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REVIEW

AI-enabled foraging in the forest: disrupting efficiency-driven sociotechnical imaginaries in wild foraging

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Abstract
This paper examines the social, ethical, and governance implications of introducing AI- and drone-based automation into wild berry foraging in Finland. Drawing on expert interviews and Science and Technology Studies (STS), particularly sociotechnical imaginaries and co-production, it focuses on an efficiency-driven imaginary embedded in the FEROX project, where automation and data-driven optimisation are positioned as solutions to labour shortages and underutilised forest resources. Rather than analysing this imaginary in isolation, the paper shows how it becomes disrupted when confronted with shifting labour conditions, cultural practices, and environmental values. Interview findings from foragers, engineers, ethicists, and forest scientists reveal how AI-enabled technologies intersect with existing socioecological dynamics in ways that generate tension and contestation. In particular, recent restrictions on seasonal migrant labour expose the fragility of assumptions underpinning the system, while local traditions, ecological ethics, and concerns about surveillance and data governance challenge efficiency-oriented approaches to automation. The paper argues that AI-enabled foraging technologies are not neutral tools but are shaped by, and reshape, the social and ecological contexts in which they are deployed. By foregrounding these tensions, it calls for participatory, culturally informed, and ecologically sensitive approaches to AI design and governance in natural resource settings.

Keywords Sociotechnical imaginaries · AI governance · Automation and labour · Environmental AI · Ecological practices

1 Introduction

Artificial intelligence and autonomous systems are increasingly being deployed beyond urban, industrial, and platform-based settings, including in natural and ecological environments. In Finland's forests, AI-enabled automation is now being explored as a means of supporting wild berry foraging through the use of drone-based sensing, algorithmic mapping, and predictive analytics. These systems promise to improve efficiency, safety, and productivity in a sector facing labour shortages and economic uncertainty. Yet their deployment also raises fundamental questions about governance, data use, and the reconfiguration of long-standing cultural and ecological practices. This paper examines how AI- and drone-enabled automation in wild berry foraging is understood, negotiated, and problematised by different stakeholders, drawing on expert interview material and situating these dynamics within broader debates on automation governance, environmental ethics, and the societal implications of AI beyond conventional industrial contexts.

In Finland, wild berry foraging has long played an important economic and cultural role, yet only a small proportion of the annual berry yield is harvested through organised trade (Turtiainen 2021). Declining local participation, low economic incentives, and the physically demanding nature of the work have led the industry to rely increasingly on seasonal migrant labour, particularly from Thailand (Tikkanen 2015; Turtiainen et al. 2005). In response to these labour dynamics and operational challenges, the EU Horizon project FEROX introduced an AI-enabled and drone-based system designed to improve berry location accuracy, enhance worker safety, and reduce physical strain.

The FEROX project is a Horizon Europe research and innovation initiative involving a multidisciplinary consortium of nine partners across seven countries. The consortium

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spans the full competence chain, from technology development to use-case evaluation and demonstration, and brings together universities, research institutions, small and medium-sized enterprises (SMEs), and an end-user association. It combines expertise in robotics, artificial intelligence, forestry, human factors, and ethics, with the aim of developing and evaluating drone-based systems to support sustainable and efficient wild berry harvesting. As an EU-funded project, FEROX is shaped by broader policy priorities around innovation, sustainability, and technological responses to labour supply challenges in rural and natural resource sectors. This institutional and policy context plays an important role in shaping the efficiency-driven sociotechnical imaginary underpinning the system.

The system combines drone-borne sensing technologies with algorithmic mapping and predictive analytics to guide harvesting and monitor working conditions. Originally envisioned as a technological response to workforce shortages, particularly in relation to seasonal migrant work, the system embeds assumptions about productivity, optimisation, and the continued availability of a flexible labour force. Recent policy changes restricting seasonal migration have disrupted these assumptions, transforming AI-assisted foraging from a seemingly technical intervention into a contested sociotechnical development situated within shifting labour, cultural, and regulatory contexts.

