter, as well as the acid produced from the nitrification process (Bregnballe 2015: 20).

To achieve effective biofiltration in such a condensed space is not straightforward. It requires complex intermodular coordination and multispecies collaboration, constantly reflecting any trace of potential water deterioration so that preemptive measurements can be undertaken promptly.[8]

The modular design of the container infrastructure breaks down complex tasks as well as biotic and abiotic processes into digestible units. It expresses a particular form of organization that aims at abstracting living realities into pieces of programmable modules bearing distinct functions. A programmable platform allows its very code to be modified; codes define the relations and arrangements of platform contents. Programming aquaculture works on the premise that relations among life-forms can be abstracted into a kind of essentialized correlation expressed in numeric terms. Biotic and abiotic agents in the container can therefore be managed according to an algorithmic relation, or what is termed ground truth in algorithms—that is, a labeled cluster of training data through which a supervised machine-learning system can generate its model of the world. It aims at defining and creating the "right"

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condition in which these processes can mechanistically express themselves in a particular way.

To a certain extent, container aquaculture promises to create an orderly, autonomously functioning ecosystem, in which whatever happens within the container rests on what Tsing (2012: 505) has termed "precision-nested scales." Scalability, according to Tsing, is a constructed feature that allows projects to grow without any indeterminacy of transformation (507). By programming both biotic and abiotic processes into functional modules of an artificial ecosystem, their relations can be holistically managed in scalable terms, which can supposedly capture contingencies, or at least enable one to quickly respond to them.

Orit Halpern, Robert Mitchell, and Bernard Dionysius Geoghegan (2017: 110) define "smartness" as a mode of governmentality embracing "the ideal of an infinite range of experimental existences, based on real-time adaptative exchanges among users, environments, and machines." According to these authors, the vision of smartness is inextricably tied to the language of crisis (120). An infrastructure might encounter unforeseen crisis; hence, present operations need to be constantly modulated to make the infrastructure more resilient to future uncertainty (112). The mechanism of container aquaculture works along a similar calculation-intensive, practical epistemology. It promulgates the belief that living relations can be formalized and therefore made algorithmically manageable and optimizable. The modular system can self-organize. The modular operations can adjust themselves automatically according to internally referential measurement of performance.

In theory, the container infrastructure yields a simplified ecosystem par excellence; it nears total automation and, by extension, significantly reduces the demand for human participation and judgment. To thrive, the fish and their surrounding biotic agents only need to passively cohabit, since the substantial flows and energy exchanges would supposedly unfold according to the structure of the system's hardware. In the next section, I show how the case of container aquaculture implicates a need to (a) resituate farming as a world-making practice taking place in a dynamic ecology rather than in a model ecosystem; and (b) reexamine what should be counted as the "smart" for farming, moving away from a technologically deterministic image of "smartness."

World Making: From Ecosystem to Ecology

An episode of *I Love to Invent*, a television program from China featuring amateur scientists' self-developed artifacts, depicts the struggles that Jinliang Chen underwent in disciplining microbes in container aquaculture (CCTV-10 2018). Chen was an agroecological entrepreneur from Anhui Province, located in the interior where natural water resources are limited. To liberate aquaculture from the natural constraints of pond-based methods, Chen aimed to turn abandoned shipping containers into "big, controllable aquacultural facilities" wherein the by-product—fish manure—could be used as organic fertilizer for growing vegetables. In the program, Chen took the challenge of raising one thousand tilapias in his first attempt, and he used a container comprised a fish-cultivation tank and a biochemical water-treatment module. Although the water was oxygenated and kept at twenty-two degrees Celsius, the number of probiotics were insufficient to exhaust the massive waste excreted by the fish. An overabundance of nutrients in water can lead to overgrowth of algae.

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When dead algae decompose, this process consumes dissolved oxygen, which leads to fish hypoxia.

In his second demonstration, Chen added mechanical filters, oxygenation equipment, heater tubes, and bioballs, a plastic medium that provides surface areas for probiotics to cling to. However, the amount of fish excrement still exceeded the biodegradation capacities of the purifying modules, resulting in an upsurge of ammonia nitrogen in water. For the third demonstration, Chen empowered the water-treatment module with an additional mechanical filter and a biochemical tank equipped with denitrifying lava rocks, bioballs, and oxygen generators to cultivate aerobic probiotics. He also installed more sensors to collect real-time environmental data. Surprisingly, this model still failed.

In an interview, Chen reflected that the circular container system relies on the symbiosis between the fish and microorganisms in the water, but human eyes or sensors cannot trace the changes in their relations in a timely manner. The proliferation of probiotics requires a farmer's ongoing, meticulous attentiveness even if full-fledged environmental monitors are in place. In Chen's experience, once indicators of ecological disturbance were picked up by the sensors, it was often too late for any remedial acts to be effective in such a condensed environment.

