# Harvesting Perspectives: A Worker-Centered Inquiry into the Future of Fruit-Picking Farm Robots

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*Abstract*— **The integration of robotics in agriculture presents promising solutions to challenges such as labour shortages and increasing global food demand. However, existing visions of agriculture robots often prioritize technological and business needs over workers'. In this paper, we explicitly investigate farm workers' perspectives on robots, particularly regarding privacy, inclusivity, and safety, three critical dimensions of agricultural HRI. Through a thematic analysis of semi-structured interviews, we: 1) outline how privacy, safety and inclusivity issues manifest within modern picking-farms; 2) reveal worker attitudes and concerns about the adoption of robots; and 3) articulate a set of worker-centered requirements and alternative visions for robotic systems deployed in farm settings. Some of these visions open the door to the development of new systems and HRI research. For example, workers' visions included robots for enhancing workplace inclusivity and solidarity, training, workplace accountability, reducing workplace accidents and responding to emergencies, as well as privacy-sensitive robots. We conclude with actionable recommendations for designers and policymakers. By centering worker perspectives, this study contributes to ongoing discussions in human-centered robotics, participatory HRI, and the future of work in agriculture.**

## I. Introduction

As agriculture faces mounting challenges—including labour shortages, climate change, and the demand for greater efficiency—robotics is emerging as a transformative force in modern farming. However, the adoption of robots in fruit-picking farms remains constrained by technical, economic and societal barriers. Beyond engineering advancements, the integration of agricultural robotics depends on navigating ethical concerns, policy frameworks and worker acceptance [1]–[3].

Despite advances in automation, fruit and vegetable harvesting continues to rely heavily on seasonal human—often migrant—labour, whose voices are currently missing from the robotics and HRI literature. This paper thus explores the perspectives of farm workers in the soft-fruit sector, particularly regarding the introduction of robots. Building on Lee's work on automation and labour relations [4], we emphasize the importance of centering lived experiences of those most directly impacted by technological change.

Existing research on farm robotics reveals key limitations: 1) farm workers are often excluded from stakeholder groups involved in designing and developing agricultural robots [3], [5], even though they are most affected by the introduction of these technologies; 2) many studies focus on imagined or hypothetical robots rather than actually deployed systems [6], leading to a lack of real-world insights; and 3) discussions on privacy, inclusivity, and worker safety in farm environments remain insufficient. To address these gaps, our study draws on the principles of *participatory human-robot interaction (HRI)* and *responsible AI/robotics* to investigate three dimensions central to farm workers' well-being: *privacy*, *inclusivity*, and *safety*. In particular, we seek to answer the following research questions:

- RQ1: What are farm workers' perceptions of privacy, inclusivity, and safety in farms?
- RQ2: What are farm workers' attitudes and concerns regarding the introduction of robots, including existing industry-led visions of farm robots?
- RQ3: What are farm workers' requirements and visions for worker-centered farm robots?

To answer these RQs, we designed, conducted and analyzed twelve (N=12) semi-structured interviews, which included a video probe with existing business-led farm-robot visions. Based on our findings, we offer recommendations for designers, policymakers, and HCI/HRI researchers advocating the ethical and responsible integration of robotics in picking-farms. We also bring attention to the nuanced challenges that farm workers encounter with the adoption of robotic systems in their roles. Lastly, we stress the importance of reducing workers' skepticism of robot in farms through open dialogue, training, awareness-building and participatory design, a responsibility that should be actively supported by policymakers, employers and trade unions.

## II. Related work

### A. Agricultural robotics and HRI

Robotic systems in agriculture now include robots for harvesting [7], weeding and mowing [8], greenhouses [9] and seed-planting, and aerial imaging [10], [11]. AI-driven solutions are also emerging for tasks like fruit sorting and transportation [12], [13]. Although these advancements hold considerable promise, research on user acceptance centers predominantly on farmers, farm managers, or agricultural specialists [14], [15]. This focus, however, leaves critical gaps regarding the perspectives of other stakeholders, such as workers themselves. An emerging body of work in *HRI* aims to address these gaps focusing on how robots and human workers collaborate in challenging agricultural settings. Cila et al. [16] propose design guidelines for agricultural robots—particularly in dairy farming—and show that transparent robot communication enhances worker trust and

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collaboration in dairy farms. They also found that user-friendly interfaces further improve collaboration. Similarly, Cheein et al. [17] showed that adaptive HRI frameworks, such as context-aware speed settings for harvesting robots, help mitigate worker fatigue and boost efficiency in Latin American farms. However, aspects of safety, inclusivity and privacy are still missing from worker-centered research.

