

# Prism of Labour:

## Unsettling Knowledge Skill and Technology in Work Infrastructures

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### Abstract

This multi-sited critical ethnography investigates how Mexican farmers' knowledge practices are reclassified as they circulate between smallholder farms in Mexico and greenhouses in Canada. These farmers are recognized as skilled at home and reclassified as 'unskilled' in Canada, a shift reinforced by surveillance technologies and managerial control. From this empirical work, we introduce the *prism of labour*. The prism traces how knowledge practices, skill classifications, and sociotechnical systems interrelate to form labour infrastructures, and provides a lens for analysis and intervention to consider how these infrastructures are formed, stabilized, and contested. Our contributions are threefold: we provide novel empirical research on migrant farm workers in HCI, introduce the prism as an analytic and intervention tool, and show how migration reorganizes expertise through classification, producing hybrid knowledge practices that reshape how technologies are adopted.

### CCS Concepts

• **Applied computing** → **Agriculture**; • **Social and professional topics** → Corporate surveillance; Cultural characteristics; • **Human-centered computing** → **Ethnographic studies**.

### Keywords

digital agriculture, migrant labour, surveillance, infrastructure, classification systems, managed workforce, workplace technology, worker advocacy, technological adoption, ethnography

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### 1 INTRODUCTION

Since the 1980s, HCI and CSCW scholarship has shown that technologies are never neutral [58, 128]: they are shaped by capitalist logics of efficiency and western epistemic traditions [47, 58, 67, 126]. These forces do not only shape how work is supported, but how it is *classified*: which forms of labour and knowledge are recognized as valuable and which are rendered invisible [117]. From emotional, bodily, and temporal demands placed on rideshare drivers and house cleaners [71, 97, 105] to the workarounds devised by custodians working with 'assistive' robots [41] to the uncredited cultural translation work of Global South data annotators [52], so-called 'low-skilled' workers bear the brunt of classification systems that simultaneously devalue *and* depend on their expertise to sustain vital sociotechnical systems.

Suchman, Strauss, and others [112, 117, 129] have called for attention to the context of workers and technological systems to expose hidden procedures like unpaid tasks that enable exploitation [34], and to support informal practices that allow collaboration beyond managerial control [68, 73, 127]. Bowker and Star extend this stance through an infrastructural lens attentive to how classifications, routines, and standards are embedded into systems that shape how labour is recognized and who participates in design [12].

Yet, conditions identified during the rise of knowledge work have hardened: pervasive surveillance, task automation, inequitable regulation, and precarious employment now leave what feels like little room for worker-led alternatives [9, 64, 76, 130, 132]. These challenges are intensified under transnational labour regimes, where sociotechnical systems span local and global contexts, further complicating dynamics of power and responsibility [52, 66, 67]. These realities have ignited critical HCI to move beyond technological design as the central intervention [6, 41, 65], seeing it as "*only one moment within a lifecycle of a computational artifact*" [41]. This shift presents an opportunity for HCI to examine labour through the arrangements that organize work itself, such as how knowledge is learned and enacted, how authority is privileged and assigned, and how these distinctions are encoded into technologies. Together, these dynamics determine whose knowledge counts, who participates in design, and how labour is governed across contexts.

Against this backdrop, we introduce our critical multi-sited ethnography, following five Mexican men as *campesino* farmers in



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Mexico to migrant greenhouse workers in Canada [79, 135]. While these men have agricultural expertise, they are reclassified as ‘unskilled’ in Canada, hired primarily for their bodily labour [85]. To surface tensions between knowledge, authority, and sociotechnical systems in daily work, we ask: **RQ1**: How do migrant greenhouse workers describe, learn, and organize agricultural knowledge practices in Canada and Mexico?; **RQ2**: How are workers’ skills classified in Canada and Mexico, and with what impacts on workers and their labour practices?; and **RQ3**: What sociotechnical systems do workers design and engage with in Canada and Mexico?

Grounded in this empirical work, we introduce the *prism of labour*. The prism is composed of three interacting dimensions – knowledge practices, skill classification, and sociotechnical systems – that are examined relationally to form labour infrastructures. For knowledge, we draw on Polanyi’s tacit/explicit and proximal/distal knowledge practices [98, 99]. For skills, we follow Iskander’s account of skill as a political classification [69]. For sociotechnical systems, we refer to workers’ direct encounters with tools and technologies. *Tools* refer to material implements used by workers (e.g., machetes), and *technologies* automate tasks and monitor the agricultural process (e.g., robots) [123, 140]. We use Bowker and Star’s work on classification systems to show how categories become embedded infrastructurally [12]. The prism serves two roles: it is an analytic lens for tracing how these domains interact to form labour infrastructures, locating where arrangements stabilize or are resisted and renegotiated, and it also broadens the depth of interventional responses in HCI by identifying actionable sites to counter unjust classification systems, support worker resistance, anticipate transnational technology adoption, and interrogate research practice itself.

This paper makes three contributions to CHI. First, we offer novel empirical research following migrant farm workers, expanding HCI literature on agriculture to include hired labour that sustain global food systems. Second, as outlined above, we introduce the *prism of labour* as an analytic lens and intervention tool for HCI. Third, we show how treating labour as infrastructure exposes how expertise is reorganized through migration, enabling hybrid knowledge practices and technological appropriation – unsettling assumptions about where design occurs and who is responsible for it.

## 2 RELATED WORK

### 2.1 HCI and Agriculture

HCI research on agriculture spans Information and Communication Technology for Development (ICT4D), Sustainable HCI (SHCI), and community informatics. In ICT4D, scholars often address livelihood insecurity in low-literacy contexts via information systems like ICT tools to provide access to market prices and crop advice [2, 28, 30, 45, 88, 93, 107]. SHCI and community informatics scholars highlight how small-scale farmers resist industrial agricultural technologies (agtech) that misalign with their sustainable practices [6, 92, 103, 121], and have aided farmers with participatory information systems [91, 103] oriented toward ecological and community aims [6, 121].

Across scholarship, both in HCI and in related fields like Science and Technology Studies (STS), researchers point to persistent misalignments between bespoke farming practices and standardized

digital platforms [18, 21, 61, 101]. Farmers’ informal data practices often clash with commercial farm management systems, undermining adoption [43, 87, 110]. Other work shows how farming practices overlap with social life [75] and other vocational responsibilities [122], underscoring the temporal and spatial entanglements that shape technology use [54]. Despite this breadth, farm workers remain largely absent from this body of work [32]. While some scholars have noted their exclusion from dominant agricultural imaginaries and decision making [31, 32, 109, 121, 124], emerging studies show that workers are already deeply entangled with agtechs associated with poor health outcomes and constrained autonomy [27, 33].

Critical scholars have begun historicizing these dynamics, linking agtechs to legacies of racialized land dispossession and labour exploitation [35, 77]. Others call for alternatives to industrial logics and more sustainable futures [6, 8, 55]. Yet, little research examines how sociotechnical systems and labour regimes circulate across borders or intersect with political-economic histories [56].

Building on these strands, our study connects the transnational movement of agtechs and the everyday experiences of migrant farm workers. By following *campesino* farmers between Mexico and Canada, we show how expertise is reclassified and how these shifts reshape encounters with technology. This perspective expands HCI’s focus beyond adoption and design practices to the labour infrastructures that sustain or erase agricultural knowledge. By doing so, we open up space for rethinking how agtechs are developed, circulated, and contested in ways that account for the workers on whom global food systems rely.

### 2.2 Tech-Mediated Work Management Practices

Long before digital systems, employers reorganized work into discrete tasks to increase efficiency and tighten control [36, 84]. Braverman described how task segmentation “*dismembers the worker*,” stripping away control over the whole process while transferring authority to the employer [17, 113]. Scientific management formalized such tactics: Taylor’s studies of workflow optimization entrenched a model where thinking and doing were separated, craft knowledge was deskilled, and power over work organization rested with management [17, 133, 134]. These early practices produced durable epistemic hierarchies and classification systems like ‘skilled’ and ‘unskilled,’ which continue to lock workers into body-intensive roles [95, 131, 134]. In contemporary workplaces, algorithmic management and surveillance systems revise these same logics [73, 109, 124].

HCI scholarship examines how contemporary management technologies are designed, deployed, and contested. Studies trace how data tracking and algorithmic decision-making reshape everyday work [5, 100], often producing tensions between efficiency and privacy [63]. Researchers also show the strategies workers use to navigate these systems by sometimes collaborating with algorithmic tools [41, 145], other times contesting them outright [62, 137].

Scholars also argue that essential knowledge practices remain excluded from formal recognition. Emotional and care work – whether driving rideshare passengers [105], crafting beauty routines [89], or cleaning houses and caring for children [71, 78] – rarely count as ‘skill’ in institutional frameworks. ‘Low-skilled’

workers shoulder the burden of patching misaligned systems to keep them running [41, 52, 96]. These burdens fall unevenly on racialized and precarious workers.

While labour organizations often resist these dynamics through supporting collective organization [102, 137], deeper structural and epistemic forces continue to sort whose knowledge is recognized, authorized, and represented in sociotechnical systems [130, 132]. In the section that follows, we outline our theoretical framework.