For aquaculture, the cultivation of probiotics is crucial: they can denitrify, improve the digestibility of aquatic species, release chemical substances with bacteriostatic effects, and consume excessive nutrients to enhance water stress tolerance (Y. Wang, Li, and Lin 2008). However, aquatic microbes unfold at scales below everyday human perception and below even the quantifying capacity of sensors.

Chen's collapsed ecosystem raises questions. Is controlling an ecology solely via technologized means even attainable? What are the limits of algorithmic methods in programming and managing life? Chen's failed experiments show that container ecology is actually a unit of contingency and frailty, rather than a machine that can smoothly function according to preestablished principles. Even though the "right" number of probiotics are introduced, they refuse to be made scalable. The ways they form symbiotic attachments are fundamentally ephemeral and transcorporeal: they do not act according to uniform, precision-nested scales.

In recent years, scholars in anthropology and social studies of science have paid specific attention to microorganisms, in several ways: their participation in post-Pasteurian discourse and practice— for example, in artisanal cheese making— invites one to revisit the nature/culture divide (Paxson 2008); their forms and structure challenge conventional analytic frameworks and boundaries (Helmreich 2009; Hird 2009; Paxon and Helmreich 2014); and their elusiveness presents an alternative to the episteme of modern science and capitalist value production (Hathaway 2022; Satsuka 2019; Tsing 2015). Astrid Schrader (2019: 256) notes that marine microbes exist "predominantly hauntologically." The life-sustaining tendencies of microbial collectives disrupt the individual/population dichotomy (259), which has led to profound scientific uncertainties about the pathways to death for aquatic microbes (even how life/death should be defined for them) because microbial intra-actions within an algal bloom are fundamentally indeterminant (269). In one of her earlier works, examining an ongoing political-scientific controversy over the toxicity of a fish-killing microorganism, Schrader (2010) suggested

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that the inextricable entanglement of (potentially) toxic dinoflagellates with life-forms in water challenges the conventional notion of linear causality. Microbial "response-ability" must be seen as a condition of "ontological indeterminacies" wherein their ephemeral activities cannot be easily transcoded into a program that runs in linear time (277).

Satsuka (2018) has provided a useful framework within which to understand the contingent nature of microbial multitudes. Satsuka argues that modern science conceptualizes the world "as a universal space filled with things in which humans try to see things by separating them into individual units and by observing them from a perspectival vantage point" (82).[9] That is, the episteme of modern science privileges the mutually exclusive, individual body that occupies space as the model unit of ontological existence. Reflecting on her ethnographic research on a forest biomass study and the grassroots *satoyama* forest revitalization movement in Japan, Satsuka suggests that the ways in which microbes form interspecies entanglement are much more elusive than the modernist spatial topology. The existence of microbes should be approached as "events" (82), a constant act of emergence through which life composes itself via encounters with its surrounding world. For microorganisms like mycorrhizal fungi, it is difficult to discern the structural mechanism of their symbiotic relations and dissect the functionality of each species (94). Their interspecies entanglements never reach a point of completion, nor do they form relations in a defined, hierarchical manner. Their elusiveness requires "the art of noticing" (Tsing 2015) or meticulous "attunement" (Satsuka 2019) to see how microbial multitudes compose themselves along with other beings.

In container aquaculture, the ways in which aquatic microbes flow and form symbiotic attachments do not conform to an atomistic ontology (which presumes the existence of discreet entities that can be anchored in a spatial representational scheme). The movements and effects of aquatic microbes cannot be fully programmed because their life cycles and boundaries evade the gaze that guides the design of the container infrastructure or other smart-farming facilities: organizing production based on regimentation, systematic ordering, and informed calculation.

As discussed in earlier sections, automating a simplified, self-contained ecosystem depends on breaking down both biotic and abiotic processes into functional modules along a procedural chain. It works on the premise that there exists an essentialized, quantitative correlation that leads to ecosystem stability, and that can be analyzed and actualized via surveillance and automation. Life-forms would only need to passively cohabit and do work. However, as Chen's failed experiments remind us, aquatic microbes' ephemeral appearances and disappearances and their interspecies "response-ability" cannot be fully relegated to the position of background supporters for the well-being of the fish. They unfold as a cloud of possibilities that are "materially real" yet only "partially knowable," emergent amid "contingent relations of multiple beings and entities" (Ogden, Hall, and Kimiko 2013: 6). Therefore, to maintain reciprocal symbiosis in the water ecology, humans' attentiveness remains indispensable if one wishes to make the organismic relations in tune with the overall operativity of the container system.

However, this does not necessarily mean that the existence of microbial multitudes is ontologically incompatible

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with algorithmic methods. Nor do I intend to make a case that one need to become an "animist" in a traditional sense—to "communicate" with microbes in order to raise fish. What is at stake here is that container aquaculture testifies to the need to rethink the taken-for-granted mythology of calculative relationality that presumes the legibility and manipulability of life-forms and their relations in mechanistic terms.