To examine these tensions, this paper draws on Science and Technology Studies (STS), particularly the concepts of sociotechnical imaginaries and co-production (Jasanoff 2004; Jasanoff and Kim 2009). Sociotechnical imaginaries refer to collectively held and institutionally stabilised visions of desirable futures that are animated by shared understandings of social order and technological progress. In this context, the analysis focuses on an efficiency-driven sociotechnical imaginary, in which automation and data-driven optimisation are framed as solutions to labour shortages and underutilised forest resources. Co-production further highlights how such technological systems are shaped by, and in turn reshape, social relations, labour practices, and governance arrangements. Applying this framework allows the analysis to move beyond viewing AI-enabled drones as neutral tools and instead to examine how algorithmic mapping, monitoring, and prediction reconfigure relationships between humans, technology, and forest environments. This perspective foregrounds how efficiency-oriented automation imaginaries intersect with local foraging traditions, ecological ethics, and concerns about autonomy, surveillance, and control. This paper adopts a reflexive, empirically grounded approach to examine AI-enabled foraging through the lens of sociotechnical imaginaries and co-production.

Despite growing interest in AI-enabled automation as a response to labour shortages and efficiency challenges, little is known about how such systems are interpreted, negotiated, and contested when introduced into culturally significant and ecologically embedded practices. In the context of Finnish wild berry foraging, AI-assisted technologies intersect with long-standing traditions, informal governance arrangements shaped by "Everyone's Right" (jokaisenoikeudet), the contemporary Finnish term for the Nordic right to roam, historically referred to as "Everyman's Right" (jokamiehenoikeudet), which grants public access to nature, including the right to forage for wild berries regardless of land ownership, and complex labour relations involving seasonal migrant workers (Tikkanen 2015; Turtiainen 2021). The FEROX system illustrates how AI-enabled mapping, monitoring, and predictive analytics embed particular assumptions about productivity, labour availability, and control, assumptions that have become increasingly unstable in light of recent policy changes affecting migrant labour. Drawing on expert interviews and STS concepts of sociotechnical imaginaries and co-production, this paper explores how different stakeholders understand and evaluate AI-enabled foraging, how concerns about governance, surveillance, environmental ethics, and labour relations shape responses to automation, and what these tensions reveal about the broader challenges of governing AI in non-industrial and ecological settings. Rather than analysing sociotechnical imaginaries in isolation, this paper examines how an efficiency-driven imaginary becomes disrupted when confronted with shifting labour conditions, culturally embedded foraging practices, and evolving environmental and governance concerns.

Section 2 outlines the empirical and conceptual background, introducing the AI-enabled and drone-assisted foraging system, the dynamics of migrant labour in the Finnish berry sector, and the concept of sociotechnical imaginaries. Section 3 details the interview-based qualitative methodology. Section 4 presents the empirical findings, focussing on imaginaries of efficiency and productivity, cultural practices and community dynamics, privacy, surveillance and trust, environmental impacts, and labour and governance tensions. Section 5 discusses how these findings reveal misalignments between AI-enabled technology design and evolving social, cultural, and policy contexts. Section 6 concludes by reflecting on the implications of these misalignments and arguing for participatory, culturally informed, and ecologically sensitive approaches to the design and governance of future AI-enabled technologies.

2 Background

2.1 The FEROX AI-enabled foraging system

The FEROX project, driven by its commitment to improving both worker well-being and productivity, seeks to transform the collection of wild berries and mushrooms through

AI-enabled and drone-based automation. Harvesting these forest products is highly challenging due to the diverse and unpredictable conditions of forest habitats (Yalcinkaya et al. 2024). Successful foraging requires significant physical strength, patience, and endurance to cope with weather that can range from cold to hot and dry, or even heavy rain during the collection season. Pickers' earnings depend on the quantity and quality of berries they gather each day, which in turn rely on luck or intimate prior knowledge of where the most fruitful areas are located. Currently, the choice of picking locations is guided primarily by local experience and observations of seasonal weather patterns, which can result in uncertainty and variability in harvesting outcomes.