### 3 THEORETICAL FRAMEWORK

To investigate the interplay between knowledge practices, skill classifications, and sociotechnical systems in labour infrastructures, we draw on three strands of theory. First, Polanyi's distinctions of tacit/explicit and proximal/distal knowledge foreground the situated and relational character of agricultural expertise [98, 99]. Second, Iskander's account of skill classification shows how these epistemic forms are politicized when workers are labeled as 'skilled' or 'unskilled' [70]. Finally, Bowker and Star's work on classification systems shows how categories are embedded in standards, routines, and institutions, stabilizing them in daily work and making them difficult to contest [12, 116]. Together, these lenses help to analyze how agricultural expertise is recognized, erased, and negotiated through workers' encounters with sociotechnical systems.

#### 3.1 Polanyi: Knowledge Practices

We draw on Polanyi's tacit/explicit and proximal/distal knowledge [98, 99] to foreground greenhouse workers' agricultural practices and epistemic agency across contexts. These distinctions allow us to identify forms of knowledge that are often overlooked in formal accounts of agricultural expertise. To describe tacit knowledge, Polanyi famously wrote "we can know more than we can tell" [98]. This statement reveals the embodied, experiential nature of tacit knowledge and the limits of articulation and transfer across contexts. Tacit knowledge becomes *explicit* once in the form of words, certifications, and so on, which allows for knowledge to be specified [70, 98, 136].

Knowledge functions as an active process when it moves from what Polanyi describes as *proximal* to *distal* knowledge. These elements refer to cognitive distance: how close the knowledge is to the individual's personal experience or direct action (proximal) versus how abstract or removed it is (distal) [98, 99]. Proximal and distal knowledge are part of a continuum rather than discrete categories and do not necessarily correspond to formal or informal knowledge [98].

To illustrate these concepts with the example of a worker troubleshooting a machine:

- *Proximal knowledge*: The worker may rely on their direct feel or sense of the machine's vibrations to detect an issue. This is immediate and sensory;
- *Distal knowledge*: The worker may gain a conceptual understanding (e.g., consulting a manual), offering abstract rules about how the machine works without direct engagement;
- *Tacit knowledge*: The worker knows through experience how the machine should sound or feel when working correctly, even if they cannot exactly articulate this knowledge;

- *Explicit knowledge*: Written procedures on how to diagnose and fix the machine represent a formalised set of steps that can be easily communicated and shared.

Proximal/distal and tacit/explicit are therefore orthogonal distinctions: the former are about cognitive engagement with experience, whereas the latter focus on how knowledge is shared and formalised [98, 99]. In our analysis, tacit/proximal practices often, but not always, co-occur in repair and intergenerational demonstration; explicit/distal forms are visible in metrics and protocols.

#### 3.2 Iskander: Politics of Skill Classification

We leverage Iskander's theory of skill classifications to demonstrate how Polanyi's knowledge distinctions become politicized: explicit, formal forms of knowledge are disproportionately valued as 'skilled,' while tacit, embodied forms are relegated to 'unskilled.' While skill can denote capacity or potential, in practice it often functions as a classification system that divides workers into 'skilled' and 'unskilled' categories [95]. This binary privileges explicit, formalized indicators of knowledge as evidence of skill (e.g. certifications), while tacit and embodied practices are rendered 'unskilled.'

This classification is epistemological and deeply political. Drawing on Marx's critique of labour alienation [83], Iskander shows how capitalist production anchors labour power in the worker's body while detaching skill as a transferable, purchasable resource [69]. This separation allows workers who rely on tacit, proximal knowledge to register as lacking capacity altogether. She writes: "it is not that the unskilled are prevented from enacting the generative, agentic capacity of skillful practice; it is that their status as unskilled [...] indicates that they may not have that capacity to begin with" [69]. By this logic, those who are designated as 'unskilled' remain so as "almost [an] ontological condition" [95], shaping access to resources, recognition, and professional advancement.

This epistemological hierarchy is racialized and gendered. In migrant labour regimes, for example, Global South workers are imagined as biologically-suited for manual tasks but epistemically deficient, a devaluation that is critical for western countries to maintain their stable workforce [59, 90, 108]. Skill classification, therefore, is not merely a technical distinction, but serves as political infrastructure [12]. Once institutionalized, these classifications are hard to contest: they determine whose knowledge is recognized, which actors are authorized, and what forms of knowledge are encoded into sociotechnical systems.

#### 3.3 Bowker and Star: Classification Systems and Infrastructures

We draw on the infrastructure studies scholars, Bowker and Star, [12, 115, 116] who show how classification systems become stabilized in laws, sociotechnical systems, and so on. Classification systems are the "spatial, temporal, or spatio-temporal segmentations of the world," while categories are labels in them [12]. Infrastructure, meanwhile, is relational: it becomes infrastructure only *in situ*, once it is embedded in routines, tools, and institutions and assumed in daily work [116]. When infrastructures work well, they are "completely transparent" [116], only appearing upon breakdown.

Classifications and infrastructures are mutually constitutive, meaning categories like 'skilled / unskilled' shape and are reshaped

by infrastructures [116]. As classification systems are felt differently based on one's position (relational) and coupled across diverse elements (ecological), they become durable, partly hidden arrangements that sort how knowledge is valued. Infrastructural inversion [11] is the analytic move to expose invisible arrangements. As Bowker and Star outline, infrastructural inversion is "a struggle against the tendency of infrastructure to disappear [...] It means learning to look closely at technologies and arrangements that [...] fade into the woodwork" [12]. This lens highlights **convergence**, where classifications are entwined into systems [12], and **resistance**, which ensures infrastructures are never fully closed as frictions continually reshape them [12].

By situating Polanyi's knowledge practices, Iskander's skill classifications, and Bowker and Star's infrastructural lens alongside one another, we are able to trace how agricultural expertise is recognized in some contexts, erased in others, and stabilized or unsettled through everyday interactions with technologies and labour arrangements. This framing links epistemic forms, political classifications, and infrastructural processes, providing a foundation for our critical ethnographic analysis of how migrant workers navigate, contest, and reshape agricultural knowledge, practices and sociotechnical systems across Canada and Mexico. In the section that follows, we detail our methods process for conducting our multi-sited critical ethnography.

## 4 METHODS

### 4.1 Multi-Sited Critical Ethnography

To investigate how migrant greenhouse workers' knowledge practices, skill classifications, and engagements with sociotechnical systems intersect in transnational labour infrastructures, we conducted a multi-sited critical ethnography following five Mexican men between high-tech greenhouses in Ontario, Canada and their farms in Oaxaca and Veracruz, Mexico, in 2022 and 2023. Multi-sited ethnography follows a "logic of association" — in this case, the transnational trajectories of workers — to understand how meanings, practices, and identities circulate across distinct yet connected contexts [80, 81]. A critical stance extends this approach beyond a description of workers' lives to interrogate how skill regimes and technologies reproduce or resist labour hierarchies [42, 79]. By following individual workers rather than a single community, we treat participants as connective nodes in broader infrastructures of migration, production, and knowledge exchange [80]. This study was approved by the authors' university research ethics board.

### 4.2 Data Collection

The first author collected data for two years through observations and interviews in Canada and Mexico. In Canada, she conducted observations at high-tech greenhouses, community events, and social spaces like greenhouse bunkhouses. In Mexico, she made observations at workers' farms, homes, and community spaces like *zócalos* (town squares). Field work in Canada occurred over many multi-day site visits to Ontario from May 2022 to January 2023, and in Mexico during a two-month visit in winter 2023. These data were supplemented by informal *in-situ* interviews, a common ethnographic practice during participant observation, and interviews [114].

Owing to employer restrictions and ethical considerations related to workers' status in Canada, field access varied in Canada and Mexico. The main impact of this uneven access on data collection was that the first author could not directly observe study participants' greenhouse practices. Instead, she observed greenhouses more broadly, conducting observations and informal interviews at three commercial greenhouses that employed migrant workers. These observations ranged from one to two hours, focusing on workers' labour practices and technological encounters. Through her own networks, the first author then separately recruited participants to interview in-depth and follow to their home farms in Mexico. The first author conducted semi-structured interviews with these workers, inviting them to bring artifacts like technologies and photographs of their work, and to draw greenhouse layouts and workflows. These materials offered visual and narrative detail that clarified labour processes and technology use when observation of participants' greenhouse practices was impossible. In Mexico, where access was more flexible, the first author began farm visits with a tour where participants described their crops, tools, and work processes. The first author then observed the day's activities focusing on farm practices, tools, and the natural environment. Visits ended with semi-structured interviews. In total, visits lasted between two and six hours.

Fieldwork was conducted in Spanish by the first author with support from migrant community representatives and a professional translator who also worked with migrant communities in Mexico. All semi-structured interviews ranged from one and two hours. These interviews explored the following based on our research questions: (1) How agricultural knowledge practices are learned, transferred, and classified; (2) How workers' skill is classified, and with what impacts; and (3) How workers design and engage with sociotechnical systems. Across contexts, the first author audio-recorded all interviews with participant permission, wrote field notes, and captured audio-visual of the environment and any artifacts that participants shared.<sup>1</sup>

### 4.3 Participants

The first author connected with migrant greenhouse workers at community events in Ontario. These encounters built rapport and provided preliminary information on workers' experiences with agtechs. After initial observations and informal interviews in greenhouses, the first author recruited participants from her network by the following criteria: Mexican men who had worked in Ontario greenhouses in the past five years and owned a farm in Mexico.<sup>2</sup> The first author identified three workers to follow for this study. Once in Mexico, a participant introduced the first author to two more *campesino* farmers in his community who met the inclusion criteria. Besides the Mexican context, the first author conducted semi-structured interviews with these two workers about their work in Canada, similar to the other participants.