### B. *Worker-centered design and ethical considerations*

A notable gap in current research is the limited attention given to frontline workers such as seasonal and migrant labourers, who form a significant part of sector's workforce and are primary users of these technologies [18]. Marinoudi et al. [19] advocate for a bottom-up design approach that prioritizes worker needs. Worker-centered and human-centered design frameworks emphasize augmenting human labour rather than replacing it, while promoting dignity, autonomy, and equity [18], [20]. However, pervasive sensors, cameras, and AI-based analytics in agricultural settings raise significant concerns regarding privacy and surveillance, necessitating transparent policies and active worker engagement [6], [21]–[23]. Beyond privacy concerns, research shows that *HRI* in agriculture also requires careful attention to worker well-being. Vasconez et al. [24] examine how visual strategies—such as a robot's approach, following, or avoidance behaviours—can reduce worker mental workload and improve safety perceptions in avocado harvesting by ensuring socially acceptable navigation. Deshmukh et al. [25] studied sociocultural influences on robot acceptance, including a preference for assigning gender to robots. These design choices align with calls for transparent communication and active worker participation, particularly when pervasive sensing in agricultural robots raises potential privacy issues.

Concerns over automation's socioeconomic impact also persist. Carolan et al. [26] argue that robotics risks consolidating power among large agribusinesses at the expense of smaller farmers and cooperatives. Building on this, Duckett et al. [27] and Rotz et al. [28] highlight safety risks and privacy issues, noting that many designs fail to accommodate non-expert users such as workers. Similarly, Bronson et al. [29] criticize the bias toward large-scale farms, which often marginalizes small farms and transient workers. Elias et al. [30], adds to this discourse by identifying social and organizational barriers—such as financial constraints, risk aversion, and past failures—that can hinder technology acceptance. They stress that inclusive and trust-based design strategies are important for mitigating these barriers.

To bridge the above gaps, interdisciplinary research that integrates technological innovation with worker-centered design, participatory design and ethical considerations is essential. Benjamin et al. [31] demonstrated the effectiveness of participatory design in Rwandan farms, where workers engaged through interviews, prototyping and discussions to shape automation strategies. Similarly, Baxter et al. [3] studied human-robot collaboration in strawberry farming, showing positive worker perceptions of a robot-assisted crate transport system despite navigation challenges. Recent work by Guevara et al. [32] developed a gesture-based navigation module with audiovisual alerts for robots, reducing safety incidents during strawberry picking. This approach prioritized worker comfort in shared workspaces, aligning with calls for worker-centered design by incorporating safety assurances and trust-building elements directly into robot behaviour. Our work is similar in spirit, but puts forward a large set of worker-centered visions of robot capabilities for fruit-picking farms, as well as various requirements for safe, inclusive, and privacy-aware robots in those contexts.

## III. Methodology

Between November 2024 and March 2025 we carried out a user study designed to address the research questions (RQs) introduced in Section I. The study involved conducting *semi-structured interviews* with individuals working in picking farms, selected from a range of demographics and professional roles. Below, we outline the design, participant recruitment, and implementation of this study.

### A. *Study Design*

We developed an interview script to target *RQ1-3*. This script was divided into six thematic sections each dedicated to a different set of topics. The sequence was arranged to guide interviewees smoothly through discussions about their experiences and perspectives. The first section of the script gathered information about participants' current or previous job types and responsibilities. It also focused on identifying perceived workplace challenges—particularly in relation to inclusivity, fairness, privacy, and safety—within picking-farm environments. Additionally, this section probed their familiarity with or membership in workers' unions, and how that could assist in improving workplace conditions. The next two sections turned to the topic of automation in farm work, exploring participants' recent experiences with, and views on, robotics and automated solutions.