The FEROX system was developed to address several interrelated challenges in wild berry foraging. First, it aims to improve berry location accuracy by combining drone-based sensing with AI-enabled data processing to generate detailed three-dimensional maps of forest environments (Trybała et al. 2024a). These maps help identify areas where berries are ripe and abundant, thereby optimising harvesting routes and alleviating the cognitive demands on pickers (Riz et al. 2024). Second, the system seeks to improve working conditions for berry pickers. By assisting with navigation and reducing the need for strenuous movement through dense and challenging terrain, it allows pickers to focus their efforts on gathering berries more efficiently, minimising physical strain (Fletcher et al. 2023). Third, a key feature of FEROX is its emphasis on enhancing worker safety. In "WatchDog" mode, the system routinely monitors workers' locations and status, enabling rapid intervention or delivering aid (e.g. water or medical assistance) if a picker becomes lost or injured (Ballester et al. 2025). This continuous monitoring provides an additional layer of safety oversight and supports real-time supervision, while also raising questions about data use, oversight, and worker autonomy.

At its core, FEROX employs a fleet of autonomous drones equipped with a range of sensors, including LiDAR for mapping, RGB cameras, and hyperspectral sensors for advanced environmental and crop monitoring (Trybała et al. 2024b). The drones collect data on berry growth patterns and forest conditions to inform both individual pickers and the broader industry. Under-canopy drones use simultaneous localisation and mapping (SLAM) to navigate dense vegetation and generate high-resolution data. These drones capture thousands of images to precisely detect berry locations, even in visually complex environments (Riz et al. 2024). Meanwhile, heavy-weight drones support logistics by transporting harvested berries, reducing physical strain on workers and increasing overall efficiency.

The AI system processes this data using advanced imaging and machine learning algorithms, enabling automated detection and classification of berry types, even under challenging conditions such as variable lighting and dense foliage. Predictive analytics estimate yields and identify optimal harvesting zones, guiding pickers to areas of highest productivity (Hyyppä et al. 2026). Additionally, real-time map generation continuously updates berry distribution data, which is accessible via a smartphone application to support in-field navigation and decision-making. Integrated worker monitoring, enabled by wearable sensors, tracks movement and activity patterns to further enhance safety and operational oversight.

2.2 Labour dynamics

The low wholesale price of berries does not make commercial picking a particularly attractive source of income, even though foraged berry earnings are tax-exempt for all pickers (Tikkanen 2015). The shortage of a domestic workforce threatens the economic sustainability of the sector and has increasingly motivated interest in technological and AI-enabled solutions. Within the FEROX project and related discussions, AI-enabled and drone-assisted technologies are primarily framed as tools to support workers by improving efficiency, safety, and working conditions, for example by reducing the time spent locating berry-rich areas and enhancing safety in remote forest environments. Because demand for wild berries consistently exceeds local supply (Tikkanen 2015), Finnish berry companies have long relied on foreign seasonal workers, primarily from Thailand and Ukraine. Most berries ripen in late summer, a period that conveniently coincides with the monsoon season in Thailand when work opportunities at home are scarce (Sõukand and Kalle 2016).

For many Thai pickers, coming to Finland represented a significant economic opportunity: in a good berry year, they could earn in 2.5 months what they might make in an entire year at home, while the most successful pickers could earn the equivalent of up to 15 years of income (Richards and Saastamoinen 2010; Vaarama 2021). However, this potential comes at a substantial physical and financial cost. Earnings depend on yield, quality, and berry weight, prompting workers to endure extremely long days, often beginning at 4:30 am and lasting up to 14 h (Steensig 2021). Working conditions are physically demanding, requiring strength and endurance in variable weather. Language barriers and unfamiliarity with the terrain further increase the risks of injury or becoming lost. Additionally, yield variability from year to year means pickers face significant uncertainty about whether their earnings will cover travel and living costs. According to an interviewee in Piha (2022, 23), berry pickers face considerable uncertainty, as they have no way of knowing in advance whether the harvest will be sufficient to make their trip to Finland profitable or if they will end up leaving empty-handed.