Four of the five men in this study worked in horticultural production in Canada and one in floriculture (Table 1). Most came to Canada as state-hired workers and one worker worked informally

<sup>1</sup>In Canada, we did not take pictures of workers themselves to protect their anonymity.

<sup>2</sup>We recruited Mexican men because they make up most migrant workers in Essex County [118] and reflected the first author's existing network.

**Table 1: Overview of Participants**

Name <sup>3</sup>	Age	Working Status	Years in Canada	Farm Type (Canada)	Crop Type (Canada)	Past Work
Héctor	24	Tourist	2 years	Horticulture, Field crops	Tomatoes, Peppers, Cucumbers	Farmer, Student
Angél	38	TFWP <sup>4</sup>	2 years	Horticulture, Gardening	Tomatoes, Peppers, Cucumbers, Flowers	Farmer, Mason
Samuel	22	TFWP	1 year	Horticulture	Tomatoes, Peppers, Cucumbers	Farmer
Daniel	54	TFWP	20 years+	Horticulture	Tomatoes, Peppers, Cucumbers	Farmer
Luis	29	TFWP	5 years	Floriculture	Flowers	Farmer, Mechanic

via a tourist visa. All men had at least 10 years of farming experience in Mexico, and all described growing up on farms. In this paper, we refer to these individuals as *campesinos* (which translates to a peasant or person of the land/field), farmers or greenhouse workers as they hold all of these identities depending on the context. We also include quotes from workers' family members and friends as we see these accounts as part of the social worlds that sustain workers' transnational lives and labour [80, 125, 138]. We gained informed consent, anonymized all names, and used pseudonyms to protect all parties we interviewed.

#### 4.4 Field Sites

**4.4.1 Essex County:** The first author conducted fieldwork in Essex County, Ontario, at Canada's southernmost tip. Adjacent to the Great Lakes and the U.S. border, Essex County benefits from hot, humid conditions, making it an ideal site for international agri-food production. Holding 63% of Canada's total greenhouse area, Essex County hosts North America's largest greenhouse concentration, with 135 operations across 1,300 hectares [46, 48].<sup>5</sup> This \$3-billion industry is projected to expand by 50% in the coming decade [46, 48]. Essex County also hosts about 10,000 workers hired through the Temporary Foreign Worker Program, the highest concentration in Ontario and roughly 16% of Canada's annual agricultural workforce [46, 119].<sup>6</sup>

**4.4.2 Oaxaca and Veracruz:** Field sites in Oaxaca and Veracruz varied in farm type, size, climate, and crops (Table 2). Most farms practiced a mix of arable and silvopasture (Figure 1, 2). Arable farming is when farmers practice traditional methods like plowing to grow seasonal field crops [20]. Silvopasture integrates trees, crops and livestock together on the same land with the aim of creating



**Figure 1: A mixed arable and silvopasture mountain farm in Cañada, Oaxaca**

a multi-layered production system [40, 72]. Farmers worked on *ejido* (community-owned land) and private land. These farms were often embedded with the land of their neighbors (Figure 2), and ranged from 2.5–7.5 acres. We also visited a 30-acre commercial monoculture sugar cane farm. Farmers grew a variety of regional produce, bartering these goods in local markets and sometimes selling to third-party vendors for domestic distribution.

#### 4.5 Data Analysis

Following fieldwork, the first author transcribed audio recordings to Spanish, and de-identified and translated them to English. To protect participants, transcriptions were stored locally in password-protected files. The first author worked closely with the same Spanish translator and community representatives to ensure a linguistically and culturally representative translation process.

We followed a reflexive thematic analysis grounded in a critical ethnographic framework [15, 16, 79] that treats ethnography as a

<sup>5</sup>Greenhouse share, counts, and area as reported in 2023 sources; figures may have changed since publication.

<sup>6</sup>For context, Ontario received 79,852 agricultural workers (about 28% of the national total) in 2023–2024 reports [118, 119]. Worker counts are seasonal and subject to annual revision; estimate reflects 2023 program data.

**Table 2: Overview of Participants' Home Farms**

Farms <sup>7</sup>	Location	Property Size	Years Owned	Ownership History	Farm Type	Main Product(s)
Héctor's farm	Papaloapam, Oaxaca	30 acres	50	Community authority	Monoculture, Commercial	Sugar Cane
Angél's farm	Córdoba, Veracruz	5 acres	40	Community authority	Silvopasture, Arable	Coffee, Bananas, Sugar Cane
Samuel's farm	Cañada, Oaxaca	7.5 acres	10	Private sale	Silvopasture, Arable	Mixed
Samuel's girlfriend's farm	Cañada, Oaxaca	2.5 acres	17	Private sale	Silvopasture, Arable	Mixed
Daniel & Luis's farm	Cañada, Oaxaca	7.5 acres	40	Community authority	Arable	Chilies, Limes, Green beans

**Figure 2: Silvopasture farmland located on volcanic soil in Córdoba, Veracruz**

dialectical bridge between micro-interaction and macro-structure [4]. We approached analysis as an iterative and interpretive practice aimed at examining how power moves across labour infrastructures [14, 79, 135]. By comparing early interpretations of data within a wider structural context of migrant farm labour, we treated theory (around classification, infrastructure, knowledge) and data as mutually informing rather than separate steps [4].

The first author began by reviewing transcripts, photographs, and field notes and writing reflexive memos<sup>8</sup> to capture impressions, contextual details, and reflections on positionality. She then reviewed data again to create initial descriptive codes, and themes.

<sup>8</sup>We define reflexive memos as written reflections by the researcher about the analytic process, their assumptions, emotional and theoretical responses to the data, and how these shape data interpretation [16].

All authors then engaged with these codes and themes, interpreting them using Polanyi's tacit/explicit knowledge distinctions [98], Iskander's political classification of skill [70], and Bowker and Star's work on infrastructure [12] to clarify how knowledge practices, skill, and sociotechnical systems intersect across transnational contexts. Through repeated cycles of memoing, coding, visual mapping, and interdisciplinary discussion, we developed the *prism of labour* to interpret our empirical work. The first author led the coding, memoing, and visualization processes, while all authors contributed to theoretical framing and interpretive synthesis. Throughout, the first author collaborated with community representatives, treating interpretation as a process of co-construction and ethical reflection.

#### 4.6 Researcher Positionality

The first author is a Canadian white settler, an English native speaker and Spanish second-language speaker, trained in information science and HCI. She has worked with migrant communities for a decade and is informed by critical, feminist, and decolonial approaches to design and technology. These commitments shaped the study's focus on power, classification, and justice, and guided interpretive decisions in the research process. Recognizing her own linguistic and cultural limitations, she worked closely with migrant justice groups and a translator to ensure that the study aligned with workers' values and experiences. The co-authors are interdisciplinary scholars from the same institution with expertise spanning HCI, STS, labour studies, and critical design. Their diverse stances offer theoretical and methodological grounding while serving as sites of productive tension.

In what follows, we situate our findings in the knowledge and skill regimes that structure agricultural work in Mexico and Canada, focusing on participants' identities as *campesinos* and greenhouse

workers. We then present our findings, drawing on our ethnographic data with workers.

## 5 EMPIRICAL CONTEXT: KNOWLEDGE AND SKILL REGIMES

In this section, we describe how *campesino* knowledge practices function as skill and identity in Mexico, setting the basis for analysis of how practices are reclassified in Canada. We then outline how Canadian infrastructures classify migrant workers as ‘unskilled,’ shaping worker constraints.

### 5.1 Mexico: *Campesino* Knowledge and Local Skill Regimes

In Spanish, the word ‘*campesino*’ refers to people of the countryside. In Mexico, *campesinos* are smallholder farmers or farm workers, often of Indigenous descent [19]. In the 20th century, *campesinos* rose as a social class and cultural identity [13], mobilizing for land redistribution and agrarian reform [13, 29]. These struggles secured transformative gains, even as new challenges emerged like insufficient agricultural credit and resources [13, 143]. Across generations, *campesino* families have built rich agroecological systems grounded in crop diversity, seed conservation, and soil management [3, 74]. Their fields are often described as experimental plots where farmers test seeds and techniques, sharing outcomes via horizontal, “*campesino-a-campesino*” networks [10, 82].

Since the postwar era, structural reforms and crisis-level unemployment have made smallholder farming less viable [10, 144]. In response to this political-economic erosion, Mexico agreed to join Canada’s Temporary Foreign Worker (TFW) Program in 1966 [7]. For many, the TFW program became a crucial source of income: in eight months, farmers could send home the equivalent of five to six years of wages in Mexico, approximately \$8,000 CAD [7]. Employers and governments have long drawn on workers’ strong motivations to participate in the TFW program to shape application requirements and employment conditions that position migrants as “*structurally vulnerable*” [86]. For example, applicants often must show agricultural experience, economic need, family connections, and completed military service [7]. Although the TFW program provides vital income, it can also pull families into cycles of “*migrant syndrome*” [106], in which transnational labour becomes necessary to financially support farming at home.

### 5.2 Canada: TFW Program Labour and Transnational Skill Regimes

Most temporary agricultural workers in Canada enter via the TFW program [119], including the workers in this study.<sup>9</sup> The program originated in the 1960s–70s to address agricultural labour shortages, leading Canada to form bilateral agreements with Mexico and Jamaica [7, 111]. Today, the program operates through a transnational system of employers, state bureaucracies, recruitment agencies, and the workers themselves [44, 60, 85]. What began as a short-term fix has since become a permanent stream of labour migration, supplying “*just-in-time*” farm workers [1].

