The Racialized Treadmill of Robotic Agriculture: Colonial Legacies, Legal Exceptionalism, and Labour Control

Dr. Vasanthi Venkatesh[1]

Abstract

The title of this paper draws on two historical meanings of the word "treadmill". First, it references the concept of "agricultural technology treadmill", which describes how technological advances in farming lead to market consolidation, pushing smaller producers out while benefiting agribusiness oligopolies. Second, it invokes the literal treadmill—invented in 1818 as a punitive labour technology that was used as a "rational" tool to impose discipline on racialized and indentured labourers in colonial plantations. By connecting these two threads in agricultural technology—economic domination and racialized labor control—this paper examines how robotics and automation in modern agriculture perpetuates colonial logics of exploitation under benign narratives of farmer productivity, food security, and economic development. The paper also demonstrates that legal "exceptionalism" is a misnomer even in the context of novel robotic technologies in agriculture; but rather it is part of a historical continuum that traces its roots back to the colonial plantation economy, where legal and technological structures were specifically differentiated to reinforce racialized labour exploitation and land dispossession.

Author Note: This is a work-in-progress prepared for the 2025 WeRobot Conference. It is a first draft with unfinished footnotes and a few underdeveloped sections. It is also written as a conceptual intervention, offering critical analysis and theoretical provocations. Apologies for typos and inadvertent mistakes. Comments and critiques are warmly welcome.

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[1] Associate Professor- *Law, Land, and Local Economies*; Co-Director, *J4MW-Windsor Law Migrant Farmworker Legal Clinic*, University of Windsor Faculty of Law

I. Introduction

Agriculture in Canada remains an enduring instrument of colonialism, reliant on and reproducing racialized displacement, dispossession, and agro-technological violence. Its legacy is rooted in violent dispossession of land through Indigenous genocide, the residential school system's deliberate starvation of Indigenous children while erasing traditional foodways, and the use of enslavement, indentureship and racist immigration laws to supply "bound", unfree labour for agriculture.[2] Yet this is not a national exception—it is the local expression of a global regime. In this article, I argue that automation and digitization in agriculture are not revolutionary but evolutionary continuities of the colonial plantation system, which appropriated and erased Indigenous and Global South systems to construct a massive industrial agriculture complex premised on racialized violence and concentration of wealth. This globalized system is perfected in today's corporatized racial capitalist complex—one that dehumanizes, algorithmizes, surveils, and expropriates racialized people under the pretext of efficiency, food security, and modernity. I show that law has been its steadfast handmaiden, codifying enclosures, legitimizing labour exploitation, and insulating capital from accountability. The word "treadmill" in the title invokes this dual violence: the literal treadmill invented as a racialized disciplining technology in plantations,[3] and the conceptual treadmill that crystallizes the economics of technology introduction in agriculture leading to systematic dispossession and wealth concentration.[4]

Drawing on theoretical frameworks from science and technology studies (STS), anti-colonial studies, and law and political economy this paper demonstrates how automated agricultural technology operates through three interlocking logics to form a regime of techno-capitalist enclosure: securitization, neo-Malthusianism, and surveillance capitalism.[5] First, securitization reframes food production as an existential security crisis, mobilizing the language of emergency and urgency to justify surveillance systems, exceptions from labour and privacy laws and other

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[2] Sarah Rotz, "'They took our beads, it was a fair trade, get over it': Settler colonial logics, racial hierarchies and material dominance in Canadian agriculture" ScienceDirect (2017) 82 Geoforum 158–169.
[3] Thomas C Holt, *The Problem of Freedom: Race, Labor, and Politics in Jamaica and Britain, 1832-1938* (Baltimore, Md London: Johns Hopkins University Press, 1991).
[4] Richard A Levins & Willard W Cochrane, "The Treadmill Revisited" JSTOR (1996) 72:4 Land Economics 550–553.
[5] Glenn Davis Stone, "Surveillance agriculture and peasant autonomy" Wiley Online Library (2022) 22:3 Journal of Agrarian Change 608–631; Ryan Stock & Maaz Gardezi, "Make bloom and let wither: Biopolitics of precision agriculture at the dawn of surveillance capitalism" ScienceDirect (2021) 122 Geoforum 193–203; Krista Lynes, "How Like a Leaf: Vital Energy in Greenhouse Infrastructures" Project MUSE (2023) 31:2 Configurations 159–184; Jen Liu & Phoebe Sengers, "Legibility and the Legacy of Racialized Dispossession in Digital Agriculture" ACM Digital Library (2021) 5:CSCW2 Proc ACM Hum-Comput Interact 480:1-480:21; Rotz, "'They took our beads, it was a fair trade, get over it'", *supra* note 1; Christopher Miles, "The combine will tell the truth: On precision agriculture and algorithmic rationality" SAGE Journals (2019) 6:1 Big Data & Society 2053951719849444; Lynn Stephen, "Surveillance and Invisibility in the Lives of Indigenous Farmworkers in Oregon" in *Transborder Lives: Indigenous Oaxacans in Mexico, California, and Oregon* (Duke University Press, 2007); Alistair Fraser, "Land grab/data grab: precision agriculture and its new horizons" (2019) 46:5 The Journal of Peasant Studies 893–912; Kelly Bronson, "A digital "revolution" in agriculture?: Critically viewing digital innovations through a regenerative food systems lens" in *Routledge Handbook of Sustainable and Regenerative Food Systems* (Routledge, 2020); Shoshana Zuboff, "Big other: Surveillance Capitalism and the Prospects of an Information Civilization" SAGE Journals (2015) 30:1 Journal of Information Technology 75–89; Francisco Klauser, "Surveillance Farm: Towards a Research Agenda on Big Data Agriculture" (2018) 16:3 Surveillance & Society 370–378; Sarah-Louise Ruder, "The 'terms and conditions' of surveillance capitalism: theorizing agricultural data policy and governance" 0:0 The Journal of Peasant Studies 1–26.

regulations, and state-subsidized technological fixes that privilege oligarchies.[6] Neo-Malthusianism is the necropolitical discourse driving white techno-supremacist agricultural nationalism, that constructs scarcity panic and racialized demographic alarmism to frame racialized and global south populations as existential threats requiring aggressive transnational, border, and domestic enforcement.[7] It further legitimizes technological and agricultural exceptionalism in law and economic policy, while intensifying economic and extra-economic coercion of racialized bodies, rendering them as a disposable, expropriable, and exploitable surplus.[8] Surveillance capitalism, as defined by Zuboff, is a hyper-scaled extraction regime that commodifies human experience into behavioural data, bypasses democratic oversight through regulatory capture and state subsidies, and enforces mass behavioural manipulation— transforming life itself into a privatized surplus for capital accumulation.[9]

The first section maps the political economy and racial underpinnings of two key technologies currently shaping agriculture production— precision agriculture and high-tech greenhouses. The second section provides a historical analysis of technology in agriculture showing how technology was rooted, germinated, and grown in the colonial "plantation complex". The third section begins with a brief background of racialized agricultural labour exploitation in Canada to outline the regulatory framework that provides the bulwark of the contemporary avatar of the complex. Agricultural technology thrives on interlocking legal regimes of exception that perpetuate racial and colonial hierarchies: (1) immigration law that legitimates border securitization and the differential, discriminatory rights for non-citizens and provides the mechanism for supplying unfree racialized labour to agriculture, (2) agricultural exceptionalism that exempts the sector from labor, environmental and other standards in the interests of food security, and (3) technological determinism embedded in law that exceptionalizes and deregulates technology.

I. Automation Technology in Agriculture

Before examining the racialized and neocolonial dimensions of robotic and digital agriculture, this section maps two key technologies currently shaping agriculture production— precision agriculture and high-tech greenhouses.

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[6] Melanie Sommerville, Jamey Essex & Philippe Le Billon, "The 'Global Food Crisis' and the Geopolitics of Food Security" (2014) 19:2 Geopolitics 239–265; Klauser, "Surveillance Farm", *supra* note 4; Chris Ramsaroop, "Discipline and resistance in southwestern Ontario: Securitization of migrant workers and their acts of defiance" Wiley Online Library (2023) 23:3 Journal of Agrarian Change 600–610; Stock & Gardezi, "Make bloom and let wither", *supra* note 4; David Moffette & Shaira and Vadasaria, "Uninhibited violence: race and the securitization of immigration" (2016) 4:3 Critical Studies on Security 291–305.

[7] Sommerville, Essex & Billon, *supra* note 5; Stock & Gardezi, "Make bloom and let wither", *supra* note 4; Soumaya Majdoub, "Malthusian Fears in Current Migration Debates: Contemporary Manifestations of Malthusianization" in *The Politics of Replacement* (Routledge, 2023); Susanne Schultz, "The Neo-Malthusian Reflex in Climate Politics: Technocratic, Right Wing and Feminist References" (2021) 36:110 Australian Feminist Studies 485–502; Amanda Shaw & Kalpana and Wilson, "The Bill and Melinda Gates Foundation and the necro-populationism of 'climate-smart' agriculture" (2020) 27:3 Gender, Place & Culture 370–393.

[8] Majdoub, *supra* note 6; Shaw & and Wilson, *supra* note 6; Sommerville, Essex & Billon, *supra* note 5.