The fissure revealed here resonates with what Stengers (2011) refers to as the fracture between facts and values, or world and formalization. Stengers has challenged science's pretensions to universality and objectivity, as it demotes perspectives other than its own to merely secondary, irrational beliefs. For Stengers, there exist as many modes of being and values as there are entities; and the relevance of science must be revisited in the specificities of its practice. To do so, one can resituate science as part of what Stengers has called an "ecology of practices": "the science of multiplicities, disparate causalities, and unintentional creation of meaning" (34).

Stengers's (2005) notion of ecology conveys something broader than the scientific definition of the term. In ecological collectives, scientific practices come into existence via making relations to other material and value-making practices that coexist. The notion of ecology foregrounds the need to unearth the multiplicities of associations as entities participate in forming collectives, a process wherein more-than-human beings also have an important voice outside the rubric of vacuous scientific abstractions.

Chen's (CCTV-10 2018) failed demonstrations testify that farming does not take place in an abstract model ecosystem, but in a dynamic ecology. In this vein, the creation of container ecology should be seen as a world-making practice: a negotiation of relationship formation, material transmission, and value alignment that does not necessarily reach an ideal state of absolute harmony. The notion of world making does not flatten agency. It allows us to consider the agencies and identities of the more-than-human in a more nuanced way, and see how particular actions—no matter whether they are done by humans, more-than-human organisms, or machines—create worldly effects.

The unfulfilled dream of an autonomous, orderly functioning ecosystem makes visible the crossings and frictions necessary to the composition of a shared world. Understanding container aquaculture as a world-making practice does not mean that we need to abandon algorithmic technology. What is at stake here is that container aquaculture invites us to consider the differences between an ecology and an ecosystem. It reveals the very limits of algorithmic management and the hubris of achieving total control over life-forms according to calculative rationality, which attempts to objectify life as a passive resource, something that can be mobilized according to precision-nested scales toward productionist ends. The abstract formalization of ecology leads to a concept of nature—a generalized, singular noun—that legitimizes the abrasive resource exploitation that serves as the foundation for capitalist production (Williams 1976).

The container world itself is an irreducibly complex association of value-emitting organisms, technologies, and human participants, an ecological collective wherein different values and ways of being are negotiated. Creating "smart" container worlds thus requires one to take seriously the nonsingular agencies of the more-than-human and find ways to muddle through

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gaps and crossings, eschewing the fantasy of a singular criterion of evaluation and control.

Not a Conclusion: The Politics of Container Aquaculture

The datafication of farming has brought a profound change at the levels of epistemology and ethics. It reframes the concerns about the environmental impacts of intensified production as questions of infrastructure and numbers. Data-driven ecosystematic management is operationalized via translating aquacultural practices into always-updating modules, and managing biotic and abiotic processes as functional components of an artificial ecosystem in tandem with data governance. However, as philosophers of science have long showed us, science is not value free: claims to objectivity are made by subjects who observe and represent the world through particular epistemes (Daston and Galison 2007). With the rise of calculation-intensive methods crystalizing into a new orthodoxy, other voices and forms of value are sidelined.

Container aquaculture is an intriguing case with which to examine the politics of smart farming. It also provides hints about how we should understand what algorithmic methods are and what should be considered the "smart" in farming. Container ecology does not equate with an abstract ecosystem. The algorithm interprets, if not reduces, the multiplicity of life-forms and their associations to an arrangement of weighed probabilities. In "Doubt and the Algorithm," Louise Amoore (2019: 148) shows that, while algorithms condense the multiplicity of reality to a single output with a numeric value between 0 and 1, doubt and partial accounts still dwell uneasily within. Put another way, algorithms do not eradicate uncertainty. The computational structure of algorithms dictates that the output is itself a numeric probability, a single value/actionable procedure distilled from a multiplicity of potential pathways, weighings, and thresholds. Algorithmic reckoning is a process in which a series of highly malleable processual calculations are used to arrive at an output.[10] Amoore argues that algorithmic systems appear to be "objective" because their output "places a decision beyond doubt in the sense that it always already embodies the truth-telling of the ground truth data" (151). In this vein, she proposes to reinstate doubt as a posthuman critical faculty (164). The form of doubt proposed by Amoore is different from Cartesian skepticism; instead, it embraces what Donna Haraway (1988: 584) has called "partial, locatable knowledges" that are accountable and can enable the "possibility of new webs of connections."

The case of container aquaculture reveals the limits of data-driven (ecosystematic) management: it does not fulfill its promise of creating an autonomous, mechanistic artificial ecosystem. Moments of incoherence and gaps do not necessarily point to absolute incompatibility or radically different ontologies that should be taken as something negative for science to conquer. Instead, they remind us that farming actually takes place in dynamic ecological collectives, and humans still need to learn how to live with the contingencies and cacophonic rhythms among different life-forms. Many times, attuning to the rhapsodic rhythms and lines of value alignments among entangled life-forms is not easy. However, moments of pause—or even confusion or astonishment—can direct us to the possibility of communication and collaboration beyond the schemas set by modern science.