<sup>9</sup>Ontario received 79,852 TF workers (about 28% of national total) in 2023–2024 reports [118, 119] with nearly a quarter from Ontario’s horticultural sector [120]. Workers came from Mexico (44.3%), Guatemala (25.5%), and Jamaica (13.3%) [118, 119].

Unlike permanent residents in Canada, migrant workers are subject to restrictive work authorizations, limited access to settlement services, and inequalities based on ‘skill level’ [1, 26, 49]. High-skilled migrants are often granted flexible employment arrangements and pathways to residency, whereas low-skilled workers hold a “*precarious status*”: a dynamic condition of insecurity marked by employer dependency, lack of rights, and the threat of deportability [24, 49]. This precarity is structured to maintain a racialized, “*captive, disposable, just-in-time labour force*” [85, 142]. In Ontario, exemptions remove many workers from basic protections like overtime pay and rest periods, leaving migrants routinely working 10-hour days, six to seven days a week, under significant health risks and with limited recourse for compensation [22, 23, 38, 50, 51, 53, 139].

These workplace precarities have spread to workers’ technological encounters: digital tools like *chequeadoras* or surveillance and performance tracking agtechs are shown to amplify managerial control, heighten performance expectations, and reproduce health and safety risks [33, 104, 139]. Technologies, therefore, are not neutral implements but part of the same political economy that governs migrant status, embedding precarity into daily work practices.

## 6 FINDINGS

Our findings are organized geographically, following workers between their smallholder farms in Mexico and their greenhouse workplaces in Canada. In each section, we address themes related to our three research questions: (1) workers’ agricultural knowledge practices; (2) how workers’ skills are classified and with what impacts; and (3) what sociotechnical systems workers design and interact with. For interpret our ethnographic data, we engage theory from Polanyi’s tacit/explicit and proximal/distal knowledge distinctions [98], and Iskander’s skill classifications [69].

### 6.1 Smallholder Farming in Mexico

**6.1.1 Agricultural Knowledge Practices.** Through fieldwork with *campesinos* and their families in Oaxaca and Veracruz, we learned that agricultural knowledge practices are holistic and ecologically grounded: *campesinos* manage a range of tasks shaped by their values and local conditions. Farmers were responsible for the entire crop cycle and, in most cases, for repairing their own equipment and selling their produce (Table 3). For example, Samuel’s mother described their organic farm as “*purely natural, [with] very little spraying*” as they relied on free-grazing sheep to fertilize their fields. Other farmers emphasized working with environmental conditions. In his explanation of how to burn sugar cane, Angél described how “*when there is sun, we burn it. When there is rain, it is cut so it is raw*.” When asked how *campesinos* know how to burn sugar cane, Héctor’s grandfather shared: “*They already know, they use the wind [...] they burn against the wind so that the fire goes the right way*.” These accounts reflect how farmers developed their tacit agricultural expertise through years of physical work, learning to act via embodied judgment shaped by environmental cues.

In describing what knowledge is required to succeed as farmers, *campesinos* shared values like resilience and hard work. Héctor described the need to be “*rudo*” (rugged) while Samuel’s mother linked their labour to crop demands: “*We don’t have days off because*

**Table 3: Overview of Common *Campesino* Agricultural Tasks in Mexico**


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<b>Field and Soil Preparation</b> (tilling the soil, alternating crops, creating beds)
<b>Plant Care</b> (planting, weeding and harvesting)
<b>Irrigation and Fertilisation</b> (installing and managing irrigation and draining systems)
<b>Pest and Disease Control</b> (monitoring plants and soil for disease, applying treatments when required with <i>bombas</i> ) <sup>10</sup>
<b>Market/Vendor Skills</b> (cleaning and packaging product, transporting product, selling product to third party vendors)
<b>Tinkering/Mechanical Expertise</b> (repairing tractors, vehicles, irrigation systems, etc.)

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the plant doesn't wait for you. You're not going to say 'Híjole [oh gosh], I'm going to rest' because you can't. We have to work because the plant requires it." Her account frames agricultural success as an embodied capacity to work hard, adapt to environmental conditions, and dynamically respond to crop needs. We interpret this ability as a kind of tacit knowledge formed via sustained bodily engagement with farming.

We also witnessed how farmers shared their knowledge through embodied, observational practice. For example, while on a tour with Héctor and his grandfather of their sugar cane farm, Héctor wanted us to taste the sugar cane so he asked for his grandfather's machete and chopped down a stalk (Figure 3). When Héctor had trouble peeling the stalk, his grandfather took both items out of Héctor's hands and began peeling himself. In this exchange, learning unfolded quietly through hands, tools, and shared motion rather than through explicit instruction. When reflecting on how he learned how to farm, Héctor's grandfather shared: "Who taught my dad? His parents [...] They teach us because we were born into it: by watching, by working, we learn." For Héctor's grandfather, agricultural knowledge is passed down inter-generationally; learned through doing, sensing, and inhabiting the farm over time. Outside of family knowledge sharing, Angél described how "*convivencia*" (sociality) in learning is an important value in collaborative work: "If [...] that person comes to work with me in the same job, the things that I do, the little bit that I know, I will share it." Angél's statement shows how knowledge sharing is built into his daily work practices.

Finally, farmers shared how their experiences of working abroad introduced new forms of agricultural knowledge. For example, Angél learned techniques from a Canadian agronomist that he hoped to use back home: "[There] shouldn't be more than 7-8 tomatoes per plant, it can't go over 8-10 because the branch [gets] very big and it's a lot of trouble [...] to cut it to accommodate it in the boxes." Angél's explanation shows the agricultural knowledge he gained in Ontario and how he now thinks of the tomatoes' growth in siloed tasks like picking and packaging. Angél also suggested that the



**Figure 3: Héctor passes a stalk of sugar cane and machete to his grandfather**

knowledge that he gained in Canada altered his perception of his farm practices back home. When we asked if his farm was "*more natural*" than what he encountered in Ontario, he replied "Yes, *more natural: that's what I would change.*" Angél hoped to transform his farm by applying more chemicals, but not as much as in Canada: "*The chemicals, we should add a little bit. Not so much in excess, right?*" These instances show how Angél's knowledge practices are transformed from working in Ontario, resulting in a hybridization of local and host country knowledge in Mexico.

**6.1.2 Skill Classifications as *Campesinos*.** As outlined in Section 5.1, *campesinos* hold a distinctive historical and sociocultural status in Mexico with farm practices recognized as innovative, community-led, and grounded in local ecosystems [10]. In our study, we explored how this classification shapes workers' lives and labour practices by observing daily routines, control over work, and contrasts farmers drew between working in Mexico versus in Canada.



**Figure 4: Resting area in the field that Daniel and Luis share with other farmers**

We found that *campesino* skill is polyvalent, extending across agricultural tasks and into other trades like mechanics and construction. Farmers did not compartmentalize knowledge by industry; instead, they drew from a wide repertoire to address emerging needs. On Samuel's farm, for example, his cousin, who worked as a mechanic, installed a PVC drip irrigation system connected to a nearby river, ensuring water access for seasonal crops. Here, Samuel's cousin resourced his mechanical expertise to dynamically solve a problem. Other farmers split their time between farming and wage work in construction or repair, gaining expertise informally through practice. As Luis explained, "Since we have our own little machines, I learned to fix my bike, I put my hand to it." Luis' statement underscores a mode of learning rooted in experimentation and self-directed practice.

Unlike in Canada's greenhouses, where pace is tightly managed, *campesinos* described how on their own farms, they held greater control over how they allocated time and shared knowledge. Daniel contrasted the two settings: "Here, we can chill for a while [...] Like us right now. We will be here for an hour and no one says anything. But over there [in Canada], after 10 minutes, 'Let's go again!'" Because Daniel and Luis were part of an *ejido*, they could pause to rest and converse with us in a shared space where farmers regularly exchanged information and food (see Fig 4).<sup>11</sup> This autonomy stood in sharp contrast to Ontario, where interviews were typically conducted late in the evening, away from the greenhouse worksites, and after long workdays.

This autonomy extended to paid labourers. On Héctor's sugar cane farm, his grandfather shared how even day workers controlled their hours: "They don't work [in the afternoon], they don't want to. There the sun is at its peak." His comment shows how workers retain control over their hours and environmental conditions of their work. Workers also held flexibility over where they sought work, exercising agency by choosing farms and negotiating conditions.

Finally, transnational migration revealed how shifts in skill classification reshaped how *campesinos* learn and apply agricultural knowledge. As shown earlier, Angél drew on greenhouse practices to refine plant cultivation at home. In another example, Héctor

<sup>11</sup>For site visits, we shared food or drink with farmers, which appeared to be part of everyday routines rather than arranged interactions.



**Figure 5: Samuel's girlfriend holding out a carrizo (reed) fruit picker pole filled with red plums**



**Figure 6: Angél's neighbour using his machete as an ergonomic support for walking uphill**

reflected on the effects of performance tracking: "They [*chequeadoras*] should not be so demanding, they should consider that human beings also get tired and that there comes a point when the stress is too much." While Héctor described these systems as exploitative in Canada, they still influenced his goals for labour organization as a landowner in Mexico. Héctor shared how he planned to implement a daily performance quota, and to tell workers: "Look, in a day you have to finish this part. I am not going to pressure you [...] but remember that at 11 o'clock you have to finish your task, because if you don't finish it, I won't pay you." Héctor's account reflects the dynamic relationship that he has with labour tracking systems depending on the agency linked to his status and skill classification.