[9] Zuboff, "Big other", *supra* note 4; Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*, 1st edition ed (New York, NY: PublicAffairs, 2019); Klauser, "Surveillance Farm", *supra* note 4; Stone, *supra* note 4; Ruder, "The 'terms and conditions' of surveillance capitalism", *supra* note 4.

It begins with a discussion on precision agriculture, showing how automated tools and data extraction intensify the "technology treadmill," consolidating power among agribusiness oligopolies— a dynamic that the subsequent section will trace to plantation logics**.** It then examines the massive proliferation of greenhouses, where worker surveillance and controlled ecologies replicate and intensify settler-colonial logics of land and labor extraction. Together, these technologies form an infrastructure of surveillance, securitization and racial capitalism, which is masked as technological progress apparently "revolutionizing" the fight against farmer precarity, global hunger, and food insecurity.

A. Precision Agriculture

Precision agriculture (PA) presents itself as a suite of tools incorporating robotics, connected devices, remote sensing, artificial intelligence (AI), machine learning, and big data analytics designed to optimize production. This regime deploys an array of robotic and monitoring technologies—drones, yield monitors and soil sensors, GPS-guided tractors, blockchain systems, —that convert agricultural landscapes into data frontiers. [10] As Global Affairs Canada touts, "the future of farming is driven by AI and technology"[11] and Royal Bank of Canada extols the "Farmer 4.0" producting "digital vegetables."[12] With AI and automation, Global Affairs Canada claims, you can now be an agriculturalist without ever having stepped on a farm.[13]

However, scholars like Klauser argue that the true function of PA is the creation of the "surveillance farm."[14] Critiques of PA by critical STS and historical materialist agrarian studies further point out that PA severs humanity's sensory relationship to land while imposing new forms of behavioral control on farmers and workers through algorithmic discipline and promoting hyper-extractive, rentier, capital accumulation.[15]

At the heart of this system lies a coercive data economy. User agreements force farmers to surrender operational data from the sensors to agritech corporations, where it is combined with weather patterns, market trends, and the data *from other farms* to generate proprietary insights and recommendations for farming.[16] "Smart farmer" technologies promote remote farm management—a practice that eliminates tactile knowledge while centralizing control in corporate servers. The process can be summarized as follows. First, farm outputs and inputs, including

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[10] Stock & Gardezi, "Make bloom and let wither", *supra* note 4; *Robotics in Agriculture*, by Agriculture in the Classroom Canada (AITC-C) (Agriculture in the Classroom Canada (AITC-C), 2023) online: <https://aitc-canada.ca/Portals/0/adam/snapAG/ODccggt3E0aIFA4i2ZwTjA/Link/Robotics.pdf>; Kelly Bronson, "Smart Farming: Including Rights Holders for Responsible Agricultural Innovation" COinS (2018) 8:2 Technology Innovation Management Review 7–14.

[11] Global Affairs Canada, "AI and agriculture technology: a growing field of study" (8 March 2024), online: *GAC* <https://www.educanada.ca/blog-blogue/2024/ai-agriculture-ia-agricoles.aspx?lang=eng> Last Modified: 2025-01-21.

[12] Andrew Schrumm, "Digital Vegetables: The Shift to Automation in Canada's Greenhouses" (8 October 2019), online: *RBC Thought Leadership* <https://thoughtleadership.rbc.com/digital-vegetables-the-shift-to-automation-in-canadas-greenhouses/>.

[13] Global Affairs Canada, *supra* note 10.

[14] Klauser, "Surveillance Farm", *supra* note 4.

[15] Fraser, "Land grab/data grab", *supra* note 4; Miles, "The combine will tell the truth", *supra* note 4; Stone, *supra* note 4; Klauser, "Surveillance Farm", *supra* note 4; Stock & Gardezi, "Make bloom and let wither", *supra* note 4; Rotz, "'They took our beads, it was a fair trade, get over it'", *supra* note 1; Ruder, "The 'terms and conditions' of surveillance capitalism", *supra* note 4.

[16] Fraser, "Land grab/data grab", *supra* note 4; Ruder, "The 'terms and conditions' of surveillance capitalism", *supra* note 4.

worker movements, are surveilled using automated instruments including robotics, wearable technologies, and remote sensors. Then the data is collected and combined with other data and subject to algorithms and data analytics remotely. Based on the analytics, the PA system provides proprietary workflows and suggestions for every aspect of farm activity. The farm management can then implement those algorithmic suggestions from a location that may be halfway across the globe, with a click of a button that will send a signal to the automated technologies in the farm to perform the task.[17] Or, the signal to adapt or continue a task or process can be automatically sent to a robot programmed to do any farming task, without any human involvement.[18] Ultimately, the envisioned "farm of the future" operates as a networked, software-mediated ecosystem, governed by meticulously designed data collection, transmission, and computational analysis. It removes control of food production from people and dismembers the connection of humanity to the food they produce.[19]

John Deere's PA exemplifies this dispossession. The PA program harvests soil data, worker movements, and crop conditions from its customer farmers only to sell back its recommendations through paywalled subscriptions.[20] Intellectual property regimes then lock this knowledge behind digital barriers for Deere's use.[21] "Data grabbing" by Deere not only dispossesses farmers of their knowledge productivity, but also reconstitutes farmers as algorithmic subjects,[22] internalizing corporate logics through what Gardezi and Bronson call PA-shaped "social identities"—a form of agricultural governmentality.[23] PA has also been criticized as enacting a biopolitical logic of "make bloom and let wither," that can have profound consequences on global ecology where crops suited for mass "smart" production become profitable, while other crops—and the farms that grow them— "wither" away.[24]

The concept of "agriculture treadmill" proposed by William Cochrane is often used to describe the "get big or get out" dynamics driven by technology in agriculture.[25] New technologies allow early and capital-privileged adopters to produce more at higher yields, accumulate greater profits and create downward pressure on prices. One of the reasons is that food demand is somewhat inelastic because "the stomach is inelastic" and states fiscally control food prices for political stability (not accounting for the long term increase in demand caused by population growth and changes in caloric consumption behaviours).[26] Those farmers who fail to adopt technology on

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[17] *Ibid.*
[18] *Case Study: Field Crop Agricultural Robotics*, by Mithara Fonseka et al (University of Waterloo) online: <https://uwaterloo.ca/disruptive-technologies-economic-development/sites/default/files/uploads/documents/field-crop-robots_case-study-12aug2024.pdf>.
[19] Ruder, "The 'terms and conditions' of surveillance capitalism", *supra* note 4.
[20] *Ibid.*
[21] Fraser, "Land grab/data grab", *supra* note 4; Sarah Rotz et al, "The Politics of Digital Agricultural Technologies: A Preliminary Review" Wiley Online Library (2019) 59:2 Sociologia Ruralis 203–229.
[22] Miles, "The combine will tell the truth", *supra* note 4.miller
[23] Maaz Gardezi & Kelly Bronson, "Examining the social and biophysical determinants of U.S. Midwestern corn farmers' adoption of precision agriculture" par.nsf.gov (2019) Precision Agriculture, online: <https://par.nsf.gov/biblio/10118997-examining-social-biophysical-determinants-midwestern-corn-farmers-adoption-precision-agriculture>.
[24] Maaz Gardezi & Ryan Stock, "Growing algorithmic governmentality: Interrogating the social construction of trust in precision agriculture" ScienceDirect (2021) 84 Journal of Rural Studies 1–11.
[25] Levins & Cochrane, *supra* note 3.
[26] Michael Carolan, *The Sociology of Food and Agriculture*, 1st edition ed (London New York, NY: Routledge, 2012) at 8; Paul B Thompson, "Social Impact and the Technology Treadmill" in Paul B Thompson, ed, *Food and Agricultural Biotechnology in Ethical Perspective* (Cham: Springer International Publishing, 2020) 193.e

time are forced to abandon agriculture, leading to the mass peasant dispossession that has been the hallmark of agricultural expansion since the colonial era.

However, the "sunny time of his first love" —as Marx described the initial windfall profits from adopting a new technology[27]— soon dwindles as the overall rate of surplus stagnates, unless agrobusinesses introduce another new technology to maintain their accumulation and/or resort to extracting value from exploiting *labour*.[28] As will be described in the next section, several sectors of agriculture, such as horticulture, vegetable, and fruits remain labour-intensive despite agricultural automation, because cheap exploitable labour still produces predictable surplus profits.

"Agricultural treadmill" pushes the agricultural system towards continual production growth, ever-increasing input costs, and consolidation into large farms dominated by "ag-barons".[29] Therefore, unsurprisingly, a handful of transnational agribusinesses—part of the oligopolies in seeds, agrochemicals, and machinery such as Syngenta, Bayer/Monsanto, BASF, Corteva, John Deere — dominate digital agriculture, capturing over 75 percent of the global agricultural input market.[30] These firms leverage surveillance agriculture by controlling the technologies, data flows, and farming practices and locking farmers into their entire ecosystem to further consolidate their power. For example, Bayer's 'Field View' PA system "extracts 87.5 billion datapoints from 180 million acres (78.2 million hectares) of farmland in 23 countries," and in the process has also increased the adoption of Bayer's fertilizers.[31]

Recent reports by Oxfam and the the Action Group on Erosion, Technology and Concentration (ETC) highlight the rise of "food barons," whose wealth grew by one billion dollars every two days between 2020 and 2022—profiting from the cost-of-living crises and the pandemic.[32] Like colonial "entrepreneurs" who amassed extraordinary profits from plantations, these modern agribusiness wield extensive power with governments, who then further inject trillions of dollars through subsidies and offering crucial legal exceptions.