After completing these sections, we showed each participant a minute-long video montage illustrating real-world robotic systems currently used in picking farms. This video served as a shared point of reference, demonstrating how various companies envision automation in farm settings. Drawing on established research that leverages video prompts to elicit concrete feedback and requirements [33], [34], we hypothesized that seeing tangible examples of farm robots would spark more specific concerns, ideas, and suggestions—even for participants without direct experience. To create the video, we compiled publicly available footages (from YouTube) of existing agricultural robots, e.g., different types of autonomous harvesting robots, field-based agricultural robots, and autonomous transport robots, all operating alongside human workers. By including clips that showed both the robots in action and humans performing tasks, we aimed to help participants visualize what a human–robot collaborative workflow might look like if they had not previously worked with such systems. Overall the video showed various visions of farm work. Figure 1 shows a sample of frames from the video.

After watching the video, participants were asked a fourth set of questions to probe their impressions of these technologies, including perceived benefits and drawbacks of the showcased robotic solutions. Lastly, the script concluded by asking about participants' broader concerns, design requirements, and visions for how robots should be implemented—focusing on privacy, safety, inclusivity and fairness.


Fig. 1. Images from the video illustrating various robots working alongside humans in picking farms: (a) robot harvester, (b) autonomous transport robot, (c) autonomous navigation, (d) fruit detection (e) integrated farm system (f) autonomous harvesting and tray delivery system.

### B. Participants: Recruitment, Compensation, and Demographics

Recruitment was conducted through multiple channels, including field visits to farms in Godalming, Milford, Petersfield, and Horsham (England, UK), community connections in the UK, and UK-based farm-related social media groups. During recruitment conversations—whether in person or online—we outlined the study's focus on perceptions of robot usage in agriculture and emphasized that the participation was entirely voluntary. Interested individuals were invited to complete an online survey which gathered consent and demographics. We initially received 53 responses to our call for participants. From this group, we selected those with farm-work experience in the UK, and used a snowball sampling approach. We asked participants to refer others so as to recruit and schedule interview sessions. We continued interviews until code saturation was reached, resulting in a final sample of N=12 participants. Each participant received a £35 Amazon voucher as compensation. Participants had between 2 and 18 years of experience working on picking farms (see Table I). The sample included 7 women, 4 men, and 1 non-binary participant. Participants were aged 18 to 44, representing diverse ethnicities (Black, Mixed, White) categorized according to UK census classifications. While prior experience with farm robots was not an inclusion criterion, all participants were asked about it. As summarized in Table I, 1 of 12 participants reported having some experience with farm robots.

### C. Data Collection and Analysis

We conducted online interviews via video conferencing, totalling ≈18 hours of video recordings, with each interview lasting around 1-1.5 hours. After transcription and anonymization, we retained the original grammar and syntax to avoid misrepresentation, and any quotations we include in this paper are also unedited save for minor aspects: removal of word repetitions (e.g., "therefore therefore") and "uhms" and "ahs". For analysis, we employed thematic analysis using NVivo. The first author developed initial codes, iterated with co-authors to create a code-book based on recurring patterns in participant responses. The first author then applied the codebook to all transcripts. The first author then trained a second coder, with previous experience in qualitative studies, in using the codebook. The second coder applied it to a subset of transcripts (3 participants-randomly picked), leading to an agreement of 80%.

TABLE I
PARTICIPANT DEMOGRAPHICS AND EXPERIENCE

| ID | Role | Years | Age | Demographic | Robot Exp. |
|---|---|---|---|---|---|
| P1 | Picker | 6-10 | 24-34 | W, White | No |
| P2 | Picker | 1-2 | 18-24 | W, Black | Yes |
| P3 | Picker | 3-5 | 18-24 | M, Black | No |
| P4 | Picker | 3-5 | 25-34 | W, Black | No |
| P5 | Mgr/Picker | 3-5 | 25-34 | M, Black | No |
| P6 | Fruit | 1-2 | 18-24 | M, White | No |
| P7 | Fruit | 1-2 | 25-34 | W, White | No |
| P8 | Fruit | 3-5 | 18-24 | M, White | No |
| P9 | Mgr/Worker | 1-2 | 35-44 | W, Black | No |
| P10 | Picker | 3-5 | 25-34 | W, Black | No |
| P11 | Picker | 3-5 | 18-24 | M, Black | No |
| P12 | Picker | 6-10 | 35-44 | NB, Mixed | No |

W=Woman, M=Man, NB=Non-Binary. Black=Black, African, Caribbean or Black British. Mgr=Manager. Years=Experience in years.