**6.1.3 Interaction and Participation in Sociotechnical Systems.** Most tools that *campesinos* described using were made from local materials and designed to be easily repaired. One example is the fruit picker pole made from *carrizo* (river reeds) (Figure 5), which Samuel's mother explained was produced by a local family who passed down knowledge of harvesting and shaping reeds: "There was a man who [...] dedicated himself to cutting reeds in the river [...] He taught them [his children] all how to do this and they dedicated



**Figure 7: Héctor's grandfather gestures to a broken tractor**

themselves to selling reeds.” This account situates tool-making as an inter-generational technical practice in which knowledge of materials and fabrication circulates in communities. In our field-work, the machete emerged as the most versatile tool. A friend on Angél's *ejido* described using it for weeding, harvesting, and even as a support for walking (Figure 6). The *carrizo* pole and machete show how farmers rely on embodied knowledge of materials and environments to create low-tech, repairable, and adaptable tools.

Regarding technologies, *campesinos* used tractors and solar-powered pumps.<sup>12</sup> No one owned their own operable tractor due to prohibitive costs and rented instead. Standing in his yard, Héctor's grandfather waved at his broken tractor explaining: “we started renting about 6 years ago [...] It has not been possible to make our own [tractor] because these are old models of tractors, it is very difficult to find spare parts to repair [them]” (Figure 7). Other farmers described sharing flatbed trucks to transport produce to market. To manage irrigation under drought conditions, Samuel's parents invested in a solar-powered pump to draw water from their well, replacing arduous manual labour. Samuel noted that this German-imported system “worked with purely sunshine,” making it well-suited to the local climate. Samuel's mother explained that Samuel's employment in Canada was fueled by a desire to further invest in solar and greenhouse infrastructure: “He'll see if he can open up a tomato greenhouse here.” Here, foreign labour enables access to knowledge and capital to expand technological capacity even as farmers adapt systems in response to resource constraints.

## 6.2 High-Tech Greenhouses in Canada

**6.2.1 Agricultural Knowledge.** To understand *campesinos*' agricultural knowledge in Canada, we ground it in our observations of high-tech greenhouses. These facilities spanned several acres and were experienced as enclosed environments where climate control was instantly felt through heat, humidity, and mechanical airflow. Workers moved through long, uniform rows of plants performing repetitive tasks like harvesting (Fig. 8). Work was coordinated through surveillance agtechs like *chequeadoras*, implemented as stationary terminals about every 50 metres along walkways. Data

<sup>12</sup>We note that neither example is ‘high-tech’ in that data are not being collected and shared to a larger technological network for remote controlling and decision-making as is the case in most definitions of agricultural technologies [123].



**Figure 8: Rows of young cucumber plants in a high-tech greenhouse in Essex County, Ontario.**

entered at these terminals by workers were interpreted remotely by supervisors, linking bodily labour on the floor to remote managerial systems. Greenhouse operations required strict sanitation protocols, and suppression of environmental variability that could threaten plant health [94].

*Campesinos* emphasized the intensity and narrow scope of greenhouse labour. Accustomed to performing many roles as a *campesino* and mason in Veracruz, Angél explained that in Ontario he worked as a *pescador* (picker), responsible for harvesting tomatoes and cleaning “*basura*” (garbage). During a ten-hour shift, he was assigned an eight-row zone with a production target: “When there is a lot, it takes an hour, half an hour... there are times each row I'll pick forty to fifty boxes.” This organization of work reoriented agricultural knowledge away from diverse responsibilities and toward repetitive, output-driven tasks that measure skill through endurance and speed.

This reorganization also changed how workers shared agricultural knowledge. As shown earlier, Luis did not believe that the informal conversations and shared problem solving typical in his *ejido* community were possible under greenhouse expectations. Samuel echoed this, describing learning as observational and self-directed: “In Canada, you have to be very observant [...] they're not going to teach you. You study quality of the job, personal hygiene [...] you must be attentive and punctual.” By contrast, in Mexico, he described the importance for *campesinos* to be “friendly with what they know and to pay attention to how to care for a plant.” Samuel's reflections suggest that in Canada, agricultural knowledge is learned via individual distal observation of practices like quotas, hygiene standards, and schedules.

**6.2.2 Skill Classification as ‘Unskilled’ Workers in Canada.** The above examples show how *campesino* knowledge practices are reshaped in Canadian greenhouses through role segmentation and performance expectations. These shifts are tied to workers' classification as ‘unskilled,’ which limits worker agency, constraining when and how they can exercise judgment. For example, Luis, who



**Figure 9: RFID-enabled performance tracking watch (chequeadora).**

used his mechanic skills for on the farm back home, proposed a fix for a broken plant-sorting machine. His supervisor dismissed the suggestion, insisting the problem be handled “her way.” Only in her absence did Luis repair the machine. When the supervisor returned and found it working, she scolded Luis for overstepping: “She got angry and said ‘Why did you touch it if the machine is in my charge?’” This exchange shows how Luis’ technical knowledge was seen as a threat to his supervisor rather than a competency. Héctor described a similar episode when workers identified a tomato plague and tried to warn their supervisor: “They told her, this plant is already infected, you have to cut it because otherwise it will infect the others.” Their assessment was dismissed, leading to crop loss and layoffs. These accounts show how worker knowledge is overridden by supervisory authority, limiting how workers apply expertise outside of the scope of ‘unskilled’ work.

Despite these barriers, workers still exercised skill, supporting each other via informal knowledge sharing. Angél described how Latino colleagues learned together: “Your friends will help you and teach you, but other than that they don’t teach you.” As Angél shared, workers try to informally fill the knowledge gaps left by employers by teaching one another what they know. Héctor also stated how even in a competitive environment, workers still helped each other:

*When our performance begins to drop and we start to feel tired, someone will tell you ‘You got this!’ Or if you feel like going to the bathroom, ‘You go, I’ll cover for you.’ [...] If we feel tired and we want to rest our feet [...] we cover for each other [...] In that aspect, we support each other and we are brothers, at the end of the day.”*

Héctor’s account illustrates how workers’ shared embodied, proximal understanding of everyday workflows allowed them to look after one another in a form of quiet resistance, evading supervisory oversight and distally managed agtechs like *chequeadoras*.

**6.2.3 Interaction and Participation in Sociotechnical Systems.** In greenhouses, we witnessed workers using a range of tools like scissors, knives, trolleys, and trays. While workers did not report any difficulty adapting to these tools, they suggested that they could be risky when under performance pressure. For example, Samuel shared: “You may run the risk of cutting yourself if you work too quickly with the scissors, which are very sharp.” Samuel’s experience reflects how despite workers’ familiarity with sharp tools, added performance pressure pose new workplace safety hazards.

Workers also described their interactions with robots and *chequeadoras*, and how these agtechs regulated and monitored their performance. For example, Héctor explained how his workflow was shaped by robots’ pace and failures:

*“Sometimes they do make your job easier and sometimes they just cause you stress. For example, in the tomato packing area, the machine had a problem because it could not stack boxes [...] That is, they piled up and the tomatoes were squashed. So what did I do? That’s where the human comes in, no? While the machine loaded, I started taking boxes two at a time while dodging the machine. Practically, you have to go at the robot’s pace [...] That causes you stress, no? Because you have to keep up with the robot, if you miss a box, everything is deprogrammed and the chaos starts.”*

Rather than being supported by the robot, Héctor describes a role reversal: the worker becomes an assistant to the machine, patching gaps between its expected and actual performance. His phrase — “that’s where the human comes in” — highlights how workers’ expertise remains essential but unrecognized, surfacing only when technologies fail.

A similar pattern emerged with *chequeadoras*. Angél explained how his RFID-enabled watch (Fig 9) required him to punch in each row harvested, producing data that supervisors used to pressure him: “He [the supervisor] always wanted faster, faster, faster. Always. [...] It [the *chequeadora*] controls you like a controlador [TV remote]. It is the controller of the one that watches you. [...] They are measuring your time.” This statement shows the organizing power of *chequeadoras* to intensify work speed and rhythms. Daniel noted how *chequeadoras* also increase competition between workers: “We have to rush to stay on track and whoever is left behind is left behind.” Daniel’s account shows the individualizing effect of *chequeadoras* where expected work pace hinders intra-worker support.

Despite being cast as passive recipients of agtech, workers still imagined innovations for more ergonomic greenhouses. Héctor, for example, proposed a redesign of packing *estacadores* (stackers): “create a technology that would put the crate in the car and [...] use presses [...] to lift it up [...] on a platform so those people do [not have] such heavy and tiring work.” His idea shows how workers adapt their knowledge to greenhouse rhythms while imagining alternative futures for work. However, such proposals rarely gain traction. As Héctor put it, owners “do not dare to take the risk” of adopting worker-led changes. Héctor suggests that supervisors block opportunities for worker participation in innovation, training, and design. This gate-keeping occurs in spite of workers’ daily proximity to the problems these agtechs are meant to address.