Zuboff uses the term "Big Other" to define the "ubiquitous digital apparatus" that "renders, monitors, computes and modifies human behaviour."[33] The "Big Other" digital architecture of surveillance agriculture is sustained by numerous actors such as tech giants; the "shadow of the shadow state"[34] composed of the philanthropic sector, non-governmental organizations (NGOS) and international governmental organizations (IGOs) focussed on

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[27] Karl Marx, Capital: A Critique of Political Economy (Vol. 1): The Process of Capitalist Production, trans. S. Moore and E. Aveling (New York: International Publishers, 1867/1967), 299443–444
[28] Thompson, *supra* note 25.
[29] *Food Barons 2022: Crisis Profiteering, Digitalization and Shifting Power*, by ETC Group (2022) online: <https://www.etcgroup.org/files/files/food-barons-2022-full_sectors-final_16_sept.pdf>.
[30] Rotz et al, "The Politics of Digital Agricultural Technologies", *supra* note 20 at 206; ETC Group, *supra* note 28.
[31] ETC Group, *supra* note 28.
[32] *Profiting from Pain*, by Oxfam (2022) online: <https://www.oxfamamerica.org/explore/research-publications/profiting-from-pain/>; ETC Group, *supra* note 28.
[33] Zuboff, "Big other", *supra* note 4.
[34] Ruth Wilson Gilmore, "In the Shadow of the Shadow State" in *The Revolution Will Not Be Funded: Beyond the Non-Profit Industrial Complex* (Duke University Press, 2017).

development and food security; the military and weapons industry; and of course, the nation-state.[35]

Tech giants like Alphabet (with plant-monitoring robots) and Microsoft (via its FarmBeats IoT system) provide the interface for digitizing farms into predictive behavioural markets.[36] Agribusiness also rely on numerous state, intergovernmental and non-governmental allies, including the United Nations[37] to frame precision technologies as an inevitable response to future food crises and influence farmer behavior through data-driven surveillance.[38] For example, the *PAD* (Precision Agriculture for Development) initiative, a global development initiative, uses algorithmic systems to send targeted mobile phone calls to Nigerian farmers.[39] These calls promote specific practices—such as agrochemical use or harvesting schedules—based on data extracted from comprehensive monitoring tools and are even synchronised with farmers' daily routines and religious observances. The international Consultative Group for International Agricultural Research (CGIAR), which has received numerous criticisms for its technology driven policies during the Green Revolution in the Global South that increased inequalities and environmental degradation, now promotes behavioural changes in farmers and market-oriented entrepreneurialism through PA ag-tech.[40]

Drones are a crucial but controversial component of smart agriculture. While the militarized origins of unmanned aerial vehicles (UAVs) and their uses for border and domestic enforcement perpetuating racialized violence are widely documented, less attention has been paid to the technology transfer between the military and agriculture. In 2013, Association for Unmanned Vehicle Systems International predicted that *eighty percent of the future drone market* is expected to relate to agriculture.[41] Many agricultural drones either *originate* from military and state surveillance applications or have been developed using agriculture as benign pretext only to be later deployed in wars and state terror. For example, the DJI Agras T10 Drone— designed and marketed as the "ideal drone for new farmers" for its sturdiness and capacity to carry heavy payloads for spraying fertilizers and pesticides[42](retailing for $13k CAD)[43] — has been adapted by the Israel military to drop bombs on civilians during the ongoing genocide in Gaza.[44] The technological lineage of modern agricultural drones traces directly to Israeli military innovation in the 1970s, when Israeli engineer Abraham Karem (dubbed the "Drone Father") designed the first viable unmanned aerial vehicle (UAV) while at Israel Aircraft Industries (IAI).[45] Similarly, the same tracking and surveillance systems monitoring livestock and farmworkers today were

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[35] Stone, *supra* note 4.
[36] *Ibid.*
[37] *Ibid.*
[38] Stone, *supra* note 4.
[39] *Ibid.*
[40] *Ibid. Also see* Shaw & and Wilson, *supra* note 6.
[41] Sasha Khokha, "Drones: The Newest Water-Saving Tool for Parched Farms | KQED" (21 April 2014), online: <https://www.kqed.org/science/16676/drones-the-newest-water-saving-tool-for-parched-farms>.
[42] https://www.dji.com/ca/t10
[43] https://dronepoint.ca/products/dji-agras-t10-drone
[44] Israeli Drone Warfare: Gaza as a Testing Ground for Advanced Military Technology https://www.watanserb.com/en/2025/02/20/israeli-drone-warfare-gaza-as-a-testing-ground-for-advanced-military-technology/
[45] "The dronefather", *The Economist*, online: <https://www.economist.com/technology-quarterly/2012/12/01/the-dronefather>.

first deployed in counterinsurgency operations—used to identify and target farmers in Colombia and Afghanistan under the guise of the War on Drugs.[46]

Despite growing demands to ban autonomous weapons and regulate dual-use technologies, the unchecked proliferation of agricultural drones continues to implicate farmworker, farmers, and food consumers in war crimes and genocide. Drones form the paradigmatic example of how agricultural technology functions not as neutral tool but as an instrument of genocide, apartheid, and racial capitalism.

The Canadian government has proclaimed its commitment to agricultural automation and has made substantial public investments, creating the Canadian Agri-Food Automation and Intelligence Network (CAAIN) in 2019 with nearly CA$50-million initial investment to "accelerate automation and digitization in Canada's agricultural sector."[47] In 2023, the Federal Government, with an investment of $7.2 million, launched the AgriInnovate Program, aimed at supporting R&D, commercialization, demonstration, and adoption of new technologies and processes.[48] (Government of Canada, 2023). under the auspices of the Sustainable Canadian Agricultural Partnership (CAP)Canada ranked seventh globally in the total new agri-food technology investments and sixth in the number of new deals.[49] The recent tensions with the United States has intensified the calls for further investment and removing and regulatory barriers for digital agriculture.[50] Yet, Canada is a paradigm of the "agricultural treadmill" with large farms dominating agriculture. In fact, the average farm size of a Canadian farm (809.4 acres per farm in 2021) is almost double the average farm size in the US (445.0 acres per farm) and has a much higher density of greenhouses at 8,934.4 square feet of greenhouse area per 1,000 people.[51] 64 per cent of farms with annual revenues over $1 million reported using precision agriculture technologies, compared to only 24 per cent of farms with revenues under $100,000.[52]

B. Greenhouses

The production of crops under enclosed structures that capture and amplify reflected light while protected from outside weather (e.g. greenhouses) have a long history across the globe from Rome to Korea, dating back to at least the first century.[53] During the colonial era, glasshouses

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[46] Jeremy Kuzmarov, "The Failure of the U.S. High-Tech War on Drugs" Silverchair (2021) 45:5 Diplomatic History 903–914. ADD

[47] Science and Economic Development Canada Innovation, "Minister Sohi announces investment in the future of farming" (22 July 2019), online (news releases): <https://www.canada.ca/en/innovation-science-economic-development/news/2019/07/minister-sohi-announces-investment-in-the-future-of-farming.html> Last Modified: 2019-07-22.

[48] Agriculture and Agri-Food Canada, "AgriInnovate Program: Innovations in sustainable agriculture" (22 November 2024), online (backgrounders): <https://www.canada.ca/en/agriculture-agri-food/news/2024/11/agriinnovate-program-innovations-in-sustainable-agriculture.html> Last Modified: 2024-11-22.

[49] Ivus, Maryna, Matthews, Mairead, Snider, Nathan, Taillon, Paul, Watson, Mark. Canadian Agri-food Technology: Sowing the Seeds for Tomorrow. Information and Communications Technology Council (ICTC), 2021. https://ictc-ctic.ca/reports/ canadian-agrifood-technology#report.