### D. Ethics

We obtained ethical approval for this study from the "KCL Research Ethics Office" (Reg No. MRSP-23/24-43818). Before recruitment we provided participants with project information, and informed consent was sought twice. First, by indicating their willingness to participate via the consent form using Qualtrics. Second, at the beginning of the interview to allow recording and anonymization of the data. All recordings were deleted following transcription.

## IV. RQ1 FINDINGS: WORKPLACE CONDITIONS

We start by describing our findings regarding workers' perspectives on their workplace environments and overall well-being.

### A. The unsafe nature of work

Farm labour requires both physical endurance and mental resilience. Workers highlighted challenges of long hours, close supervision, and physically demanding tasks. Stress was a major concern, driven by high expectations, job insecurity, financial instability, harassment, and the strenuous nature of farm work. As one worker noted, e.g., *"You need a lot of strength and also mental stability..." (P1).*

Apart from the physical aspect of hardship, the job imposed a significant emotional burden. Many workers described experiencing chronic pains from repetitive and strenuous tasks, alongside feelings of hopelessness and isolation.

To cope with the stress some turned to unhealthy coping mechanisms, including substance use. As one worker described, *"It's stressful, and at the end of the day, we end up taking drugs. That's not how it's supposed to be" (P2).*

### B. Common accidents and mistakes

We identified various safety hazards commonly brought up by our participants, regarding work in picking farms.

*1) Allergic reactions (pesticides, fertilizers, pollen):* Workers frequently experienced discomfort from chemicals and environmental allergens, e.g., *"If you're working with fertilizers, you know these are chemicals, and you're inhaling them. It's really uncomfortable" (P4).*

*2) Falls from ladders/stairs and trees:* Falls from unstable ladders, trees, or stairs were common hazards in fruit-picking jobs. Workers often had to climb on precarious surfaces, such as ladders set up on loose soil or stairs placed on unstable tree structures, increasing the risk of slips and falls, e.g., *"Ladders were set up on soil with thin plastic sheets in the polytunnels, making them really unstable" (P7).*

*3) Common mistakes:* Workers reported that mistakes in picking farms were often caused by inexperience, miscommunication and improper use of equipment/tools. Moving large fruit crates or other heavy goods often resulted in collisions or spills, while language barriers sometimes compounded these issues, making it difficult for workers to follow instructions or coordinate effectively. As one worker expressed *"At first, I made a lot of mistakes because I couldn't communicate with colleagues or supervisors" (P2).*

### C. Broad issues of inclusivity and fairness

Participants raised various issues of discrimination in their farm experiences. Below we outline recurring themes that emerged from workers' responses.

*1) Abuse and sexual harassment.:* Several workers reported mistreatment from supervisors or managers who were often described as arrogant or verbally aggressive/abusive. One worker recalled: *"The manager would just shout at workers all the time" (P3).* Sexual harassment and inappropriate behaviour was also common. One worker reported experiencing discomfort due to overly personal interactions from management, e.g., *"...so he(manager) would say, do you want to come for drinks with? Like, come for drinks afterwards at the house" (P7).* And another worker mentioned feeling vulnerable when physically bending to pick produce.

*2) Bias and unfair treatment:* Workers reported experiencing discrimination based on physical-attributes, social-status, and personal-relationships. Some were judged by their body type, others by their wealth or experience. Task assignments were often influenced by favouritism, with some receiving easier roles, while others were given more strenuous work. As one worker said, *"They don't have respect for people they don't like. Even the elderly ones get insulted because they have less money" (P2).*

Some employers favoured certain racial or ethnic groups, while tensions between different nationalities created workplace divisions. Gender-based discrimination was also evident, with female workers excluded from tasks typically assigned to men, e.g., *"it is normal for people to see men as more physically fit for farm work than female. And I feel like that's like a very serious discrimination because I personally believe what a man can do, a woman is equally capable of" (P4).*

*3) Limited or unequal access to tools:* Workers mentioned that distribution of essential tools was often inequitable, often following a first-come—first-served basis instead of fair allocation, e.g., *"There weren't enough tools for everyone, so those who arrived later couldn't complete their tasks" (P4).* This type of distribution naturally leads to winner-take-all outcomes, where fast, young, non-disabled workers get faster with the help of tools, and others become further disadvantaged.