The formal, quantitatively conclusive,

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procedural rules of calculative rationality seemingly serve to free farming from human skills, deliberation, and judgment, all of which imply politics. Farmers can simply submit to the protocols and rules of action given by the machines. However, if we take seriously Stengers's (2011) articulation of ecology and see container aquaculture as a world-making practice, the notion of politics is brought to the forefront.[11] World making always entails the prioritization of certain relations and modes of being while obscuring others, regardless of whether the actors involved feel or are recognized as political subjects as such (Otsuki et al. 2018: 7–8). The quotidian politics of multiplicity in ecology formation is prior to representational/structuralist politics, which is a product of Enlightenment and modern liberalism, assuming that "humans are rational individuals with universal and intrinsic rights who possess the agency to resist external forces" (8).[12] Otsuki and colleagues' articulation of quotidian politics resonates with Jane Bennett's (2010) notion of "vibrant matter," which challenges the mainstream political theory that largely views the world as composed of dead matter, a collection of objects constituting a passive backdrop for human affairs. Bennett argues that more-than-human beings and nonliving things are active protagonists in and of themselves; their agencies often exceed human intentions. The frictions experienced in daily farming practices point to the subtle form of politics embodied in world making. The choice about what kind of ecology we wish to create is also about what kind of value to align, what type of world we want to be part of, or even what it means to be human.

To envision a more ethical food production system involves transgressing anthropocentric categories and the "innovate or perish" credo of the technocratic discourse. To not be foreclosed in our epistemological purview, we must be open to staying with the trouble (Haraway 2016). Pursuing something along these lines will not be straightforward. Given the pressing challenges today—wars, social inequality, corporate monopolization, environmental degradation, and the massive demand for food (including fish protein) across the globe—the matter of what happens to the more-than-human might seem like a minor issue through a capitalist lens. Nevertheless, collaborative survival at a time of ecological apocalypse demands cross-species coordination (Tsing 2015). Concerns about technical capacity or the feasibility of precision-oriented ecosystematic management miss the opportunity to engage with the politics of smart farming. What is really at stake here is what container aquaculture reveals: ecology actually entails a cloud of value-emitting interspecies associations that cannot be fully structured into a procedure of cause-and-effect control. Instead, in this light, we need to ask: How to (re)define ethics in "smart" farming? How to collaborate with the living as well as the nonliving and create more reciprocal ways of food production with human participation and technology that (re)affirm doubt and partial accounts rather than trying to erase them?

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Notes

1. Smart farming is also known as precision agriculture or digital farming. I use *smart farming* because in Chinese the phenomenon is termed

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智慧农业, which can be literally translated as "smart" or "intelligent" farming.

2. Existing scholarship on data governance has largely focused on the ways in which algorithmic systems shape human societies, reproducing—or even amplifying—social discrimination and inequality (see Angwin et al. 2016; Bucher 2018; Chun 2021; Costanza-Chock 2018; Eubanks 2018).
3. World making is different from ontology. Proponents of anthropology's recent "ontological turn" have proposed the term *pluriverse*, to challenge the Eurocentric perspective that evaluates "other" cultures, but the term risks reimagining a world consisting of multiple social bubbles/cosmologies. Thinking through the notion of world making allows one to see the polyphonic processes of value translation and association formation in real-life practice in a more nuanced way (see Tsing 2018).
4. I am aware that some of the primary sources (e.g., television documentaries) are distributed via government-funded channels, whose wider political agenda needs to be interrogated. However, this falls beyond the scope of this article, as I do not argue that container aquaculture is a perfect technological solution to ecological crises and food security problems.
5. On the conceptual level, the container functions like a quasi-enclosed life-support infrastructure, something very similar to the space cabin, wherein the astronaut's body is maintained as an "ecobiopolitical" subject (Olson 2010). For space travel, the astronaut's body and the cabin environment are dually organized via continuous probabilistic risk assessments to check for the astronaut's mission readiness (172). Originating in military research of the 1950s, space cabin development programs have researched the "carrying capacity" and "environmental ethics" of enclosed facilities, to support humans' long-term space travel (Anker 2005).
6. By *calculative rationality* I mean a kind of informed calculation that is quantitatively conclusive, something that is different from the situated understanding of consequence typical of human deliberation and judgment (see Erickson et al. 2013; Smith 2019).
7. Fish mainly excrete nitrogen in their urine, and phosphorous in their feces. A mechanical filter can remove a large amount of phosphorous but cannot remove the main fraction of the nitrogen, because it is dissolved in water. Nitrogen thus needs to be converted to nitrate biologically.
8. For example, Guangzhou Chengyi Fishery Technology Co. offers subscription-based hardware and software service for partner farms. Upon the installment of computational sensors and mobile application, farmers can examine and optimize farm performance via fifteen monitor screens. For example, when the underwater sensor detects that the oxygen dissolving rate is lower than 3 mg/L, the aerator will be automatically activated until it reaches 4 mg/L. Chengyi's intelligent monitoring and decision-support system can generate reports on farm productivity metrics (e.g., electricity conversion efficiency) to clients in real time (Liao and Luo 2019: 28).
9. In "Sensing Multispecies Entanglements," Satsuka's (2018) ideas are inspired by Bin Kimura's (1982) philosophy on the distinction between *mono* (things, which occupy space) and *koto* (event/"about-ness" of a thing, which foregrounds how things are embedded in happenings). Kimura's philosophy draws on Martin Heidegger's articulation of beings and Being; Viktor von Weizsäcker's idea that life itself does not come to an end, only individual living being does; as well as on the works of Henri Bergson, Gilles Deleuze, Michel Henry, and Japanese thinkers such as Kitaro Nishida (Satsuka 2018: 83–84).
10. For example, the thresholds between label categories are decided by designers, and the labeling of training data can be impacted by the individual annotator's subjective interpretation of the annotation guidelines.
11. The idea of ecology is related to what Stengers (2011) has called "cosmopolitics," which considers how the multitude of beings, living and nonliving, create realities wherein associations are continuously forged and broken. Stengers's cosmopolitics represents a nonfoundationalist approach, since it rejects the idea that truth exists in mind or is just there prior to practice.