[50] https://thoughtleadership.rbc.com/food-first-how-agriculture-can-lead-a-new-era-for-canadian-exports/

[51] https://www.nfu.ca/wp-content/uploads/2024/03/Canadian-Ag-by-the-Numbers-2024.pdf; https://www150.statcan.gc.ca/n1/pub/96-325-x/2021001/article/00012-eng.htm

[52] https://fsc-ccf.ca/wp-content/uploads/2024/07/the-next-frontier_2024.pdf

[53] Krishna Nemali, "History of Controlled Environment Horticulture: Greenhouses" journals.ashs.org (2022), online: <https://journals.ashs.org/hortsci/view/journals/hortsci/57/2/article-p239.xml>.

were popular in London to showcase British hegemony— glasshouses were used to flaunt the "absolute control of colonized environments and flora...[using plants] as a symbol of British Imperial power".[54] Today, this tradition of techno-agricultural spectacle continues through its two major inheritors: the Netherlands and Israel, who are the major suppliers of greenhouse technology to the world from Canada to Kenya.[55] The Netherlands rebrands both its legacy as progenitor of the colonial plantation system and its current position as the of the hub of agrobusiness by presenting itself as "this tiny country that feeds the world" through technology.[56] And Israel weaponizes greenhouse and agricultural innovation as propaganda for occupation — presenting stolen Palestinian land as a desert made fertile through technology.[57]

Leamington, Ontario is the "greenhouse capital" of Canada. Lynes describes the greenhouses in Leamington as "a potent brew of technologies, photosynthetic lighting, climate control, plant physiology- and plant pathology-research teams, computer programmed crop managers, and temporary foreign workers."[58] Greenhouse technology includes a wide array of automated tech such as robotics, sensors, drones, cameras, and AI-based analytical processing, especially for hydroponic cultivation of crops such as cannabis. The surveillance architecture is used for "controlling temperature, humidity, light, CO2 levels, 24/7 access as well as remote access".[59]

Robots and drones are used for environment control and spraying, while AI provides argronomic evidence by predicting levels of soil nutrients and materials to be added.[60] Sophisticated robots and drones can be used for scouting and identifying weeds and diseased plants. The Guelph Intelligent Greenhouse Automation System (GIGAS) is one example of an integrated system developed in Canada.[61] Another integrated system is "ANT: An Innovative Approach to a Fully Autonomous Greenhouse Mobility", which has received extensive CAINN funding and is supposedly a "brilliant blend of agriculture and state-of-the-art technology, including AI, machine learning, and robotics," inspired by the "organisational dynamics of ant colonies, where each member of the collective carries out a specific function".[62] Although, the ideal robot would be used for harvesting, the closed environment and dense cultivation creates significant barriers for automated harvesting.[63] Every type of crop requires its own specialized robot technology and with current technology a robot takes over one minute to pick a tomato

[54] https://blogs.ubc.ca/buildingempire/2021/04/26/the-palm-house-at-kew-gardens-iron-climate-control-and-commercialism/
[55] Nemali, "History of Controlled Environment Horticulture", *supra* note 52.
[56] https://www.nationalgeographic.com/magazine/article/holland-agriculture-sustainable-farming
[57] Alon Tal, "To Make a Desert Bloom: The Israeli Agricultural Adventure and the Quest for Sustainability" Silverchair (2007) 81:2 Agricultural History 228–257.
[58] Lynes, "How Like a Leaf", *supra* note 4.
[59] "Precise innovation: Greenhouse cultivation inspires new techGreenhouse Canada" (26 November 2024), online: <https://www.greenhousecanada.com/innovation-greenhouse-cultivation/>.
[60] *Ibid.*
[61] "Robots On A Roll Greenhouse Canada : February 2016", online: <https://mydigitalpublication.com/publication/?i=287503&article_id=2370502&view=articleBrowser>.
[62] "On the Road to Fully Autonomous Greenhouses - CAAIN" (21 February 2024), online: <https://caain.ca/news-and-events/on-the-road-to-fully-autonomous-greenhouses/>.
[63] note 60.

that a worker takes six to seven second.[64]A tomato-picking robot is valued at CDN$100,000 and every acre requires one robot.[65]

Greenhouse facilities are highly automated, up-to-date with the latest technology, and produce 48% in terms of value of all Canadian fresh produce exports.[66] Yet, technological intensification has not obviated the need for cheap, exploitable racialized labour, which has been consistently increasing. Accounting only for workers with valid work visas, the number of temporary foreign workers, who constitute 25% of all agricultural labour in Canada, grew from 55,171 in 2020 to 70,267 in 2023— a 27% increase in just three years, with Ontario's greenhouses alone employing over 43% of these workers.[67]

Far from replacing racialized labor, automation has deepened its exploitation**.** The promise of technological efficiency obscures how greenhouses now extract *more* work from migrant bodies—tightening biopolitical control through digital surveillance, climate-controlled discipline, and the ever-present threat of deportation. The greenhouse enables 24/7 year round production and extraction by forcefully modifying the diurnal patterns of both human and plant. Workers remain the lynchpin of production, but under conditions where every gesture, breath, and harvest is optimized through technology—not for their improving their work conditions, but for the profit of growers who deploy automation as a tool of extraction.

As Lynes argues, greenhouses represent a particular racial "chronopolitics", in which technological innovations serve as "infrastructural concealment" of racialized and gendered labour, mirroring colonialism.[68] During colonialism, racialized unfree labour produced the coffee, tea, sugar and other commodities for the burgeoning middle class in the metropole. Through physical "dislocation" to plantations in faraway colonies, the workers could be concealed and invisiblised; differential laws applied; and disciplinary methodologies deployed for maximum and efficient extraction. Today, the border, and not the sea, functions as the enclosure, foreclosing the entry of racialized people from the Caribbean, Central America and other countries, except through tightly controlled temporary work permits that bind them to specific greenhouse employers.

The technology that optimizes greenhouse environments for high yields often forces workers to endure temperatures reaching 40–50°C and getting soaked with pesticides and other chemicals that are sprayed through automated systems.[69] Dogget et al's excellent study of the surveillance

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[64] *Ibid.*
[65] Food From Thought, "U of G Engineering Lab Set to Revolutionize Greenhouse Vegetable Harvesting" (27 June 2024), online: *Food from Thought* <https://foodfromthought.ca/u-of-g-engineering-lab-set-to-revolutionize-greenhouse-vegetable-harvesting/>.
[66] https://agriculture.canada.ca/en/sector/horticulture/reports/statistical-overview-canadian-greenhouse-vegetable-and-mushroom-industry-2023
[67] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210021801; https://www150.statcan.gc.ca/n1/daily-quotidien/220613/dq220613d-eng.htm
[68] Lynes, "How Like a Leaf", *supra* note 4.
[69] Chris Ramsaroop, "Reality Check 101" (6 September 2019), online: *Data & Society* <https://medium.com/datasociety-points/reality-check-101-c6e501c3b9a3>. UFCW report

technology in greenhouses, called *chequeadora* (the checking system) by Spanish-speaking workers, describes the process that workers go through:[70]

> *chequeadoras* are usually comprised of a terminal network and a corresponding device such as a watch, which is equipped with a RFID tag. … First, workers check into a production terminal (*chequeadora)* after completing one row of activity such as harvesting plants or weeding. *Chequeadoras* are fixed across the greenhouse, approximately 50 metres apart. Once a worker finishes a row, they go to the *chequeadora* to input the relevant information. Second, workers tap their watch or enter their employee ID number. Third, workers indicate which activity they completed. If workers were harvesting, they move to the fourth step, which is entering the number of boxes they completed in the row. Workers continue this cycle until they have completed the work in their designated zones.

Employers use television screens mounted in their offices to track workers' progress.[71] The data analytics provide information on every worker's productivity and ranks the workers based on the amount of the crop picked in the ten plus hours they work per day. The high performing workers are expected to work even harder to get a bonus of $10-15 per fortnight. The lowest ranked workers each day (often differing by a handful of fruits from the "high performing" workers) are penalized through forced unpaid leave ranging from one day to a week, enacted by not assigning any work to them.

Throughout the day, the system tracks workers movements. If a worker is found to have gone on a longer or an additional restroom break or was found to be to "too still", the supervisor can use the data to admonish the workers.[72]

Organisations such as J4MW have also pointed out how these systems are used to enable wide scale wage theft.[73] For example, the clocking system is designed to skip the first increment that a worker clocks in. A worker clocking in at 6:01a.m instead of 6:00 a.m is deemed to begin work at 6:15a.m, if the increments are spaced at 15 minutes. If there are two breaks over a 10 hour work day, a worker can lose at least an hour of pay per day. There is no regulation that mandates the clocking increment.[74]

Cannabis greenhouses further collect biometric information (fingerprints) from workers everyday and are highly securitized.[75] Using the pretext of security, automation and agricultural technology subject racialized workers to an insidious disciplinary biopolitics that have direct lineage to colonialism and the plantation complex. The treadmill, that we now use for exercising, was invented in 1818, as "rational and humane way to impose discipline" in incarcerated people and enslaved and indentured plantation labour by combining punishment and routinized

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[70] Olivia Doggett, Matt Ratto & Priyank Chandra, *Migrant Farmworkers' Experiences of Agricultural Technologies: Implications for Worker Sociality and Desired Change* (New York, NY, USA: Association for Computing Machinery, 2024).
[71] *Ibid.*
[72] *Ibid.*
[73] Ramsaroop, *supra* note 68; Ramsaroop, "Discipline and resistance in southwestern Ontario", *supra* note 5.
[74] Ramsaroop, "Discipline and resistance in southwestern Ontario", *supra* note 5.
[75] Ramsaroop, *supra* note 68.

labour.[76] A critical race and colonial political economic analysis of automation technologies in agriculture reveal a throughline that connects the plantation's brutal mechanization to today's automated surveillance and digitization. Racial capitalism continually reinvents tools of control under the veneer of progress, transforming workers into monitored, disciplined inputs within an algorithmic regime of extraction.