From 2005 to 2023, the number of Thai pickers grew substantially, making them Finland's largest group of seasonal migrant workers, with around 4,000 pickers annually (Wacklin 2021; Lacuna-Richman 2021). However, recent policy changes have complicated this arrangement. Due to increasing concerns about exploitation and human trafficking, Finland's Foreign Ministry stopped accepting berry-picking visa applications from Thailand, Cambodia, and Myanmar.

Thai berry pickers have long been heavily dependent on middlemen and berry companies for nearly all essential needs, leaving them vulnerable to exploitation and, in some cases, conditions akin to human trafficking (Yle News 2024a, b). They were often forced to work long hours for low pay, becoming indebted due to travel and other upfront costs (Haapasaari et al. 2024). Their exploitation was manifest in inhumane working and living conditions, including confiscation of passports and excessive charges for accommodation and meals (Wallis 2024). Housing was frequently in disused schools or other abandoned buildings, which were overcrowded and lacked adequate hygiene facilities. Food was often poorly provided, stored without refrigeration, and prepared in unhygienic conditions (Rosenkrantz Paasch 2025).

In addition, pickers faced further financial burdens, such as high rental fees for old vans needed to reach the forests and unfair charges for minor damages. A 2024 report by HEUNI (the European Institute for Crime Prevention and Control) details how berry-buying companies tampered with weighing scales to underreport harvest weights, thereby reducing pickers' pay (Haapasaari et al. 2024).

In response to these abuses, the Finnish Immigration Service (Migri) introduced stricter oversight of employment conditions, including monitoring wages and accommodation standards. Although pickers could theoretically apply for entrepreneur permits (a type of residence permit in Finland that allows individuals to work as self-employed entrepreneurs rather than as employees), this remains rare due to complex legal requirements (Helsinki Times 2024). The 2021 Berry Act[1] aimed to improve protections by introducing a minimum daily earning requirement of €30, transitioning the sector from an informal system to a more regulated, contract-based model prioritising labour rights and welfare. From 2024 onward, Thai pickers could no longer apply for a Schengen tourist visa for a maximum of 3 months; instead, they have been required to obtain work-based residence permits, a shift that led to a sharp decline in worker numbers, with only 800 pickers participating that season. By 2025, new legislation further required that foreign pickers hold seasonal work permits and be formally employed through contracts with berry companies (Ministry of Economic Affairs and Employment 2025). According to Finnish authorities, these new rules aim to sever the link between berry picking and tourism, enforce formal employment contracts, and guarantee minimum income protections (InfoMigrants 2024). These shifts fundamentally altered the labour landscape on which the FEROX system and its underlying AI-enabled automation assumptions were originally predicated. Designed to enhance efficiency and support a large, stable migrant workforce, FEROX now finds itself misaligned with emerging realities that emphasise local engagement and stricter labour protections.

2.3 Sociotechnical imaginaries and co-production

Science and Technology Studies (STS) offers valuable tools to understand how technological systems and social contexts shape one another. Central to this analysis is the concept of *sociotechnical imaginaries*, defined as "collectively held, institutionally stabilised, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff and Kim 2009, 6). These imaginaries guide which technological solutions are developed, how they are legitimised, and whose interests they ultimately serve.

The FEROX system is not itself a sociotechnical imaginary but rather a material manifestation of one, enacted through AI-enabled automation. It embodies a vision centred on optimised productivity, economic efficiency, and worker safety through data-driven and algorithmic means. It is based on the ongoing availability of migrant labour, particularly Thai seasonal pickers. This imaginary envisions a future in which labour shortages are addressed through automation and data-driven precision, enabling sustainable and profitable use of forest resources while alleviating physical strain on workers. It frames technological development as a solution to labour shortages and harvesting inefficiencies. Although this imaginary may not be widely debated in public forums, it is stabilised within policy discussions, research funding structures, and industrial strategies. Sociotechnical imaginaries are not fixed or determinative; rather, they can be challenged and destabilised when they encounter changing social, legal, and material conditions, such as Finland's recent migration and work permit reforms. In this case, these changes do not necessarily transform the underlying imaginary of efficiency and optimisation, but they do expose its assumptions and reveal its limitations in practice. The result is a technological system that becomes misaligned with evolving needs and values, as tensions emerge between technological design and shifting labour and policy contexts.