*4) Challenges of workers with disabilities and health conditions:* Participants observed that workers with disabilities were rarely hired or quickly dismissed based on assumptions about their abilities. Those who secured jobs often faced limited roles, highlighting a lack of inclusivity in employment and contributing to broader unfair treatment, e.g., *"If they look at you and think you won't be able to do the work, you just don't get hired or you get fired" (P1).*

Farm work posed significant challenges for those with limited mobility due to inaccessible pathways and nature of tasks e.g., *"You couldn't just get up onto the farm easily...It was more like dirt and almost soil-based landscapes...You wouldn't be able to manage that if you had any kind of physical disability" (P7).* Farm work was also particularly difficult for older workers and those with pre-existing health conditions. Many older workers continued despite health issues, due to financial necessity, while psychological stressors e.g., unsupportive supervisors, added further difficulties.

### D. Surveillance and spatial privacy concerns

Workers' concerns about workplace-privacy centered around excessive monitoring and unwanted physical proximity. Many workers felt uncomfortable with constant monitoring, leading to further anxiety on the job, e.g., *"I would do whatever he told me to... I would do that. But even if I was doing that right, it would still be wrong in his eyes... So like every task, I wouldn't want him to see" (P7).* Workers also saw close physical distance as both a harassment and (spatial) privacy issue, expressing dislike towards constant close-distance monitoring as a privacy concern, e.g., *"probably when I'm squatting where you have like squats to like pick up some fruits that they are not as tall as you (...) I would really love for my manager not to be monitoring me" (P4).*

## V. RQ2 Findings: Perceptions of robots

While the previous section focused on workers' perceptions of farm work conditions in general, we now turn to their views on robots in farm settings. Workers had varied opinions about the integration of robots into picking-farms.

While some saw potential benefits in reducing workload and providing performance feedbacks, others viewed robots as competitors rather than assistants, potentially affecting worker solidarity.

### A. Robots monitoring progress as a double-edged sword

Several workers appreciated the ability of robots to monitor work progress and provide feedback, as that would make reporting easier and avoid them having to explain themselves, e.g., *"it would ease the amount of ...energy and work inputs. I would have to put into the job and definitely to be able to like monitor my work outputs and probably give feedback or results to my supervisor... So it would be able to save me the stress of having to explain myself..." (P4)*. However, workers were also uneasy about constant monitoring, fearing increased scrutiny and pressure. Many opposed robots recording private conversations or reporting mistakes, while others raised concerns about the transparency of data collection and its impact on worker safety. As one worker put it, *"..if they are recording all the time and sending that to the bosses then I will have much more pressure because I have like a camera videotaping me all the time" (P1)*. Furthermore, workers worried about being held responsible for robot malfunctions, e.g., *"Imagine you forget a bucket on the floor, and the robot smashes it...you'll be responsible, not the robot" (P1)*. However, robot-based monitoring and data-analysis could potentially be used to recognize when accidents were triggered by the robot itself, or when its actions could have made an accident more likely.

### B. Robots perceived as competition rather than assistants

One recurring sentiment was that robots were more like competition than support at work, e.g., *"I'll say competition, we kind of competing with a robot" (P2)*. Some workers felt that robots would be prioritized over human labour, fearing they would be treated with more care and importance than the workers themselves, e.g., *"...They care for their robot and...they make us feel like nothing" (P2)*.

### C. Effects on traditional and human aspects of farming

It was also believed that the introduction of robots would take away the traditional and human aspects of farming, e.g., *"I think it would strange because then it gets less traditional, and I think it loses a bit the beauty of farming" (P1)*. Another traditional aspect of farming is human connection, such as camaraderie built through shared struggles. Some workers feared that increased automation would weaken this bond if robots reduced teamwork, for example: *"with the robots, there'll be less of that because they'll be doing those types of roles. So less kind of camaraderie between team mates" (P7)*.