II. Plantation Complex Legacies of Agricultural Technology

Kris Manjapra's characterisation of the plantation complex is especially informative in understanding the continuity and connections between colonial extraction and contemporary "smart" agriculture.[77] He uses the term plantation complex to refer to a set of economic, political, and legal relationships controlled from Europe or Euro-America for a global commercial network using transported foreign labour. This regime combined violent territorial expropriation from Indigenous populations with brutal systems of coerced labor management over enslaved and indentured populations. Its operational logic depended on three key mechanisms: the large-scale enclosure of lands for monoculture export commodities, the use of proto-algorithmic data driven management systems informed by scientific racism, and the mobilization of capital (and labour) through regulatory changes and novel financial instruments to consolidate big multinational agro-businesses. Between the sixteenth and eighteenth centuries, Caribbean plantations crystallized as an integrated apparatus fusing racial capitalism, colonial domination, military force, and agroscientific knowledge into a replicable model of accumulation.[78] This destructive cellular formation proliferated across the Global South generating what we might call a planetary archipelago of plantation modernity,[79] the afterlife of which persists in the greenhouses of Leamington.

As Manjapra shows, the propagation of agricultural capitalism around the world occurred through discrete steps. It began with the commercial cultivation of sugar, monocropping, cashcropping, and year-long production schedules due to favourable weather conditions in colonies in the tropics.[80] The economic impetus was the consumer demands for exports goods — tea and sugar for industrial workers, jute for packaging, tea and chocolate for the middle class. In other words, the commodity fetishism in the new class structure of industrial revolution sustained agricultural colonialism.

Todays greenhouse production replicates this colonial logic of exploitation through artificial environments that enable year-long harvests of export-oriented cash crops. As with the highly automated greenhouse production in Ontario, colonial-era technologies never eliminated the need for labour—they intensified it. Cheap, brutally disciplined colonial workers became even more essential as their exploited labour generated greater surpluses from these "efficiency" gains.

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[76] Holt, *supra* note 2 at 106.
[77] Kris Manjapra, "14. Plantation Dispossessions: The Global Travel of Agricultural Racial Capitalism" in Sven Beckert & Christine Desan, eds, *American Capitalism: New Histories* (Columbia University Press, 2018) 361.
[78] *Ibid.*
[79] Adom Getachew, "The Plantation's Colonial Modernity in Comparative Perspective" in Leigh K Jenco, Murad Idris & Megan C Thomas, eds, *The Oxford Handbook of Comparative Political Theory* (Oxford University Press, 2020) 0; Paul Musselwhite, ""Plantation," the Public Good, and the Rise of Capitalist Agriculture in the Early Seventeenth-Century Caribbean" Project MUSE (2022) 20:4 Early American Studies: An Interdisciplinary Journal 597–618.
[80] Manjapra, *supra* note 76.

The cotton gin's 1793 invention exemplifies this paradox: while it mechanized seed separation, the resulting production boom dramatically increased demand for enslaved labour to plant, harvest, and process the expanded cotton output.[81] Automation's relationship to exploitation is thus often dialectical, not substitutive.

Miles posits that precision agriculture does not represent true innovation but rather an evolution of the plantation systems developed during colonialism.[82] Building on Sidney Mintz's definition of plantations as a "synthesis of field and factory,"[83] Miles introduces the concept of *algorithmic normativity*—the process by which capitalist values become embedded as technical inevitabilities. His analysis identifies two key historical developments in agricultural rationalization: first, the Enlightenment's shift from substance-based to function-based thinking, which enabled capitalist valuation of land and labor; and second, the rise of *algorithmic epistemology*, which ascribes near-mystical authority to data-driven systems.[84] Precision agriculture thus emerges as the latest stage in imposing algorithmic factory logic on farming, exemplified by Adam Smith's pin-production allegory: any "skilled" work from pin production to artisanal work to agriculture can be fragmented into atomized, repetitive tasks for high productivity while rendering the labor alienated, interchangeable and deskilled.[85]

Meredith Whitaker extends this argument, revealing how the plantation's rationalized brutality prefigured modern computing and surveillance capitalism by connecting Charles Babbage's 19th-century analytical engine—often celebrated as a progenitor of computing—and its less-evident inspiration: the industrialized violence of Caribbean sugar plantations.[86] Plantation overseers employed meticulous record-keeping—documenting daily picking quotas, weather impacts, and individualized worker outputs—to optimize production through proto-algorithmic systems. These practices did more than maximize profits; they codified racial violence into productivity metrics, embedding racial hierarchy into the very architecture of agricultural management. When Babbage later envisioned automating mathematical calculations, he transplanted this plantation logic into algorithms, replacing the atomised tasks of plantation workers with calculation subroutines but retaining the same extractive worldview where atomised, hierarchized (racialized and dehumanized) labour was the "the enabling condition for automation".[87]

Plantation recordkeeping also enabled "management at a distance," abstracting enslaved people into quantifiable inputs—a practice that allowed owners to obscure violence behind fantasies of mechanical control, as seen in manuals comparing the plantation to a "well-constructed machine."[88] This haunting metaphor reveals how today's data colonialism inherits material colonialism's frameworks: technological neutrality masking the racial violence of surveillance.

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[81] Carolan, *supra* note 25.
[82] Miles, "The combine will tell the truth", *supra* note 4.
[83] Sidney W Mintz, *Sweetness and Power: The Place of Sugar in Modern History*, illustrated edition ed (New York, NY: Penguin Books, 1986).
[84] Miles, "The combine will tell the truth", *supra* note 4.
[85] *Ibid*; Carolan, *supra* note 25; Deborah Fitzgerald, *Every Farm a Factory: The Industrial Ideal in American Agriculture* (New Haven, Conn.: Yale University Press, 2010).
[86] Meredith Whitaker, "Origin Stories: Plantations, Computers, and Industrial Control", *Logic(s) Magazine* (2023), online: <https://logicmag.io/supa-dupa-skies/origin-stories-plantations-computers-and-industrial-control/>.*Ibid.*
[87] Whitaker, *supra* note 85.
[88] *Ibid.*

Manjapra further outlines how racial technologies of production and control were transferred, replicated, and locally transformed.[89] Agricultural research institutes were set up to institutionalize colonial knowledge, algorithmizing field data into standardized manuals for global circulation.[90] Mississippi plantation overseers, for instance, were recruited by the East India Company to implement slave-derived labour regimes on Indian indigo plantations, while Cuban sugar cultivation manuals informed Dutch colonial practices in Java.[91] These cases demonstrate how racial capitalism's agrarian techniques globalized through colonial networks of transfer, replication, and transformation.

The contemporary digital architecture of surveillance agriculture is similarly propagated by the transfer of technologies. Dutch and Israeli greenhouse systems and worker monitoring technologies propagate to Canada, Kenya, and Ecuador; Israeli drone technology and its agricultural science model built on occupation and colonial taming of the land is being adapted in India; and Canada's Seasonal Agricultural Worker Program (SAWP) is branded as a "model" for migrant labor schemes worldwide to emulate.[92] As with the export of the SAWP program, these technical transfers are accompanied with the convergence of regulatory exceptions. Agri-businesses enjoy sweeping deregulation—from lax data governance to exceptionalist labour laws—across national contexts. I will elaborate on this in the subsequent section.

The concept of "legibility" was introduced by James C. Scott to show that algorithmic management, regimentation and standardization of practices is an inherent part of "seeing like a state," where complexities of society and humanity are simplified to make certain aspects legible, but not other.[93] Liu and Sengers demonstrate the role of technology in producing a racialized "legibility" in agriculture, where "the institutionalization of scientific agriculture …. led to a racialization of *who* could be a scientific farmer;" *who* is deemed to generate knowledge versus *who* is deemed to be a "blank slate"; *who* can have control over their life and data and *who* is erasable and extractable.[94] Even outside of the plantation complex, they show how the knowledge of Black agriculturalists was excluded from shaping scientific agriculture. Several scholars of plantations have shown that the "*majority* of actual innovations of West Indian or American slave horticulture and agribusiness was contributed by the conceptual and practical innovation of the slaves themselves,"[95] but these practices were made "illegible" in the algorithms in scientific agriculture and these erasures are now embedded in the logics automatized by contemporary "smart" agriculture.

Moreover, this appropriation and dispossession of Indigenous and racialized knowledge was the hallmark of colonialism. Today, data grabbing— "the dispossession of producers' quantified and monetized digital information generated in stealth through their use of the technologies" — is

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[89] Manjapra, *supra* note 76.
[90] *Ibid.*
[91] *Ibid.*
[92] Tanya Basok, "Canada's Temporary Migration Program: A Model Despite Flaws | migrationpolicy.org" (2007), online: <http://www.migrationpolicy.org/article/canadas-temporary-migration-program-model-despite-flaws>. ADD
[93] James C Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, revised ed. edition ed (New Haven, CT London: Yale University Press, 1999).
[94] Liu & Sengers, *supra* note 4.
[95] Manjapra, *supra* note 76.

often used as to describe the capture of information by technology companies, which is then used to mine value and profit, and subsequently used to reshape behaviour and then hegemonically engineer a whole new ecosystem and society, which will, in turn, generate further profits. [96] Although the concept of data grabbing directly borrows from land grabbing and dispossession, we can see how the plantation complex was built not *only* through land grabbing and dispossession but also through active, racialized data grabbing. Precision agriculture is merely a continuation of this process.