[1] Picking of natural products under the Berry Act—Tyosuojelu.fi—Occupational Safety and Health Administration.

Closely linked to imaginaries is the concept of *co-production*, which emphasises that technology and society are not separate but evolve together (Jasanoff 2004; Norström et al. 2020; Bandola-Gill et al. 2023). Technologies are not neutral tools; they embody assumptions about social order, labour relations, and cultural values (Winner 2017; Whelchel 1986; Miller 2021; Heyndels 2023). In the case of FEROX, the system was co-produced within a context that assumed a stable migrant workforce and prioritised efficiency over cultural and environmental considerations. As new policies restrict migrant labour and local cultural practices gain prominence, these assumptions are made visible and challenged in practice, revealing their limitations.

This framework helps illuminate how actors involved in berry picking—engineers, policymakers, local and migrant pickers—navigate and contest these imaginaries. It allows us to analyse how visions of the future become embedded in design choices and how those choices, in turn, shape and are shaped by shifting social, cultural, and environmental dynamics. This paper analyses how foraging, as both a cultural and economic practice, is being reshaped by AI-enabled automation and drone technologies, and how this process is contested by various stakeholders.

3 Methodology

3.1 Study design

This study employs a qualitative research design based on expert interviews and thematic analysis to examine how AI-enabled and drone-assisted technologies for wild berry foraging are understood, evaluated, and negotiated by different stakeholder groups. A qualitative approach was selected to capture the meanings, values, and assumptions embedded in participants' experiences and professional expertise, particularly in relation to sociotechnical imaginaries, labour relations, cultural practices, and environmental ethics. Expert interviews are especially suitable for exploring emerging technologies and complex sociotechnical systems, as they enable access to practical, experience-based knowledge of how foraging is carried out.

3.2 Participants and sampling

The study draws on 15 expert interviews with participants whose professional backgrounds include wild food foraging, AI and robotics ethics, drone and robotics engineering, ecology, forest sciences, and agricultural economics. Participants represented a wide range of stakeholder groups, including commercial foragers, recreational foragers, environmental educators specialising in foraging, representatives of commercial berry companies, and researchers and members of non-governmental organisations working on foraging, drone technologies, and ethical innovation. None of the interviewees were directly involved as core members of the FEROX project; however, several participants were identified through project partners due to their relevant expertise in foraging, drone technologies, and governance.

Participants were recruited using purposive sampling to ensure relevance to the research questions. Experts were identified through a targeted review of grey literature and relevant organisational websites, complemented by recommendations from FEROX project partners. Snowball sampling was subsequently employed, whereby interviewees suggested additional experts with relevant expertise. This strategy enabled the inclusion of diverse perspectives across technical, ecological, ethical, and cultural domains (Table 1).

3.3 Procedure

Prior to the interviews, all participants received an accessible written explanation of the FEROX system, outlining its purpose, AI-enabled core functionalities, and intended applications. This step was necessary because many participants were unfamiliar with the use of AI-enabled systems and drones for wild berry picking and initially found it difficult to envision what such a system would entail.

Interviews were conducted online using video conferencing platforms selected by the participants (e.g. Microsoft Teams, Skype, Google Meet). All interviews were conducted in English and lasted between 34 min and 1 h and 24 min. With participants' informed consent, all interviews were audio-recorded and later transcribed verbatim. Participants were assured anonymity and confidentiality prior to participation.

3.4 Materials

Data were collected using systematised expert interviews, a form of semi-structured interviewing designed to elicit experts' technical, experiential, and procedural knowledge of AI-enabled automation and its governance implications (Bogner et al. 2018). A semi-structured interview guide was developed in advance, allowing for comparability across interviews while retaining flexibility to explore emerging topics.