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12. Grant Jun Otsuki and colleagues' (2018) notion of quotidian politics takes inspiration from postcolonial perspectives (Chakrabarty 2009; Spivak 1999), the "one-world world" debate (Law 2015; Ingold 2018), and Michel Foucault's (1988) discussion of micropolitics in the basic conduct of life. The authors use the term *quotidian* because it is "capacious enough to hold other forms of worlding" in which the "possibilities of an 'otherwise' can be found in quotidian practices" (Otsuki et al. 2018: 8). The concept pushes us to sense, and perhaps touch, other modes of value and being in subtle yet profound ways; it enables us to attend to new affinities and obligations (9).

References

Alaimo, Stacy. 2012. "Porous Bodies and Trans-corporeality." *Larval Subjects* (blog), May 24. https://larvalsubjects.wordpress.com/2012/05/24/stacy-alaimo-porous-bodies-and-trans-corporeality.

Amoore, Louise. 2019. "Doubt and the Algorithm: On the Partial Accounts of Machine Learning." *Theory, Culture, and Society* 36, no. 6: 147–69.

Angwin, Julie, Jeff Larson, Surya Mattu, and Lauren Kirchner. 2016. "Machine Bias: There's Software Used across the Country to Predict Future Criminals. And It's Biased against Blacks." *ProPublica*, May 23. https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing.

Anker, Peder. 2005. "The Ecological Colonization of Space." *Environmental History* 10, no. 2: 239–68.

Antonucci, Francesca, and Corrado Costa. 2020. "Precision Aquaculture: A Short Review on Engineering Innovation." *Aquaculture International* 28, no. 1: 41–57.

Benkler, Yochai. 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven, CT: Yale University Press.

Bennett, Jane. 2010. *Vibrant Matter: A Political Ecology of Things*. Durham, NC: Duke University Press.

boyd, danah, and Kate Crawford. 2012. "Critical Questions for Big Data: Provocations for a Cultural, Technological, and Scholarly Phenomenon." *Information, Communication, and Society* 15, no. 5: 662–79.

Bregnballe, Jacob. 2015. *A Guide to Recirculation Aquaculture: An Introduction to the New Environmentally Friendly and Highly Productive Closed Fish Farming Systems*. Coopenhagen: Food and Agriculture Organization of the United Nations and EUROFISH International Organization.

Bronson, Kelly, and Irena Knezevic. 2016. "Big Data in Food and Agriculture." *Big Data and Society* 3, no. 1: 1–5.

Bucher, Taina. 2018. *If . . . Then: Algorithmic Power and Politics*. Oxford: Oxford University Press.

Carolan, Michael. 2017. "'Smart' Farming Techniques as Political Ontology: Access, Sovereignty, and the Performance of Neoliberal and Not-So-Neoliberal Worlds." *Sociologia Ruralis* 58, no. 4: 745–64.

CCTV-10. 2018. *Wo ai faming* (*I Love to Invent*). "Baibian yuxiang" ("Versatile Fish Container"). Aired December 25. China Central Televsion-10. http://tv.cctv.com/2018/12/25/VIDETrHUZ7oryAWscLjPiRHG181225.shtml.

CCTV-17. 2021. *Shui zhi panzhongcan* (*Who Knows That Meal in the Dish*). "'Sishui' ruhe yang huoyu" ("How to Raise Living Fish in 'Dead Water'"). Aired April 19. China Central Television-17. https://tv.cctv.com/2021/04/19/VIDEs7Wj7w01Lr2i483vfKKu210419.shtml?spm=C47996.PmwNE0WIyO1P.EYeIwa11HCnl.30.