Lastly, the plantation complex relied on an infrastructure of legal exceptions, — exemplifying what Partha Chatterjee and others have called "the rule of colonial difference,"[97] differential entitlements for different subjects — to enable the recruitment, displacement, and discipline of racialized labour and the movement of capital. Before the treadmill could be used as a labour sanction, extensive imperial legislation was passed in Jamaica and other colonies, overriding both local laws as well as British laws that tempered the laws for subjects in Britain with human rights and other societal and humane concerns.[98]

During what Manjapra calls, the "bonanza years for the mutating plantation complex", the legal framework for agricultural exceptionalism and agro-capitalism was structurally entrenched.[99] Key legal instruments for finance and property law were crafted from the system of slave insurance. Agricultural exceptionalism began to take shape with the Sugar Duties Act and the repeal of the Corn Laws in 1846, and other land regulations to benefit planters in Europe.[100] Across the colonial world, a series of government acts were passed for "developing more uniform, rationalized approaches to farming", such as the 1862 Morrill Land-Grant Act, the 1887 Hatch Act, and the 1914 Smith-Lever Act that established specialized agricultural research institutes across the US.[101]

The next section now turns to how these logics evolved in the Canadian context. It examines the development of racialized labour systems in Canadian agriculture and the regulatory frameworks that continue to enforce what we might call a "law of colonial difference" in contemporary agricultural technology policy.

III. Law, labour, and technology in Canadian agriculture.

A. History of Agricultural Labour in Canada

The myth of the yeoman farmer—that independent, self-sufficient (white) figure presiding over a family farm with minimal hired labor—has long served as ideological cover for agricultural

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[96] Ruder, "The 'terms and conditions' of surveillance capitalism", *supra* note 4; Fraser, "Land grab/data grab", *supra* note 4.
[97] Partha Chatterjee, *The nation and its fragments: colonial and postcolonial histories* (Princeton, N.J: Princeton University Press, 1993) Princeton studies in culture/power/history; Elizabeth Kolsky, "Codification and the Rule of Colonial Difference: Criminal Procedure in British India" JSTOR (2005) 23:3 Law and History Review 631–683; Radhika Mongia, *Indian Migration and Empire: A Colonial Genealogy of the Modern State* (Durham, NC: Duke University Press, 2018).
[98] Holt, *supra* note 2 at 107–110.
[99] Manjapra, *supra* note 76.
[100] *Ibid.*
[101] Miles, "The combine will tell the truth", *supra* note 4. ADD

exceptionalism in Canada.[102] This romanticized archetype, often accompanied with the combine harvester (invented in the 1830s to combine and automate farming tasks), embodies the idealized citizen-entrepreneur who must have legal protection at all costs. The agriculture sector is further protected under an often neo-Malthusian mythological fabrication that it composed of small farms supplying local food for local (white) communities.[103] These mythological narratives are deeply embedded in the law.

The analysis presented above demonstrates that these myths obscure the racial capitalist and neocolonial foundations of modern agriculture. In fact, over the past fifty years, the number of farms in Canada has decreased by half, while the average farm size has doubled, and the value per acre has nearly quadrupled.[104] Today, a small number of large farms generate the majority of agricultural revenues. Seventy percent of migrant farmworkers are employed by large farms earning over $2 million in revenue, largely from exports. Realized net income in agriculture during the pandemic year rose by 84.4 per cent to $9.4 billion in 2020.[105] Yet, the Canadian heavily subsidies this sector with government expenditure on agriculture accounts for an estimated 26% of the country's GDP.[106] Labour is another crucial subsidy where a system of legal exceptions ensures the expropriation of racialized labour value. A third subsidy—the stolen land itself—underwrites the entire system: agriculture has always functioned as an engine of settler-colonial occupation, converting Indigenous territories into capital through the alibi of 'productive use' while sustaining ongoing displacement.

Lockean property theories—which codified the myth of agrarian individualism through the 'labor theory of property' in his *Second Treatise of Government*—provided the legal-philosophical foundation for settler land theft.[107] This framework operationalizes a triad of colonial violence: (1) codifying 'uncultivated' land as *terra nullius* in the law to be tamed and extracted, (2) relegating Indigenous and racialized peoples to the category of 'primitive nature' (or 'non-beings' as per Fanon[108]) — raw materials for capitalist transformation and exempted from equal human rights and (3) sanctifying technology as the telos of human progress.[109]

By defining legitimate ownership as requiring (European, capitalist) agricultural cultivation, Lockean and other Enlightenment and settler colonial thinkers, provide ideological and legal cover for colonial dispossession and racialized labour extraction that continues to structure

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[102] Vasanthi Venkatesh, "Confronting myths: agricultural citizenship and temporary foreign worker programs" inderscienceonline.com (Atypon) (2019) 5:1–2 International Journal of Migration and Border Studies 82–98.
[103] *Ibid.*
[104] Agriculture and Agri-Food Canada, *An Overview of the Canadian Agriculture and Agri-Food System 2016* (AGR 2016), http://www.agr.gc.ca/eng/about-us/publications/economic-publications/an-overview-of-the-canadian-agriculture-and-agri-food-system-2016/?id=1462288050282
[105] Statistics Canada, "Farm income, 2020 (revised data)", (November 2021), online: <https://www150.statcan.gc.ca/n1/daily-quotidien/211124/dq211124a-eng.htm?indid=3687-4&indgeo=0>.
[106] Agriculture and Agri-Food Canada, "Overview of the Canadian Agriculture and Agri-Food System," (May 2016), online: <canada.ca/en/agriculture-agri-food/news/2016/05/overview-of-the-canadian-agriculture-and-agri-food-system.html>
[107] Locke, J. (1690) *The Second Treatise of Civil Government*, pp.265–427, Cambridge University Press, Cambridge.
[108] Frantz Fanon, *Black Skin, White Masks* (London: Pluto Press, 2008); Lewis R Gordon, "Through the Zone of Nonbeing A Reading of Black Skin, White Masks in Celebration of Fanon's Eightieth Birthday" Open WorldCat (2005) 11:1 The CLR James Journal 1–43.
[109] Venkatesh, "Confronting myths", *supra* note 101.

agricultural law's racial-capitalist logics today.[110] These logics persist in the Zionist claims of 'making the desert bloom'[111] (which renders Palestinians as landscape to be erased) to Agtech's rhetoric of optimization (which reduces migrant and racialized workers to algorithmic inputs).

The myth of taming unproductive land, promoted by English jurists to justify North American settlement, obscured a fundamental contradiction: despite romanticizing yeoman farmers as *the* stewards of white Christian values,[112] settler colonial agriculture has fundamentally depended on labour of Indigenous and racialized "foreign" populations. The law becomes a tool of settler-colonial law to construct the unfree conditions for Indigenous and racialized population to provide labour in agriculture.

Fulfilling agricultural labour shortage has been a challenge for Canada from its inception as a settler-colonial state. The seasonal demands of northern farming rendered slavery economically untenable—off-season maintenance costs proved prohibitive, and enslaved labourers demonstrated 25% lower productivity than a free worker.[113] Indentured servitude emerged as an alternative, but its collapse was inevitable: British indentured laborers routinely abandoned their contracts within months of arrival, exposing the system's fragility.[114] The sector was forced to depend on Indigenous, racialized, and migrant labour. Technology and several legal mechanisms were crucial to facilitate the exploitation of these workers to maintain Canada's agricultural dominance.

Canada's sugar beet production exemplifies how racialized labour extraction operates through technological systems enabled by regulatory exceptions.[115] Unable to cultivate tropical sugarcane, Canada turned to sugar beets—a crop whose profitability depended on technological advances in osmosis and refining, but still required intensive "stoop labor" deemed fit only for demeaned racialized groups.[116] Despite being marketed as "pure" and "white" (in contrast to Caribbean racialized sugar), this industry was dependent on racialized labour: from Japanese internees to Indigenous communities in the Prairies.[117] But it was through the law, that the Canadian state engineered Indigenous agricultural labour. The Indian Act facilitated coercive dispossession by legally confining First Nations peoples to reserves and racially discriminatory practices excluded them from other employment. Under the aegis of the Act, the Department of Indian Affairs threatened withdrawal of food rations, medical care, or even custody of children for those without work.[118] This forced Indigenous people to work on sugar beet farms. Indigenous

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[110] Koskenniemi, M. (2017) 'Sovereignty, property and empire: early modern English contexts', *Theoretical Inquiries in Law*, Vol. 18, No. 2, pp.355–389; Tully, J. (1993) 'Rediscovering America: the two treatises and aboriginal rights', *An Approach to Political Philosophy: Locke in Contexts*, pp.165–96, Cambridge University Press, Cambridge.
[111] Shmuel Lederman, "Making the Desert Bloom: Hannah Arendt and Zionist Discourse" Taylor and Francis (2016) 21:4 The European Legacy 393–407; Alan George, ""Making the Desert Bloom" A Myth Examined" www.tandfonline.com (1979) Journal of Palestine Studies, online: <https://www.tandfonline.com/doi/abs/10.2307/2536511>.
[112] McDonald, S.A. (2016) 'Georgic themes and myths of entitlement in the life writing of prairie settlers', in McDonald, S.A. and Barnetson, B. (Eds.): *Farm Workers in Western Canada: Injustices and Activism*, pp.xii–xxiv, University of Alberta Press, Edmonton at pages 55-56
[113] Pentland, H.C. (1981) *Labour and Capital in Canada, 1650–1860*, Lorimer, Toronto.
[114] Venkatesh, "Confronting myths", *supra* note 101.
[115] Donica Belisle, "Is Cane Sugar "Canadian"? The Disavowal of Global Lives and Lands within Canadian Sugar Marketing" (2024) 10:1 Global Food History 68–86.
[116] Eric Eustace Williams, *Capitalism & slavery* (New York: Russell & Russell, 1961) at 149–150; Komori Komori, "The Canadian 'War of the Two Sugars'" (2023) 31 (2 & 3) Historical Materialism 252–275.
[117] Ibid
[118] Komori, *supra* note 115; Donna Carreiro, ""You had no choice": Indigenous Manitobans shed light on exploitative farm labour program that ran for decades", *CBC News* (19 June 2017), online: <https://www.cbc.ca/news/canada/manitoba/indigenous-forced-labour-sugar-beet-farms-1.4165272>.