## 7 INTRODUCING THE PRISM OF LABOUR

In our findings, we analyzed workers’ knowledge practices using Polanyi’s distinctions of tacit/explicit and proximal/distal knowledge [98, 99], and workers’ skill classifications through Iskander’s theorization of skill as political classification [69]. For sociotechnical systems, we investigated how workers directly participated in design and used tools and technologies. We organized our findings across these three analytic perspectives, tracing them between

**Table 4: Summary of Findings by Domain.**

Domain	Mexico	Canada
<b>Knowledge Practices</b>	<ul style="list-style-type: none"> <li>• Knowledge is proximal: embodied, ecologically attuned, and operates across multiple domains.</li> <li>• Knowledge is learned tacitly through observation and embodied practice.</li> <li>• Knowledge sharing is communal and family-oriented.</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge is both proximal and distal: embodied execution but narrow task scope.</li> <li>• Knowledge is learned tacitly through observation.</li> <li>• Knowledge sharing is limited by individualized performance expectations.</li> </ul>
<b>Skill Classifications</b>	<ul style="list-style-type: none"> <li>• <i>Campeño</i> status enables temporal and spatial agency over work.</li> <li>• Skill is polyvalent and socially recognized as valuable.</li> <li>• Skill is informally learned through experimentation and self-directed practice.</li> </ul>	<ul style="list-style-type: none"> <li>• “Unskilled” status restricts agency and emphasizes physical task execution.</li> <li>• Supervisory structures limit chances to apply broader skill sets.</li> <li>• Workers continue to support one another despite classification constraints.</li> </ul>
<b>Sociotechnical Systems</b>	<ul style="list-style-type: none"> <li>• Tools are adaptable, repairable, and locally fabricated.</li> <li>• Technologies are scarce and communally shared.</li> </ul>	<ul style="list-style-type: none"> <li>• Technologies intensify pace and segment labour.</li> <li>• Workers form design ideas despite limited authority.</li> </ul>

workers’ family farms in Mexico and commercial greenhouses in Canada. Table 4 summarizes these findings by domain.

While this empirical organization clarifies how each domain separately shaped workers’ lives and labour, our analysis shows that these domains are never experienced in isolation: shifts in classifications shaped how workers’ knowledge was counted as expertise and knowledge practices reconfigured how tools and technologies were designed and operated across contexts. Using a relational framework to analyze the findings is therefore critical because these domains interrelate to form labour infrastructure. Drawing on Bowker and Star’s theories of infrastructure as mutually constitutive [12], we approach these three domains as infrastructural dimensions rather than discrete variables, orienting our analysis toward the *relations* through which labour is organized. Our multi-sited analysis extends infrastructural inversion: by following workers transnationally, we render visible how classifications, sociotechnical systems, and knowledge practices interact and are reconfigured across contexts. To interrogate how these domains operate relationally, we created the *prism of labour* (Fig. 10).

The prism consists of three nodes corresponding to the three domains depicted by white circles in Figure 10, and empirically grounded in the patterns summarized in Table 4. We treated these nodes/domains as empirical entry points to interpret labour infrastructure in our study. Crucially, the analytic work of the prism lies in the relations *between* nodes rather than in the nodes themselves. The prism emerged as we analyzed the data and noticed that many patterns were refractive and relational. To capture these patterns, we operationalize the prism by tracing how shifts in one node reorganize the others through three relational pairings: Knowledge  $\leftrightarrow$  Skill, Skill  $\leftrightarrow$  Tech, and Tech  $\leftrightarrow$  Knowledge. These relations are depicted as edges in the prism and connect via analytic prompts. For

example, Knowledge  $\leftrightarrow$  Skill are linked via *what forms of knowledge are recognized and valued?*. These prompts guide how to interpret the relations between nodes.

In Table 5, we present the analytic prompts along with an explanation of how the nodes mutually influence each other. For example, for Knowledge  $\leftrightarrow$  Skill, while knowledge practices both contest and re-legitimate skill classifications, these classifications, in turn, determine which knowledge practices are recognized as legitimate. In Fig. 10, the arrows along each edge indicate this two-way movement. The dotted boundary surrounding the prism represents the labour infrastructure as a whole. The prism reveals how knowledge practices, skill classifications, and sociotechnical systems are co-constitutive in the labour infrastructure: each shapes and is shaped by the others, such that their alignments stabilize certain infrastructural configurations. Simultaneously, the prism highlights openings where these arrangements can be resisted or renegotiated. The arrows along the dotted boundary thus diverge, representing how these arrangements can be stabilized or resisted.

## 8 INTERPRETING WITH THE PRISM

In this section, we operationalize the prism of labour (Fig. 10) as an analytic lens to interpret our findings. We read the data relationally in two ways: we examine each edge to trace how knowledge practices, skill classifications, and sociotechnical systems are produced in Mexico and Canada, and then shift analysis to the infrastructural level to show how these relations converge to stabilize systems or open sites of resistance. Together, these layers move the analysis from situated experience toward identifying points for intervention.

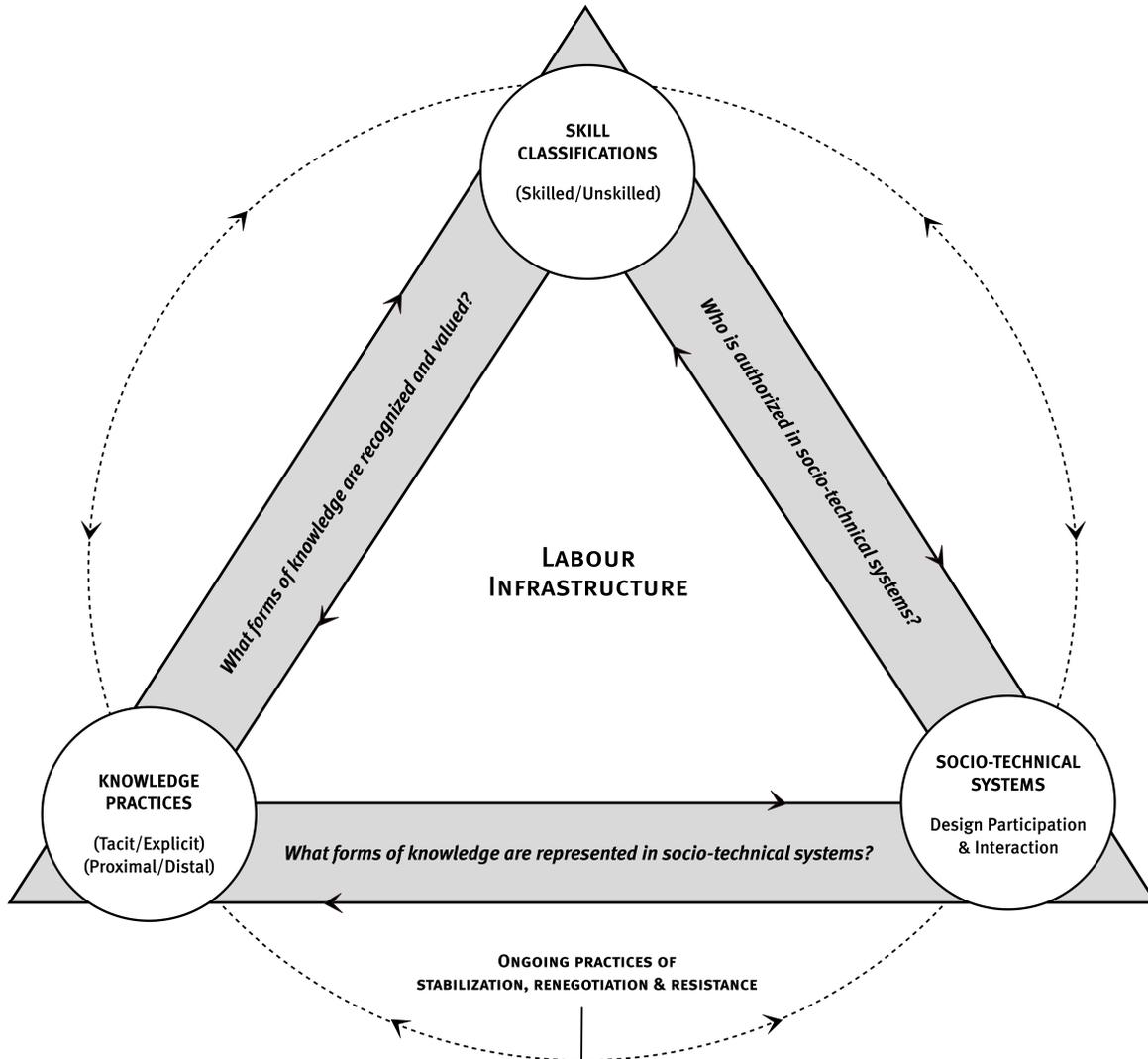


Figure 10: *Prism of Labour*

### 8.1 Reading Along the Prism: Relational Dynamics

We first interpret our findings through the prism’s nodes, tracing how they merge into relational edges in Canada, Mexico, and transnationally. We summarize this analysis in Table 6.

*8.1.1 Whose Knowledge is Recognized? (Knowledge  $\Leftrightarrow$  Skill).* In Mexico, *campesinos*’ knowledge practices, grounded in embodied experience and environmental attunement, are socially recognized as legitimate despite how these practices are not formally accredited. Informal, tacit practices (e.g., burning sugar cane via environmental

knowledge) are treated as markers of skill. This recognition enables *campesinos* to exercise agency over their farms, embedding informal knowledge sharing into their work practices (e.g., Hector’s grandfather showing how to peel sugar cane (Section 6.1.1)).