## VI. RQ3 Findings: Worker-centered robot visions

In this section, we present worker-centered visions and requirements for picking-farm robots that address the concerns presented in previous sections.

### A. Robots for efficient and less straining farms

Many workers envisioned robots speeding up the harvesting while maintaining quality, in a way that could address current stress, e.g., *"They have the method to increase speed and quality...if they pick 30 times faster than us, it could reduce our stress" (P2)*. In general, workers envisioned robots assisting with the current physical hardships of the work, such as heavy lifting, transporting harvested produce, and tidying workspaces. Automated carriers could follow workers to collect produce, while others suggested robots for moving large crates, soil bags, or clearing fallen fruit to keep work areas safe, e.g., *"robot that could push the 300 and 350 kilo boxes...a robot that rolls and smashes fallen apples would keep the floor clear" (P1)*. Workers also suggested that robots could enhance farm efficiency by analysing data to optimize harvesting and productivity, *e.g.,"...if the data and the graphs and the robotics are able to tell us these many strawberries are ripe... I think it would be really useful for like data analysis for farms efficiency" (P7)*.

### B. Robots preventing and responding to accidents

Workers believed that robots could enhance the safety in farms by identifying hazards and ensuring compliance. Some workers wanted robots to detect misplaced tools, fallen objects, and other risks, e.g., *"If the robot could identify something out of place...it would be very helpful" (P4)*. Stability assistance was another theme suggested for robots working at heights, such as by holding stairs and making sure workers do no fall. And others were positive about the use of robots to monitor the use of protective equipment by workers, as a way of putting pressure on employers to provide it (since they often don't), e.g., *"if the government made a policy that they had to be robots telling them if we were wearing PPE then it would probably encourage farms to give out PPE" (P8)*. Workers were also interested in robots that could promptly alert supervisors or colleagues in critical situations and assist with tasks that might be challenging during emergencies, e.g., *" If I'm in an accident, it should call the manager immediately" (P2)*, as well as being able to provide emergency assistance, *"I'd want robots to be trained in first aid" (P4)*.

### C. Robots for an inclusive and enjoyable workplace

Several workers believed that robots could reduce the workload for those with physical limitations and health conditions, e.g., *"it would actually improve that in aspects where they reduce the workload on people that are not exactly physically or health-wise fit do some kind of thing" (P4)*. Participants thus suggested a different vision of task assignment in farm work, which is focused on lifting those that struggle most instead of providing further advantages (e.g., tools, tasks, as seen in Section IV-C) to high-performers. In similar spirit, they saw robots as potential tools to help train newcomers and those that are struggling most, *"so that everyone can handle the same tasks" (P4)*. Workers also thought robots could act as advocates for workers, so as to reduce workplace unfairness and *"save me the stress* *of having to explain myself" (P4)*. Finally, some workers envisioned robots that could improve work environment by playing music or jokes, or mimicking humorous workplace moments. Others believed entertainment could boost morale and productivity, *e.g., "to have something to entertain you while working makes you work faster and find it enjoyable" (P12)*.

### D. Robots improving workplace accountability

Workers saw the potential in robots for improving fairness and reducing unethical practices by monitoring (managers') workplace behaviour and reporting issues such as theft or harassment to worker protection institutions such as unions. As one worker noted, *"Yes, I'd want it to record the manager's unfair shouting so the union could see if it's right" (P3)*.

### E. Privacy-sensitive robots

Workers expressed wanting clear boundaries on when would and would not record data. Consistent with the vision of robots for accountability, participants supported the idea of using robots to ensure managerial fairness, e.g., *"It could record when bosses come, to see if they treat everyone fairly" (P1)*. However, workers opposed excessive surveillance and recording of personal moments, since they *"wouldn't feel comfortable with robots watching me all the time" (P2)*.

## VII. Discussion

### A. Answering the RQs and comparison with existing works

We now discuss and contextualize our findings with respect to earlier studies.