workers have testified that they "had no choice" but to work in the abysmal conditions in sugar beet fields.[119] Jane Komori, working off of Eric Williams' thesis, observed:

> "What is most 'Canadian' about the sugar beet industry is the innovation and perpetuation of a **racially stratified labour force.** Where the industry purports to support white Canadians, it does the inverse: it employs a legion of non-Canadian workers, undermining the labour rights and quality of life of all workers in the region.
>
> Put another way, on either side of the Canadian 'war of the two sugars' we find the same kinds of foot soldiers: temporary, non-citizen workers bearing the punishing weight of sugar cultivation. "

Canada's Seasonal Agricultural Worker Program (SAWP), launched in 1966, stands as one of the world's longest-running temporary foreign worker schemes.[120] Touted internationally as a "model" program,[121] it recruits workers from Mexico and the Caribbean under conditions that enforce family separation and employer dependency through eight-month contracts. Designed to prop up a settler-colonial agricultural sector struggling with climatic limitations and global competition, the program continues more or less as is today. It has undergone only superficial modifications—such as expanded sector eligibility and a parallel two-year permit system to accommodate all year-round greenhouse labour—while preserving its core architecture of disposability.[122] Workers return annually under this system, spending decades of their lives in cyclical migration without access to permanent residency, their labour sustaining Canadian farms while their futures remain indefinitely deferred. The closed work permit system legally binds the workers to work for a single agricultural employer during the term of their contract, creating a modern indenture where labour mobility is structurally prohibited.

B. Agricultural Exceptionalism in Law

Canadian agriculture operates under a legal paradox: while evidently industrial in most ways including through automation, it remains classified as "pre-Fordist" to exempt it from standard labour protections like collective bargaining and employment standards regulations.[123] This mirrors colonial labour regimes where indentured workers in colonies faced exceptional laws, under a "law of colonial difference". Agricultural workers are similarly excluded from basic workplace rights (rest periods, overtime pay) and functionally barred from employment insurance despite contributing to it, as access requires continuous residency with a valid permit—an impossible condition for those whose immigration status evaporates with unemployment.[124]

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[119] Carreiro, *supra* note 117.
[120] Venkatesh, "Confronting myths", *supra* note 101; Vasanthi Venkatesh, "Radical Resistance in the Penumbra of the Law: Legal Mobilization for Migrant Farmworkers under Neo-colonial Racial Capitalism" (2022) Journal of Law and Policy; Ramsaroop, "Discipline and resistance in southwestern Ontario", *supra* note 5.
[121] Basok, *supra* note 91; *Migrant Workers in Commercial Agriculture*, by Philip Martin (Geneva: International Labour Organization, 2016).
[122] Venkatesh, *supra* note 119; Venkatesh, "Confronting myths", *supra* note 101.
[123] Leah F Vosko & Rebecca Casey, "Enforcing Employment Standards for Temporary Migrant Agricultural Workers in Ontario, Canada: Exposing Underexplored Layers of Vulnerability" kluwerlawonline.com (2019) 35:2 International Journal of Comparative Labour Law and Industrial Relations; Venkatesh, *supra* note 119.
[124] Venkatesh, *supra* note 7; Ramsaroop, "Discipline and resistance in southwestern Ontario", *supra* note 7; Leah F Vosko & Rebecca Casey, "Enforcing Employment Standards for Temporary Migrant Agricultural Workers in Ontario, Canada: Exposing Underexplored Layers of Vulnerability" kluwerlawonline.com (2019) 35:2 International Journal of Comparative Labour Law and Industrial Relations.

Workers can be arbitrarily terminated at employers' discretion—forced into premature "repatriation" (a sanitized term distinguishing it from formal deportation, which in fact has more procedural protections than privatised repatriation) for reasons ranging from slow harvests to workplace injuries to asserting basic rights.[125] This system operates through a racialized patronage model: employers selectively rehire based on racial stereotypes of docility, weaponizing the threat of exclusion to enforce discipline.[126] The result is a climate of fear where workers internalize their disposability, knowing Canadian law provides no meaningful safeguards against retaliatory repatriation. Even nominal protections like reprisal claims are functionally inaccessible to workers expelled from the country, while blacklisted individuals face program-wide exclusion. Compounding this precarity, seasonal workers have no access to permanent residency even after decades of employment and terminated workers lose healthcare access even when exposing labour violations.

Organization like Justicia for Migrant Workers (J4MW), United Food and Commercial Workers Union, and numerous others have raised several concerns about the impact of automation on racialized farmworkers.[127] Chris Ramsaroop of J4MW has written seminal articles centering race, colonialism and immigration, when considering how automation in Canadian agriculture in the name of technological "progress" exacerbates racialized labour precarity under the guise of efficiency.[128] As he points out, the push for automation by Canadian state and agricultural industry reinforces a two-tiered system: for employers, capital-intensive innovation, and for workers, a regime of control where broken robots are repaired faster than violated labour rights. He rightly notes that without centering race and immigration status in tech debates, automation will only deepen the stratification of an industry built on racialized expendability.

Additionally, using the pretext of food security and farm protection, several Canadian provinces have adopted "ag-gag" laws to prevent investigations of farms. In general, such laws prohibit agricultural interference—including audio or visual recording on farms without the farm's consent— and criminalize anyone alleged to accessing a farm under false pretenses.[129] The purported intention is to protect reputation of farmers from "extremist animal activists", protect agricultural business infrastructure, and protect biosecurity and food security.[130] The dominant criticism is that these laws impact the freedom of expression and association of environmental and animal rights activists.[131] However, I argue that these laws replicate the same colonial and racist logics of enclosure and erasure that have severe repercussions on health and safety of racialized migrant workers. The farm is a securitized zone of racial exploitation, where migrant

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[125] Venkatesh, *supra* note 119; Aaron M Orkin et al, "Medical repatriation of migrant farm workers in Ontario: a descriptive analysis" www.cmajopen.ca (2014) 2:3 Canadian Medical Association Open Access Journal E192–E198.
[126] Venkatesh, *supra* note 119; Kerry Preibisch & Leigh Binford, "Interrogating Racialized Global Labour Supply: An Exploration of the Racial/National Replacement of Foreign Agricultural Workers in Canada" Wiley Online Library (2007) 44:1 Canadian Review of Sociology/Revue canadienne de sociologie 5–36.
[127] Ramsaroop, *supra* note 68; *The Status of Migrant Farm Workers in Canada,* by UFCW (UFCW Canada, 2023) online: <https://www.ufcw.ca/templates/ufcwcanada/images/Agriculture_Workers/2024/Migrant-Workers-Report-2023-V7-EN.pdf>.
[128] Ramsaroop, *supra* note 68; Ramsaroop, "Discipline and resistance in southwestern Ontario", *supra* note 5.*Ibid.*
[129] Anelyse M Weiler & Tayler Zavitz, "Nothing to hide: How governments justify the adoption of ag-gag laws" Wiley Online Library (2025) 62:1 Canadian Review of Sociology/Revue canadienne de sociologie 75–98.
[130] Caitlin A Ceryes & Christopher D Heaney, ""Ag-Gag" Laws: Evolution, Resurgence, and Public Health Implications" PubMed Central (2019) 28:4 New Solut 664–682; Weiler & Zavitz, "Nothing to hide", *supra* note 130.
[131] Autumn Johnson, "Agriculture, freedom of speech, and the birth of ag-gag" in *Food System Transparency* (CRC Press, 2021); Will Potter, "Ag-Gag Laws: Corporate Attempts to Keep Consumers in the Dark" griffithlawjournal.org (2017) 5:1 Griffith Journal of Law & Human Dignity, online: <https://griffithlawjournal.org/index.php/gjlhd/article/view/934>; Katharine Gelber & Siobhan and O'Sullivan, "Cat got your tongue? Free speech, democracy and Australia's 'ag-gag' laws" Taylor and Francis+NEJM (2021) 56:1 Australian Journal of Political Science 19–34.

workers are disciplined with severe penalties for exposing health and safety issues, despite agriculture being one of the most hazardous sectors for workers— classified by the International Labour Organization as '3D'- dangerous, dirty, demeaning (or degrading or difficult). [132]

The UN Special Rapporteur on Contemporary Forms of Slavery, has deemed Canadian agriculture with its system of tied permits for migrant workers and discriminatory exclusions as serving a "breeding ground for contemporary forms of slavery."[133] The ag-gag laws are part of the modern plantation complex enclosure regime that cages not only the bodies, but also the information, of racialized workers from the public, even while farms are surrendering data sovereignty to agribusiness. Precision agriculture systems extract worker and ecological data for corporate profit, even as these same laws silence documentation of labour (and ecological) abuses—a dual move that replicates the plantation complex's historical dual reliance on isolation and global proliferation. Where colonial plantations used geographic distance to evade metropolitan oversight, today's ag-gag laws use legal barriers to shield racial labour apartheid from scrutiny. The ag-gag laws preserve a production regime where racialized bodies remain both hyper-visible to capital (via surveillance tech) and invisible to the public (via legal silences).