In Canada, workers are reclassified as ‘unskilled,’ limiting how knowledge is recognized. By isolating workers into segmented, surveilled roles, employers intensify the pressures on workers’ bodies while disregarding expertise like plant care and troubleshooting. Workers’ proximal knowledge is superseded by distal forms of knowledge like performance metrics, recasting workers as labour to be measured. Importantly, worker diagnostic and repair knowledge

**Table 5: Relational Mechanisms of the *Prism of Labour* (Fig. 10).**

Prism Edge	Analytic Prompt	Relational Mechanisms
Knowledge ↔ Skill	<b>Recognizing knowledge:</b> What forms of knowledge are recognized and valued?	<ul style="list-style-type: none"> <li>• Knowledge practices contest, calibrate, and re-legitimate skill classifications.</li> <li>• Skill classifications shape which knowledge practices are recognized as legitimate.</li> </ul>
Skill ↔ Tech	<b>Authorizing actors:</b> Who is granted or denied authority in sociotechnical systems?	<ul style="list-style-type: none"> <li>• Skill classifications grant authority to participate in sociotechnical systems.</li> <li>• Sociotechnical systems encode and operationalize skill classifications.</li> </ul>
Tech ↔ Knowledge	<b>Encoding into sociotechnical systems:</b> What forms of knowledge are represented or erased?	<ul style="list-style-type: none"> <li>• Sociotechnical systems configure which knowledge practices are represented.</li> <li>• Knowledge practices shape sociotechnical systems.</li> </ul>

still surfaces (e.g., Luis fixing the plant-sorting machine; workers identifying crop disease (Section 6.2.2)) but is often de-legitimated, with material consequences for production and safety.

The Knowledge ↔ Skill relation reveals a key transnational shift: **epistemic reclaiming**. Workers develop hybrid knowledge through transnational labour and selectively reintegrate it once they regain recognition as *campesinos*. Practices learned in Canadian greenhouses (e.g., tomato growing methods, approaches to chemical use (Section 6.1.1)) are adapted to local values and needs on family farms. These hybridized practices are only possible under conditions of restored authority of land, time, and technique, transforming deskilled labour in Canada into locally grounded expertise at home. The prism edge thus makes visible how shifts in skill classification reorganize which knowledges can travel, be recomposed, and become authoritative.

**8.1.2 Who is Authorized in Sociotechnical Systems? (Skill ↔ Tech).** In Mexico, *campesinos*' expertise is socially recognized, positioning them as makers and designers of tools that meet their needs and values. Tools like the machete and *carrizo* pole are flexible, repairable and made from local materials (Section 6.1.3). These tools reflect *campesinos*' polyvalent expertise and multi-purpose usage. Authority is distributed through everyday practice.

In Canada, *campesinos* are denied authorization due to their 'unskilled' classification. As physical 'doers,' workers' presence is reduced to quantifiable outputs (e.g., boxes picked). These inputs are measured by *chequeadoras*, agtechs of managerial oversight. Workers' suggestions (e.g., Héctor's recommendation for a more ergonomic packing agtech (Section 6.2.3)) are frequently ignored or dismissed, even when workers are knowledgeable of how sociotechnical systems work in practice. Nonetheless, workers still find ways to subvert the scope of their 'unskilled' duties, like with

Luis, who fixed a plant-sorting machine against his supervisor's wishes (Section 6.2.2).

The Skill ↔ Tech relation reveals **dual positionalities** across contexts: in Canada, workers were denied agency and treated as inputs to sociotechnical systems, yet as *campesinos* in Mexico, they could evaluate and sometimes adopt Canadian labour systems and tools. For example, in Canada, Héctor critiqued *chequeadoras* as exploitative yet drew on its performance logics to reorganize work expectations for his workers once his authority was restored in Mexico. These shifts destabilize the 'skilled/unskilled' binary, revealing how it is relational to how skill is classified and encoded in sociotechnical systems rather than an inherent measure of ability.

**8.1.3 (Tech ↔ Knowledge): What Forms of Knowledge are Encoded into Sociotechnical Systems?** In Mexico, *campesinos*' tools like *carrizo* poles encode their tacit and proximal knowledge practices. Tool design reflects farmers' intimate knowledge of their work and land, making them practical for daily use (Section 6.1.1). Financial and resource constraints block access to higher-cost technologies like tractors, which depend on hard-to-source imported parts. Such constraints push farmers toward communal solutions like sharing and hybrid innovations that blend proximal expertise with available resources like Samuel's cousin jimmy-rigging an irrigation system (Section 6.1.1). Here, sociotechnical systems make *campesino* knowledge central and visible.

In Canada, workers encounter agtechs like robots and *chequeadoras*, which privilege explicit, distal forms of knowledge (e.g., speed, uniformity) that are then formalized into metrics (Section 6.2.3). Workers' tacit, proximal knowledge (e.g., sensing plant disease) remains invisible to these systems. Through *chequeadoras*, distal forms of managerial oversight are imposed onto workers' bodies, producing stress and rivalry. While workers understand *chequeadoras*' effects (e.g. bodily fatigue), they do not know how it works, nor

**Table 6: Edge-Level Relational Analysis through the *Prism of Labour*.**

Relation	Mexico	Canada	Transnational Shifts
<b>Knowledge ↔ Skill</b> <i>What forms of knowledge are recognized?</i>	Informal tacit knowledge is socially legitimate; embodied knowledge is recognized as skill. Farmers hold agency over time, land, and learning.	Knowledge is narrowed through classification as “unskilled.” Physical endurance is recognized as skill.	<b>Epistemic reclaiming:</b> restored authority enables knowledge hybridization.
<b>Skill ↔ Tech</b> <i>Who is authorized in sociotechnical systems?</i>	Farmers are authorized as decision-makers. Tools (e.g., machetes) are adaptable and locally made, reflecting polyvalent skill.	Workers are denied design authority. Technologies (e.g., <i>chequeadoras</i> ) treat workers’ physical labour as inputs; skill is reduced to speed and compliance.	<b>Dual positionalities:</b> executors in Canada, decision-makers at home.
<b>Tech ↔ Knowledge</b> <i>What forms of knowledge are encoded in sociotechnical systems?</i>	Tools encode tacit, proximal knowledge of the body, terrain, and crops. Technologies encode specialized expertise that can hinder adoption and maintenance.	Technologies encode managerial priorities (speed, metrics, surveillance). Tacit knowledge (disease detection, repair) is excluded and rendered invisible.	<b>Reactive design capacity:</b> innovations revived across transnational contexts.

how their data are processed. Worker knowledge is thus proximal, felt immediately through the pressure to keep pace, and distal, kept at arm’s length by systems that obscure their inner logics. The *chequeadora* is therefore a sociotechnical system designed for the ‘unskilled’ worker: its operations and data are intentionally opaque, reinforcing the assumption that workers have neither the need nor capacity to learn. Yet, the systems’ effects are deeply intimate, regimenting workers’ bodies, and undermining collective ways knowledge is shared. Workers nonetheless find ways to support one another by relying on their embodied understanding of their workflows to evade distally managed agtechs, which have knowledge gaps regarding how embodied work is actually executed on the greenhouse floor (Section 6.2.2).

The Tech ↔ Knowledge relation reveals a transnational pattern: **reactivated design capacity**. Workers draw on experiences with Canadian agtechs to reinterpret and revive design ideas in Mexico under conditions of greater agency. They adopt aspects of greenhouse organization or mechanization (Section 6.1.3) in ways that align with communal values, ecological constraints, and personal well-being. This shift shows how design knowledge persists across contexts but becomes materially grounded only when it can be re-embedded in local practice. The prism edge thus surfaces how technologies mediate not only what counts as knowledge, but where and how design capacity is recognized and reclaimed.

## 8.2 Reading Through the Prism: Infrastructural Effects

Reading across the prism’s three edges as co-constitutive in labour infrastructures reveals two dynamics: **convergence**, where relations align to stabilize into apparently seamless labour infrastructures or **resistance**, where frictions open space for renegotiation. In the prism diagram (Fig. 10), this ongoing negotiation is shown by the dotted circular boundary and divergent arrows.

**8.2.1 Sites of Convergence and Restabilization.** In Canada, workers’ tacit knowledge is reduced (from a managerial stance) to corporeal output, their classification as ‘unskilled’ strips them of decision-making power, and agtechs like *chequeadoras* work to converge work infrastructures that appear seamless. These elements align to stabilize a system where agricultural labour is represented via standardized metrics rather than experiential knowledge, and where workers’ contributions outside their prescribed tasks are systematically invalidated. Here, convergence naturalizes the category of ‘unskilled,’ excluding workers from technological participation.

In Mexico, labour infrastructures converge around very different logics where workers’ recognized status as *campesino* is intertwined with their tacit knowledge practices and polyvalent expertise. This status authorizes *campesinos* as knowledge producers whose daily practices shape the design and use of tools. Tools and techniques are stabilized through inter-generational teaching, communal labour exchanges, and rhythms of care rooted in ecological awareness. Labour infrastructures thus converge around embodied skill, ecological attunement, and collective responsibility.

**8.2.2 Sites for Resistance and Renegotiation.** In Canada, *campesinos*’ resist infrastructural convergence through solidarity practices like covering for each other, and informally sharing knowledge (Section 6.2). Despite how managerial control attempts to erase workers’ tacit knowledge (e.g., plant care), workers still leverage these skills, and draw on misalignments in managerial expectations of their work practices to form resistance pathways. For example, workers intentionally keep certain knowledge practices informal, and, therefore, illegible to *chequeadoras*. By working off the radar, workers preserve spaces where care and solidarity circulate without being captured by metrics. These subversions resist integration into formal infrastructures, and while they could, in theory, be renegotiated into recognition, doing so would risk more surveillance and control [105, 129].