The interview guide was adapted for each stakeholder group and, where relevant, tailored to individual participants' specific expertise. It covered themes including:

- foraging practices and cultural meanings of berry picking
- the perceived benefits of AI-enabled and drone-assisted foraging, particularly regarding efficiency, safety, and working conditions

Table 1 The participant's profiles

Unique code	Role	Gender	Nationality	Area of expertise	Interview duration
P1AC	AI Ethics expert	Female	English	Philosophy, AI Ethics, practical ethics, and Machine Ethics	55:47
P2AC	STS researcher	Male	Dutch	Science and Technology Studies, Social Informatics	1:24:19
P3AC	Safety researcher	Male	English	Organisational Safety, Ethics, Agriculture and Forest Sciences	1:08:53
P4AC	Agricultural economist	Male	Greek	Agricultural Economics, Sustainable intensification of farming systems, Innovation in agriculture	1:06:35
P5FO	Forager educator	Female	Finnish	Forager, biologist and herbalist. Organises workshops, foraging walks, and lectures about mushrooms, berries and herbs growing in Finnish forests and meadows. Teaches wild food identification and preservation, everyone's right and sustainable foraging	1:00:43
P6FO	Recreational forager	Female	Finnish	Recreational picker. Wilderness and nature guide	34:00
P7AC	Sustainable agriculture researcher	Male	English	Sustainable Agriculture and Agroforestry. Socio-economic and policy analysis	1:03:26
P8FO	Forager entrepreneur	Female	Finnish	Forager, entrepreneur berry company paying a fair wage	1:02:27
P9FO	Recreational forager	Female	Finnish	Young recreational picker	40:18
P10AC	Drone engineer	Male	Vietnamese	Advanced Manufacturing Technology, Robotics, drones	1:08:35
P11FO	Recreational forager	Female	Finnish	Berry forager, recreational picker	1:14:43
P12AC	Forest scientist	Male	Finnish	Researcher National Resources Institute	41:47
P13AC	Environmental engineer	Female	Spanish	Environmental Systems Engineering. The use of emerging technologies (drones) for robust environmental monitoring	1:01:02
P14FO	Forager entrepreneur	Male	English	Forager, entrepreneur	57.:04
P15AC	Drone engineer	Male	Greek	Autonomous and Cyber-Physical Systems. Drones	1:06:29

- issues of trust, acceptance, and transparency related to AI, robotics, and data use
- concerns surrounding privacy, surveillance, and data governance
- environmental impacts and sustainability, and
- future visions for innovation and governance in forest-based technologies.

The authors are involved in the FEROX project as researchers, providing contextual insight into the system under study. At the same time, the study was designed to critically examine the system from a socioethical perspective and drew on the broad range of stakeholder perspectives beyond the immediate project consortium.

3.5 Data analysis

The interview data were analysed using reflexive thematic analysis following the approach developed by Braun and Clarke (2006, 2021). Analysis began with an active and repeated reading of all interview transcripts to achieve familiarity with the dataset. During this phase, the primary researcher generated an initial set of descriptive codes. Codes were defined as "analytically interesting ideas, concepts, or meanings associated with particular segments of data" (Braun and Clarke 2021, 53).

Subsequently, all relevant excerpts were systematically coded, and preliminary themes were developed. A theme was understood as "a pattern of shared meaning organised around a central concept" (Terry et al. 2017; Braun and Clarke 2021). The initial themes were then iteratively refined through continuous comparison between the emerging thematic structure and the raw data. This process involved multiple cycles of rereading and reevaluating coded excerpts within each theme to ensure internal coherence and conceptual clarity. Selected quotes are used to illustrate key themes identified across the dataset.

Analytic discussions with the co-author were used to critically assess and refine the thematic structure. As part of this iterative process, themes and subthemes were reformulated where necessary, and excerpts were reclassified accordingly. This process continued until a coherent and comprehensive set of themes and subthemes emerged that accurately reflected participants' perspectives on the use of

AI-enabled and drone-assisted technologies for wild berry picking (Table 2).

Coding and theme development were conducted by a single researcher, a well-established and accepted practice within reflexive thematic analysis (Braun and Clarke 2021, 55). Intercoder reliability metrics were not calculated; instead, analytical rigour was ensured through reflexive review and collaborative interpretation, consistent with reflexive thematic analysis (Terry and Hayfield 2021).