Chakrabarty, Dipesh. 2009. "The Climate of History: Four Theses." *Critical Inquiry* 35, no. 2: 197–222.

China Fishery Law Enforcement, and Ministry of Agriculture and Rural Affairs. 2018. "Nongye nongcun buzhang Yu Kangzhen: Jizhuangxiangyangyu shi yizhong xin jishu moshi, shi yangzhiye lvse fazhan de yici juti shijian" ("Kangzhen Yu, Minister of Agriculture and Rural Affairs: Container Aquaculture Is a New Technological Model, an Experiment of Green Faming Development"). *Aquaculture Business Guide* 8: 4–5.

China Fishery Law Enforcement, National Fisheries Technology Extension Center, and China Society of Fisheries. 2020. *Zhongguo yuye tongji nianjian* (*China Fishery Statistical Yearbook 2020*). China Agriculture Press.

Chun, Wendy H. K. 2021. *Discriminating Data: Correlation, Neighborhoods, and the New Politics of Recognition*. Cambridge, MA: MIT Press.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/19/2/159/2011667/159zhang.pdf by CEFET-RJ user on 04 October 2025

Costanza-Chock, Sasha. 2018. “Design Justice, A. I., and Escape from the Matrix of Domination.” *Journal of Design and Science*. https://jod .mitpress.mit.edu/pub/costanza-chock/release/4.

Dajiang Fishery. 2021. “Zhihuihua yuye shi shuichan yangzhi de xin fengkou, zheshi zhende ma?” (“Is It True That Smart Aquaculture Will Be the Next Big Thing for the Aquacultural Industry?”). *Tencent*, March 29. https://new.qq.com/omn /20210329/20210329A0625L00.html.

Daston, Lorraine, and Peter Galison. 2007. *Objectivity*. Princeton, NJ: Princeton University Press.

Erickson, Paul, Judy L. Klein, Lorraine Daston, Rebecca Lemov, Thomas Sturm, and Michael D. Gordin. 2013. *How Reason Almost Lost Its Mind: The Strange Career of Cold War Rationality*. Chicago: University of Chicago Press.

Eubanks, Virginia. 2018. *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor*. New York: Macmillan.

Foucault, Michel. 1988. “Technologies of the Self.” In *Technologies of the Self: A Seminar with Michel Foucault*, edited by Luther H. Martin, Hugh Gutman, and Patrick H. Hutton, 16–49. Amherst: University of Massachusetts Press.

Fraser, Alistair. 2019. “Land Grab/Data Grab: Precision Agriculture and Its New Horizons.” *Journal of Peasant Studies* 46, no. 5: 893–912.

Godfrey, Mark. 2020. “Chinese Container Aquaculture Firm Selected for Government-Funded Demonstration Project.” *Seafood Source*, September 8. https://www.seafoodsource .com/news/aquaculture/chinese-container -aquaculture-firm-selected-for-government -funded-demonstration-project.

Grumbine, R. Edward. 1994. “What Is Ecosystem Management?” *Conservation Biology* 8, no. 1: 27–38.

Halpern, Orit, Robert Mitchell, and Bernard Dionysius Geoghegan. 2017. “The Smartness Mandate: Notes toward a Critique.” *Grey Room*, no. 68: 106–29.

Haraway, Donna J. 1988. “Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective.” *Feminist Studies* 14, no. 3: 575–99.

Haraway, Donna J. 2016. *Staying with the Trouble: Making Kin in the Chthulucene*. Durham, NC: Duke University Press.

Hathaway, Michael J. 2022. *What a Mushroom Lives for: Matsutake and the Worlds They Make*. Princeton, NJ: Princeton University Press.

Helmond, Anne. 2015. “The Platformization of the Web: Making Web Data Platform Ready.” *Social Media and Society* 1, no. 2: 1–11.

Helmreich, Stefan. 2009. *Alien Ocean: Anthropological Voyages in Microbial Seas*. Berkeley: University of California Press.

Hird, Myra J. 2009. *The Origins of Sociable Life: Evolution after Science Studies*. New York: Macmillan.

Ingold, Tim. 2018. “One World Anthropology.” *HAU: Journal of Ethnographic Theory* 8, nos. 1–2: 158–71.

Kimura, Bin. 1982. *Jikan to jiko* (*Time and Self*). Tokyo: Chuokoronsha.

Kirksey, S. Eben, and Stefan Helmreich. 2010. “The Emergence of Multispecies Ethnography.” *Cultural Anthropology* 25, no. 4: 545–76.

Law, John. 2015. “What’s Wrong with a One-World World?” *Distinktion: Scandinavian Journal of Social Theory* 16, no. 1: 126–39.