**Table 7: Infrastructural Convergence and Resistance through the *Prism of Labour*.**

Infrastructure Effects	Mexico	Canada
<b>Infrastructural Convergence</b> <i>What is stabilized?</i>	Infrastructure stabilizes around embodied skill, ecological care, and collective responsibility. Learning is social, embedded in work practices.	Infrastructure stabilizes around deskilling, task division, and metrication. Learning is individualized and competitive.
<b>Infrastructural Resistance</b> <i>What is resisted?</i>	Resistance is <b>generative</b> : selective adoption, repair, and innovation.	Resistance is <b>covert</b> : workers cover for each other, working off the radar.

In Mexico, resistance emerges through selective uptake of transnational knowledge practices (e.g., Angé’s pruning techniques, Héctor’s revisions to labour structure in Sections 6.1.1 and 6.1.2), but also via aspirations for new forms of agricultural practice. *Campesinos* seek technologies that lessen physical work, stabilize yields, and adapt to shifting climates. Their desire for locally adapted greenhouses or moderate chemical use reflects an orientation toward innovation on their own terms. These practices reflect hybrid infrastructures where *campesinos* blend embodied ecological knowledge with distal techniques learned abroad. The prism identifies this as a site of renegotiation where resistance pushes beyond system maintenance toward reconfigured agricultural futures — ones where *campesino* expertise guides technological adoption for resilience in an evolving climate. These moves are not only resistant but generative, akin to Eglash’s “*appropriation*,” a bottom-up reworking of imported techniques into vernacular, worker-owned systems [37].

What emerges from this analysis, summarized in Table 7, is how vital skill recognition and authority are in determining which infrastructural elements are reinforced as well as the nature and scope of workers’ resistance practices. As workers’ skill classifications shift between Canada and Mexico, their control over epistemic practices and participation in sociotechnical design also change dramatically. Under different skill regimes, workers’ resistance practices also evolve, shaped by vulnerabilities and opportunities they face across contexts. In what follows, we show how HCI researchers can use the prism to support interventions for workers.

## 9 INTERVENING THROUGH THE PRISM

This section develops the prism as an intervention lens that repositions how HCI engages with labour. The interventions that follow work across various sites of action: engaging structural conditions where labour infrastructures stabilize, supporting worker-led practices, addressing how technologies and knowledge shift across borders, and intervening in research practice itself. We see these interventions as tactics to denaturalize and interrogate unjust pathways where labour infrastructures converge, and to foster alternative trajectories that workers are already forging for themselves.

### 9.1 Disrupting Infrastructural Convergence

The prism enables researchers to trace how classification systems shape how workers interact with technologies, who holds decision-making authority, and whose knowledge is prioritized. This diagnostic work is particularly vital when workers have low political power and limited ability to negotiate their work conditions, as

with the participants of this study. These workers were positioned as interchangeable and expendable, governed via metrics tied to bodily output. Under these conditions, deskilling, task segmentation, and metrication reinforce one another, producing systems that appear seamless from a managerial perspective.

When work infrastructures stabilize under such conditions, some of the most impactful interventions involve interrogating how skill classifications are encoded into systems, workflows, and institutions. This diagnostic work can produce evidence supporting worker advocacy groups in policy writing, negotiation, and public campaigns by showing how inequality is enforced via institutional and technological design. By naming and challenging these arrangements, the prism enables HCI researchers to expose practices that have become ‘seamlessly’ embedded into labour infrastructures, and support long-term transformations for workers.

### 9.2 Supporting Infrastructural Resistance

We also see the prism as aiding labour justice work by helping researchers diagnose when and how to intervene. In this study, workers actively resisted and renegotiated infrastructures by modifying tools, redistributing labour, and sharing knowledge in ways that existing systems neither recognized nor supported. These resistance practices are vital mechanisms in informal collective work, but supporting them is not so simple: making tacit practices visible in sociotechnical systems can intensify managerial control [25, 105, 129]. Supporting worker resistance, therefore, may require guarding opacity rather than increasing transparency.

Before proposing technologies or policy recommendations, researchers can use the prism’s prompts to map existing conditions. This analytic work matters because changes along one relational axis reverberate across others. Recognizing workers’ knowledge in new tools may support practice, but can also expose workers to surveillance when data become linked to accountability systems. Redistributing authority may enable participation while introducing new tensions in hierarchies. Encoding expertise may increase visibility but detach knowledge from the contexts that sustain it. Interventions often carry unintended effects [41]. The prism does not eliminate uncertainty, but it equips HCI researchers to engage with interventions as infrastructural shifts whose effects propagate across knowledge, skill, and technology. Crucially, such work cannot be done for workers. Decisions to surface or shield practices, which forms of recognition are desirable, and which alliances are safe or valuable must be made with workers and their communities, with the prism informing these conversations.

### 9.3 Fostering Hybrid Knowledge and Transnational Workers

The prism also highlights how workers who move across borders carry hybrid knowledge and design capacities that are often overlooked. Designing with this transnational position in mind has two main implications. First, it suggests that migrant workers are not only users of technologies in receiving countries but also potential designers, translators, and critics of technologies that later travel back to their communities. Interventions can therefore support workers in documenting and evaluating the techniques and systems they encounter abroad, not to extend their exploitation, but to strengthen their ability to adapt, refuse, or repurpose these systems once they are back in control of land and work. Second, because technologies themselves circulate across borders, the prism invites designers to intervene at points of translation. Here, the prism's questions — about which knowledge is recognized, who is authorized, and what is encoded — can guide adaptations that reinforce worker expertise rather than undermine it. The transnational reframing thus helps HCI researchers think about local design, and also how technologies travel, when they should be resisted, and where they may be reimaged to support more equitable futures.

### 9.4 Meta-Intervention: Turning the Prism on HCI

Researchers are not outside of the systems they study; they are embedded in the same classification regimes, epistemic hierarchies, and sociotechnical systems as their projects. Focusing on authority over knowledge practices, the prism directs attention to how researchers themselves are classified (e.g., as 'neutral' experts), which forms of knowledge are prioritized through methodological choices (e.g. language use), and how institutions shape what work can be done and for whom. This perspective supports more deliberate research design by prompting reflection on how funding influences knowledge production, how technologies are framed as design objects, and how research relationships can be built in more epistemically and culturally responsible ways.

In this study, turning the prism on research process reframed the first author's understanding of uneven field access. What initially appeared as a methodological weakness became legible as evidence of the same classificatory regimes shaping workers' lives. In Canada, institutional ethics requirements and employment precarity restricted workplace engagement to protect livelihoods; in Mexico, access depended on invitation, trust, and care. These differences reflected uneven distributions of authority, visibility, and risk. Reading these differences through the prism enabled us to interpret access not as a failure of fieldwork design but as part of the labour infrastructure itself. For HCI, this inward turn matters because it places researchers in the systems they seek to change. The prism frames accountability as an infrastructural concern — one that requires attention to how research reproduces or challenges classification, authority, and knowledge hierarchies, and to how scholars align their own practices with the worker-centered futures they aim to support.

## 10 STUDY LIMITATIONS

This study has limitations that shape how it should be read. Most immediately, and stated above, the empirical record is uneven across sites, a common challenge faced in multi-sited ethnographies [141]. This imbalance reflects not only the practical challenges of fieldwork, but also the conditions under which greenhouse workers live and work in Ontario: marked by employer dependency, limited rights, and the constant risk of deportability [49].

This study is also based on a small sample size. Consistent with critical multi-sited ethnography's emphasis on depth of engagement, and relational insight [39, 79, 135], we do not claim to capture the full range of migrant greenhouse worker experiences. The findings should therefore be read as tracing infrastructural dynamics through specific lives, not as claims about the population at large.

The prism of labour is also untested beyond this case. While we hope it proves useful to others studying labour and technology, its transferability beyond transnational agricultural work is still an open question. We therefore treat the prism as provisional, shaped through ongoing dialogue with other scholars and cases that are already surfacing new questions, frictions, and limits.

Finally, our goal is not to romanticize *campesino* life or treat participants' knowledge as static or idealized. We also note that greenhouse work is changing: many workers now enter greenhouses from other sectors like construction and do not always hold agricultural expertise. Against this shifting landscape, our purpose is to insist that worker perspectives on agricultural technologies and labour futures are taken seriously as sources of knowledge, critique, and design insight.

## 11 CONCLUSION

This paper argues that understanding labour in contemporary sociotechnical systems requires moving beyond technological design to broader arrangements that organize work. Through a critical multi-sited ethnography of migrant farm work in Mexico and Canada, we have shown that labour is organized through the joint operation of knowledge practices, skill classifications, and sociotechnical systems. These relations determine not only how work is done, but what knowledge is recognized, who is authorized, and what knowledge is encoded into technologies.

The prism of labour offers a way to make these relations visible and actionable. Analytically, the prism enables labour to be read as an infrastructure through the relations outlined above. Interventionally, the prism repositions where HCI can act: in labour policy, in informal worker practices, and in the transnational circulation of technologies. Design, therefore, becomes infrastructural, concerned with how labour systems are assembled, stabilized, and contested.

The prism is not a framework for critique alone. It is a device for locating responsibility and possibility in labour infrastructures that often appear seamless and inevitable. For HCI, the prism offers a way to surface how inequality is built into classifications, epistemic practices, and design, and to support workers in contesting those arrangements. In this sense, the prism does not promise resolution, but offers a way of *staying with the trouble* [57], of intervening in places where harms are stabilizing and where alternative worker paths are already quietly unfolding.

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