*1) RQ1: privacy, inclusivity, safety:* Workers in our study expressed grave concerns about workplace surveillance, inequities, and compromised safety in current (non-automated) farms—especially for those who are older, disabled, or non-native. While previous studies [24], [25], [32] propose technical solutions for transparent communication and reducing workload, we identify concerns about discrimination and power imbalances which expand the discussion of worker-centered robotics to ethical and sociopolitical dimensions. This exposes a gap in existing *HRI* literature, which rarely addresses how marginalized worker groups (e.g., migrant and seasonal labourers) may be disproportionately impacted by discriminatory practices and managerial control in farm settings.

*2) RQ2: attitudes & concerns about robots:* Our findings reveal mixed attitudes toward farm robots—while workers appreciate the potential to alleviate physical strain, they also worry that increased monitoring and loss of autonomy could erode workplace solidarity. Cheein et al. [17] report optimism among workers in Latin American farms when *HRI* adapt to local tasks, but they overlook psycho-social fears (e.g., erosion of camaraderie or managers prioritizing robots over human well-being) that emerged in our interviews. These concerns further motivate bottom-up methodologies [3], [18], [19], yet also highlight how emotional and cultural concerns (e.g., fear of being outcompeted by robots) remain underexplored in prior *HRI* research.

*3) RQ3: worker-centered visions:* Workers articulated specific design requirements for farm robots. They emphasized tasks that reduce heavy lifting, support safety protocols, and mitigate unethical management practices (e.g., harassment, exploitation). While Cila et al. [16] show that transparent interfaces can build trust, our participants argued that equitable oversight (e.g., monitoring both workers and supervisors) is equally crucial. This finding extends those of Elias et al. [30] by showing the importance of practical worker-focused guardrails (e.g., robust compliance mechanisms) and fair attribution of errors to robots when they happen, which further reflect the deep-rooted social tensions in farm labour environments.

### B. Marginalization and worker vulnerabilities

Our interviews revealed that a majority of fruit-picking workers in the UK endure sexual harassment, verbal abuse, and exploitation tied to discriminatory practices based on race, nationality, gender, or physical ability. Also, managers may leverage power differentials—threatening visa statuses or assigning tasks unfairly—to maintain control. These micro-level abuses align with the findings of Lee et al. [4], Carolan et al. [26] and Bronson et al. [29], who note how automation can exacerbate existing inequalities by reinforcing oppressive hierarchies.

Our interviewed workers were marginalized along various dimensions. Using the *"Wheel of Privilege and Power"* [35] framework to characterize marginalization, we saw how fruit-picking workers in the UK often struggle with the local language, are generally poor, often live in farm-provided accommodation, suffer discrimination related to body size and disability, are of often-discriminated nationalities and ethnicities (e.g., Nigerian, Pakistani), and have vulnerable citizenship status (employer-sponsored or seasonal visa, undocumented). Workers likely to be most affected by robots in fruit-picking farms are thus already at the margins of society, and this aspect of the workforce should be central to HRI design. Without safeguards, new technologies risk intensifying surveillance and exploitation. Conversely, co-designed robotics, paired with robust policies (see Section VII-D), could strengthen accountability (e.g., documenting unethical supervision). This tension makes clear the urgency of integrating social equity into HRI design, so that automation does not make precarious workers even more vulnerable.

### C. Contributions to existing literature

Our results expand the body of current *HRI* research and agricultural robots, which so far has focused strongly on the perspectives of farm managers and technical experts [14], [15] and thus overlooked the lived-experiences of frontline workers. In contrast, we foreground the voices of seasonal and migrant workers—an approach that aligns with the calls for more inclusive, bottom-up methodologies in robotics design [3], [18], [19].

Furthermore, workers' concerns regarding privacy, surveillance, and accountability echo broader discussions in responsible AI and ethical robotics [6], [21]. Specifically, our study highlights several risks (e.g., *technology-induced discrimination* and the *erosion of workplace camaraderie*) which reinforce the need for *transparent*, *participatory*, and *context-aware design practices* [3], [16], [17], [24], [25]. This provides further support to frameworks advocating for human-centered and participatory design in high-stakes environments [5], to ensure that technology supports workers and counter-balances rather than exacerbates inequalities. While previous work notes organizational barriers like high costs or risk aversion [30], we contribute with further social and cultural considerations of farm robots (e.g., solidarity, fear of deportation/job-loss, ethnic/social discrimination).