Liao, Fen. 2020. “Zhihui yuye chanye tupu, yiwen kandong wulianwang, dashuju qudong xia yuye xin moshi” (“An Industry Map of Smart Aquaculture, an Article that Introduces You to a New Mode of Aquaculture Powered by the Internet of Things and Big Data Analysis”). Zhongguo Chanye Jingji Xinxi Wang (China Industry Economy Information Network). http:// www.cinic.org.cn/sj/sdxz/nysc/895513.html.

Liao, Jing, and Yong Luo. 2019. “Guangzhou chengyi shuichan: Zhihui yangyu keji xingyu” (“Guangzhou Chengyi Fishery: Fishing Intelligently, Aquacultural Development via Technological Innovation”). *Haiyang yu yuye* (*Ocean and Fishery*) 11: 26–28.

Livingstone, Carly, and Irena Knezevic. 2020. “From Online Cart to Plate: What Amazon’s Retail Domination Means for the Future of Food.” *Journal of Agriculture, Food Systems, and Community Development* 9, no. 4: 311–29.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/19/2/159/2011667/159zhang.pdf by CEFET-RJ user on 04 October 2025

Mattern, Shannon. 2015. “Deep Time in Media Infrastructure.” In *Signal Traffic: Critical Studies of Media Infrastructures*, edited by Lisa Parks and Nicole Starosielski, 95–112. Urbana: University of Illinois Press.

Mayer-Schoenberger, Viktor, and Kenneth Cukier. 2013. *Big Data: A Revolution That Will Transform How We Live, Work, and Think*. London: John Murray.

McKelvey, Fenwick. 2011. “A Programmable Platform? Drupal, Modularity, and the Future of the Web.” *Fibreculture Journal*, no. 18. https://fibreculture journal.org/fcj-128-programmable-platform -drupal-modularity-and-the-future-of-the-web/.

Miles, Christopher. 2019. “The Combine Will Tell the Truth: On Precision Agriculture and Algorithmic Rationality.” *Big Data and Society* 6, no. 1: 1–12.

Murray, Nick. 2018. “Agriculture Wars.” *Viewpoint Magazine*, March 12. https://www.viewpointmag .com/ 2018/03/12/agriculture-wars.

NFTEC (National Fisheries Technology Extension Center), and China Society of Fisheries. 2018. “Jizhuangxiangyangyu moshi zhu hebei zhuolu tuopingongjian” (“Container Aquaculture Method Helps Zhuolu in Hebei Province Get Rid of Poverty”). *Zongzhan xuehui dongtai* (*The Main Center Academic Association News*), May 29. http://www.nftec.agri.cn/zzxhdt/201902 /t20190222_6341982.htm.

Nieborg, David B., and Anne Helmond. 2018. “The Political Economy of Facebook’s Platformization in the Mobile Ecosystem: Facebook Messenger as a Platform Instance.” *Media, Culture, and Society* 41, no. 2: 196–218.

Nongxin. 2018. “Wangxiang yangyu xin chulu—jizhuangxiang shi shengtai yangzhi” (“A New Approach to Net Fishing—Container-Based Ecological Fishing”). *Nongye yangzhi xin jishu* (*New Agricultural Technology*) 11: 4–7.

Ogden, Laura A., Billy Hall, and Tanita Kimiko. 2013. “Animals, Plants, People, and Things: A Review of Multispecies Ethnography.” *Environment and Society: Advances in Research* 4, no. 1: 1–23.

Olson, Valerie A. 2010. “The Eco-Biopolitics of Space Biomedicine.” *Medical Anthropology* 29, no. 2: 170–93.

Otsuki, Grant Jun, Shiho Satsuka, Keiichi Omura, and Atsuro Morita. 2018. Introduction to *The World Multiple: The Quotidian Politics of Knowing and Generating Entangled Worlds*, edited by Keiichi Omura, Grant Jun Otsuki, Shiho Satsuka, and Atsuro Morita, 1–17. New York: Routledge.

Paxson, Heather. 2008. “Post-Pasteurian Cultures: The Microbiopolitics of Raw-Milk Cheese in the United States.” *Cultural Anthropology* 23, no. 1: 15–47.

Paxson, Heather, and Stefan Helmreich. 2014. “The Perils and Promises of Microbial Abundance: Novel Natures and Model Ecosystems, from Artisanal Cheese to Alien Seas.” *Social Studies of Science* 44, no. 2: 165–93.

Puig de la Bellacasa, Maria. 2015. “Making Time for Soil: Technoscientific Futurity and the Pace of Care.” *Social Studies of Science* 45, no. 5: 691–716.

Ren, Min, executive producer. 2018. *Keji yuan* (*Agriculture and Farming*). “Datie xiangzi lai yangyu” (“Using a Huge Iron Container to Raise Fish”). Aired July 30. China Central Television-7. YouTube video, 25:23. https://www.youtube.com /watch?v=S0ewzIEKPew.