Emerging research suggests that automated technology need not only be deployed to maximize profit at workers' expense; it can, in fact, be used to benefit workers.[134] For example, heat stress poses a serious threat to agricultural workers, whether in greenhouses or open fields.[135] Greenhouses trap heat and humidity, creating dangerously oppressive conditions, while outdoor workers face relentless sun, limited airflow, and physically demanding labour—all of which increase the risk of heat exhaustion and heatstroke. Precision agriculture and remote farming systems, designed to optimize yields through technology, often exacerbate these risks. By prioritizing efficiency over worker safety, such practices can intensify workloads, reduce rest periods, and isolate labourers from oversight, leaving them more vulnerable to extreme heat.

C: Technological Exceptionalism

As described earlier, agricultural data encompasses everything from field geography, environmental conditions, agronomic practices, crop and agricultural inputs information to information on workers including their status, and their everyday actions. However, as Ruder points out, agricultural data remains undefined in law, and the lack of sector-specific governance for food and agriculture means that most farm data—including worker surveillance data—operates in a regulatory vacuum.[136] Federal and provincial legislation related to data, such as the Privacy Act (RSC 1985, c. P-21) and the Personal Information Protection and Electronic Documents Act (PIPEDA) (SC 2000, c. 5) focus only on *personal information*. Moreover, corporate actors, such as agri-businesses, have several mechanisms to assert control and ownership over data including contract law that protect end-user licence agreements (EULA) and service

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[132] https://www.ilo.org/resource/agriculture-hazardous-work-0#:~:text=According%20to%20the%20latest%20ILO,with%20workers%20in%20other%20sectors.; https://www.ilo.org/media/448351/download

[133] https://documents.un.org/doc/undoc/gen/g24/120/97/pdf/g2412097.pdf

[134] Arsénio Reis et al, *The Ambient Assisted Working (AAW) concept: Assistance according to I4.0 Technical Assistance design principle* (Corfu Greece: ACM, 2022); Pablo Pancardo et al, "Real-Time Personalized Monitoring to Estimate Occupational Heat Stress in Ambient Assisted Working" www.mdpi.com (2015) 15:7 Sensors 16956–16980; Ryan T Cannady et al, "Understanding and perceiving heat stress risk control: Critical insights from agriculture workers" Taylor and Francis+NEJM (2025) 22:3 Journal of Occupational and Environmental Hygiene 203–213.

[135] UFCW report

[136] Ruder, "The 'terms and conditions' of surveillance capitalism", *supra* note 4.

agreements, copyright, patents, trade secrets and other intellectual property protections. Moreover, Ruder argues, the foundational assumption that agricultural data exists as raw, neutral, and freely available—simply awaiting extraction by farmers and corporations—echoes the colonial doctrine of terra nullius, which dispossessed Indigenous peoples by framing their lands as empty and unclaimed. .[137] In a similar vein, data on workers (and farming) is treated as unclaimed and empty to be exploited for profit and productivity.

In the context of agricultural drone regulations, Transport Canada decides on regulation for drones while Health Canada regulates pesticide application methods, but not all chemical and sprayable products are regulated under the Pest Control Products Act. Products that are classified as pesticides under the Act can only be approved for drone use after a "drone-specific risk assessment" and then labelled as "Remotely Piloted Aircraft Systems (RPAS)".[138] In September 2022, amendments were made to allow for drone spraying of biological larvicide products. Outside of these few exceptions, crop protection products cannot be sprayed in Canada, unlike the US, much to the consternation of the agricultural lobby. [139]

However, biosecurity and physical security appear to be the primary motivations for regulations and there seems to be a policy trajectory overwhelmingly favouring automation systems in agriculture. Canada was one of the first countries to introduce rules for drones (RPAs), [140] but only after those flying planes raised concerns. Transport Canada also has an operator certification process before drones can be used. For larger drones, the certificate is supped to be "onerous" to obtain, according to farm lobbyists.[141]. However, once Transport Canada approves a special flight operations certification, drones can be used to even transport weapons, explosives, and ammunition. Moreover, the voluntary standards developed by organizations like the Canadian Standards Association, such as on "Biosecurity for Robotics in Greenhouses," will likely become "soft" industry standards without meaningful democratic, community and worker consultation.

Recent agroeconomic research has explored the potential of wearable technology and AI to monitor and prevent heat stress and to ensure that workplace conditions are in compliance with ISO standards recognized by the International Labour Organization (ILO) or provincial health and safety regulation. Ambient Assisted Working (AAW) solutions is an emerging AI-driven approach to workplace safety. Initially developed for sectors like construction and manufacturing (e.g., Continental AG's German factories), AAW uses smart systems—such as sensor-equipped jackets and predictive algorithms—to detect occupational hazards, alert workers in real time, and notify remote supervisors of recurring risks, ostensibly to pre-empt health issues. Proponents argue such tools could be adapted for agriculture, particularly to safeguard migrant workers labouring in extreme heat or remote fields.[142] Yet these proposals rarely address the structural power imbalances they reinforce. By outsourcing safety to wearable devices and algorithmic

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[137] *Ibid.*
[138] https://www.canada.ca/en/health-canada/services/consumer-product-safety/reports-publications/pesticides-pest-management/fact-sheets-other-resources/drones-applying-pesticides.html
[139] https://www.albertafarmexpress.ca/crops/drones-are-ready-to-go-spraying-but-regs-havent-kept-up/; https://spudsmart.com/when-will-canada-finally-allow-ag-pesticide-application-by-drone/
[140] https://www.cbc.ca/news/canada/canada-drone-rules-1.7418332
[141] https://spudsmart.com/when-will-canada-finally-allow-ag-pesticide-application-by-drone/
[142] Pancardo et al, *supra* note 135; Reis et al, *supra* note 135.

oversight, employers gain unprecedented surveillance capabilities while workers, already vulnerable, shoulder the risks of data exploitation.

The reality for migrant agricultural workers in Canada underscores the limitation. Their precarious immigration status—tied to employer-dependent contracts under the SAWP — renders them powerless to demand even basic protections. Employers routinely deny transportation to medical care, retaliate against requests for Personal Protection Equipment, and threaten repatriation for complaints about pesticides or excessive workloads.[143] Termination and repatriation, often executed within a day, leaves workers jobless, undocumented, and excluded from future employment via blacklisting. In this context, AAW's promise of "safety through data" rings hollow: it presumes employers will act on alerts to protect workers, yet existing systems incentivize the opposite. Additionally, agricultural technology remains insufficiently regulated and is absent of any protections for workers.

In general, there is no indication that racial, colonial, and labour impacts of automation or robotics in agriculture are going to play a major role in the regulation of agricultural technology. The systemic harms outlined demand regulatory intervention and social change that explicitly centers racial justice and decolonial frameworks. Without systemic safeguards, a redistribution of power, and a rupture in the legal-political frameworks that exalt agriculture and technology, technologies meant to modernize farming will deepen the colonial and racial exploitation.

IV. Conclusion

This paper seeks to show that from land grabs to labour camps, from combines to AI-driven greenhouses, the tools may change, but the logics endure. Science and technology have long been central to agricultural systems, beginning with their critical function in the colonial era, where they were instrumental in the establishment and perpetuation of the global "racial plantation complex," which was marked by mass commercial agricultural productivity through the displacement, exploitation, and control of the labour of enslaved and indentured workers. The data-driven oversight, regimentation and algorithmic management of labour that originated during this time lent its way to practices and logics that continues to this day.

The logic of racialized labour control is therefore embedded in these technologies, including in precision agriculture, use of robotics and drones, and greenhouse technologies. In fact, the adoption of robotic technologies has not only increased racial dispossession of land globally but has also heightened worker surveillance. Precision farming, supported by data analytics, enables farm managers to make highly detailed decisions about when, where, and how to deploy labour and technology, effectively managing the workforce as an extension of the machines themselves. Drones and other surveillance-based technologies play a critical role in reinforcing the subordination of migrant labour within a broader system of technological control, blurring the boundaries between agricultural labour and border surveillance and militarization.

Legal "exceptionalism" is a misnomer in the context of both agriculture and novel technologies; but rather it is part of a historical continuum that traces its roots back to the colonial plantation economy, where structures of law and technology were specifically differentiated to reinforce

[143] Ramsaroop, "Discipline and resistance in southwestern Ontario", *supra* note 5.

racialized labour exploitation and land dispossession. The regulatory framework is also crucial for reinforcing what has been called the "technological treadmill in agriculture," where new technologies result in capital consolidation and increased monopolization for the benefit of Big-Ag and "Food Barons", while entrenching racial stratification of labour and global inequalities. The legal and technological ecosystem is therefore not "exceptional" but banal and necessary aspects of the systems of power first forged in the colonial plantation complex.