### D. Recommendations for robot designers and policy makers

In response to our findings we recommend that *designers and researchers*:

- Develop robot capabilities for lifting the physical strains of fruit-picking work, detecting safety hazards, and responding to safety emergencies.
- Give workers control and transparency over privacy to mitigate discomfort and potential misuse.
- Develop robot capabilities that promote human-human teamwork and interaction, preserving human contact and camaraderie.
- Develop entertainment capabilities, such as music or conversation, to improve wellbeing and enjoyment.
- Explicitly involve vulnerable groups (migrant, disabled, older, female workers) in co-design to ensure systems reflect their needs.
- Investigate the utility of robots for effective training of newer and struggling employees, to ensure equitable skill development.
- Develop management-monitoring, and harassment and abuse-reporting tools that avoid fear of retaliation—to address unethical practices, promote accountability, and improve worker conditions by empowering unions with data.

Furthermore, we recommend that *policy makers*:

- Propose policy that enforces equitable workload-distribution, task-allocation and training, preventing marginalization of specific worker groups.
- Propose policy that gives power to workers and unions in the use of robots in farms, for example by enforcing auditing systems that monitor the impact of robots on safety, farm owners and manager's practices, and the compliance with safety standards and workers' rights.
- Develop guidelines that protect social aspects of farm work, preventing robots from increasing social isolation and work dissatisfaction.
- Develop guidelines and regulation on worker-related data capture, analysis and retention, to guarantee personal and sensitive data is not recorded or analyzed, and that data cannot be used by management to continue or exacerbate current exploitation practices.
- Propose policy that enforces transparency and accountability in monitoring, so that workers are aware of what type of data is being gathered by robots and when, and so that workers themselves can have access to that data so they can verify and confront management claims.

### E. Limitations

Our study has several limitations. Participants were recruited through field visits, local contacts, social media, and snowball sampling. While effective, these methods may not fully represent all fruit-picking farm workers. Recruitment faced challenges such as: 1) workers' hesitation to speak openly due to legal status or job security concerns, 2) cash-paid workers feared repercussions (e.g., immigration, job loss), and 3) management was often reluctant to grant access. As a result, our sample was limited to UK-based, self-selecting participants, potentially affecting generalizability. Despite reaching response saturation, limitations include a small sample (N=12) with possible regional and cultural biases. Findings are restricted to fruit-picking farms involving large amounts of manual labour, and may not extend to highly mechanized or large-scale farms. Furthermore, the video probes used to elicit participant responses, while diverse, still depicted a limited range of robotic systems which may restrict the applicability of the findings to other types of agricultural robots or tasks. Future research should incorporate field experiments and a broader, more diverse, sample of participants.

## VIII. Conclusion and Future Works

This paper presented a user study employing semi-structured interviews and a video probe to investigate farm workers' perspectives on robots in agricultural settings, with a particular attention to ethical dimensions that shape workers' environment. Our goal was to identify and articulate worker-centered requirements for farm robotics. Our analysis revealed critical perspectives in the areas of *workplace-conditions* (e.g., precarious work conditions, fears, harassment, exploitation), *privacy* (e.g., surveillance concerns, privacy preferences for robots), *inclusivity* (e.g., prejudice, unfairness, workload imbalances and discriminatory practices, barriers to farm work faced by worker groups', perceived effects on solidarity), and *safety* (e.g., health and environmental well-being concerns, accountability and errors, workplace hazards).

We proposed several design and policy recommendations to address these concerns and developed specific actionable, worker-centered visions and requirements for farm robots. These visions included robots enhancing workplace inclusivity, entertainment robots, robots for training, robots for data analysis and farm efficiency, robots for monitoring safety compliance and identifying hazards, emergency response robots, and privacy-sensitive robots. Alongside situating these findings within the existing literature, we highlight several limitations that future work could address. Moving forward, we plan to engage workers directly in the co-design and prototyping of select concepts introduced in this paper, and to evaluate their real-world impact.

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