Satsuka, Shiho. 2018. “Sensing Multispecies Entanglements: *Koto* as an ‘Ontology’ of Living.” *Social Analysis* 62, no. 4: 78–101.

Satsuka, Shiho. 2019. “Rhapsody in the Forest: Wild Mushrooms and the Multispecies Multitude.” In *How Nature Works: Rethinking Labor in a Troubled Planet*, edited by Sarah Besky and Alex Blanchette, 191–211. Albuquerque: University of New Mexico Press.

Schrader, Astrid. 2010. “Responding to Pfiesteria Piscicida (the Fish Killer): Phantomatic Ontologies, Indeterminacy, and Responsibility in Toxic Microbiology.” *Social Studies of Science* 40, no. 2: 275–306.

Schrader, Astrid. 2019. “Marine Microbiopolitics: Haunted Microbes before the Law.” In *Blue Legalities: The Life and Laws of the Sea*, edited by Irus Braverman and Elizabeth R. Johnson, 255–73. Durham, NC: Duke University Press.

Smith, Brian Cantwell. 2019. *The Promise of Artificial Intelligence: Reckoning and Reasoning*. Cambridge, MA: MIT Press.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/19/2/159/2011667/159zhang.pdf by CEFET-RJ user on 04 October 2025

Spivak, Gayatri Chakravorty. 1999. *A Critique of Postcolonial Reason: Toward a History of the Vanishing Present*. Cambridge, MA: Harvard University Press.

The State Council. 2015. "China Unveils Internet Plus Action Plan to Fuel Growth." *Xinhua*, July 4. http://english.www.gov.cn/policies/latest_releases/2015/07/04/content_281475140165588.htm.

Stengers, Isabelle. 2005. "Introductory Notes on an Ecology of Practices." *Cultural Studies Review* 11, no. 1: 183–96.

Stengers, Isabelle. 2011. *Cosmopolitics II*. Minneapolis: University of Minnesota Press.

Tsing, Anna N. 2012. "On Nonscalability: The Living World Is Not Amenable to Precision-Nested Scales." *Common Knowledge* 18, no. 3: 505–24.

Tsing, Anna N. 2015. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton, NJ: Princeton University Press.

Tsing, Anna N. 2018. "A Multispecies Ontological Turn?" In *The World Multiple: The Quotidian Politics of Knowing and Generating Entangled Worlds*, edited by Keiichi Omura, Grant Jun Otsuki, Shiho Satsuka, and Atsuro Mori, 233–47. New York: Routledge.

Wang, Lei. 2018. "Chen Jinliang: Yong jizhuangxiang yangchu jiankang yu" ("Jinliang Chen: Using Containers to Cultivate Healthy Fish"). *China Youth Daily*, December 25. http://zqb.cyol.com/html/2018-12/25/nw.D110000zgqnb_20181225_2-12.htm.

Wang, Yan-Bo, Jian-Rong Li, and Junda Lin. 2008. "Probiotics in Aquaculture: Challenges and Outlook." *Aquaculture* 281, nos. 1–4: 1–4.

Williams, Raymond. 1976. *Keywords: A Vocabulary of Culture and Society*. New York: Oxford University Press.

Yang, Yang. 2020. "Zhihui yangyu: Chuangye daren de xin nongye mengxiang" ("Smart Aquaculture: An Avid Entrepreneur's New Aquacultural Dream"). *Zhongguo nongcun keji* (*China Rural Technology*) 307: 35–37.

Yao, Junyao, Yuebo Xie, and Yuqing Lin. 2019. "Mokuaihua shengtai shuichan yangzhi fangfa" ("A Module-Based Ecological Aquaculture Method"). China patent no. CN1093291184A. China National Intellectual Property Administration. http://epub.cnipa.gov.cn/tdcdesc.action?strWhere=CN109329184A.

Zhang, Yuxing. 2022. "From Social Trust to Blockchain-Mediated Trust." *Roadsides*, no. 7: 44–50. https://doi.org/10.26034/roadsides-202200707.

Zhao, Junlan, Zhixiong Guo, and Ningjing Wu. 2020. "Xianchang qianyue 1.6 yi! Nongxin hulian tuichu zhulianwang 5.0, quanmian kaiqi yangzhu shuzhi shidai" ("Contracting 1.6 Hundred Millions on Site! Nxin Launched Pig Network 5.0 and a New Era of Smart Pig Farming"). *Nongmu qianyan* (*Agricultural Husbandry Frontiers*), October 14. https://mp.weixin.qq.com/s/VKYmF57WsboqgryPPSxQIw.

Zhu, Zewen, Rui Shu, and Jun Xie. 2019. "Jizhuangxiang shi shuichan yangzhi moshi fazhan xianzhuang fenxi ji duice jianyi" ("An Analysis of the Development and Future of Container Aquaculture"). *China Fishery* 4: 28–30.

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