3.6 Ethical considerations

All participants were informed that their contributions would be treated confidentially in accordance with the General Data Protection Regulation (EU GDPR) and the UK Data Protection Act 1998. Interview transcripts were anonymised by removing identifying information such as names, ages, and locations. Under no circumstances were identifiable responses shared with third parties.

Audio recordings and transcripts were securely stored on a password-protected hard drive at Cranfield University and will be deleted once they are no longer required. The study was reviewed and approved by the University Research Ethics System.

Although the interviews were conducted prior to policy changes restricting Thai berry picker visas, participants' accounts reveal underlying assumptions about labour, belonging, and technological futures that remain highly

Table 2 Overview of themes and subthemes

Themes	Subthemes
1. Key benefits	a. Improved efficiency in locating and harvesting berries b. Potential to reduce physical strain and risks for workers c. Worker (physical/mental) health & safety d. Productivity enhancement e. Accessibility to hard-to-reach places
2. Trust in technology	a. Trust in the technology for immediate tasks vs. broader socio-ecological consequences b. Building trust through transparency c. Concerns about data ownership, usage, and trust in data companies
3. Privacy and surveillance	a. Potential misuse of drones for unauthorised surveillance b. Workers' and local populations' privacy concerns c. Worker productivity monitoring
4. Risks and challenges	a. Risks of hacking and misuse by hostile actors b. Safety issues for drones in dense environments
5. Environmental impacts	a. Potential disturbance to wildlife and ecosystems b. Concerns about over-harvesting and its impact on regeneration c. Wildlife adaptation d. Noise pollution e. Accidental damage f. Sustainability concerns
6. Community dynamics	a. Generational differences b. Cultural practices c. Social tensions between local foragers and commercial pickers
7. Adoption and education	a. Importance of educating local communities b. Local resistance c. Training of workers d. Balancing community involvement with operational efficiency e. Accessibility for small communities
8. Role of governance	a. Need for regulations and legislation to manage privacy and ethical concerns b. Stakeholder involvement: NGOs, governments, and communities in shaping drone policies c. Dual-use concerns (military, border surveillance) d. Resource management
9. Labour dynamics	a. Fair distribution of benefits/economic disparities/monopolisation b. Balancing ethics and productivity
10. Future innovations	a. Expanded applications: Potential for drones to aid in conservation efforts (e.g. rewilding, seed distribution, environmental monitoring) b. Wildlife and habitat monitoring c. Improved drone technology. Minimising risks of wildlife desensitisation due to drone noise and presence d. Increased safety e. Predictive analysis

relevant. This retrospective perspective enables an examination of how sociotechnical imaginaries embedded in the FEROX project intersect with, and are challenged by, evolving social and policy contexts.

4 Results

4.1 Efficiency, productivity, and automation imaginaries

The development of the FEROX AI-enabled and drone-assisted system embodies a sociotechnical imaginary focussed on efficiency and productivity. At its core lies the belief that foraging, especially wild berry picking, can be approached as an economic and technical challenge to be optimised. AI-enabled technologies such as precision yield mapping and real-time monitoring promise solutions to labour shortages and underutilised forest resources. This imaginary frames berry picking as an economic system to be streamlined, sidelining its cultural significance and embedded local traditions. Whilst promising increased profitability and improved safety for workers, especially Thai seasonal pickers, it also generates tension. As the AI ethics expert remarked: *"I think there's an art behind foraging. That dimension of it could disappear. It's about maintaining traditions. It's the tradition that will be lost, I think. Could be lost*" (P1AC). Such sentiments highlight alternative values of autonomy, experiential knowledge, and connection to nature.

By prioritising economic efficiency, this vision marginalises these alternative values, illustrating how sociotechnical imaginaries not only define solutions but also what problems matter. Success becomes measured in kilos harvested and profits rather than cultural meaning or personal agency. This instrumental view aligns with broader techno-economic logics privileging standardisation and predictability over diversity and spontaneity.

Historically, the industry has relied heavily on foreign seasonal pickers (between 2000 and 4300 annually until 2023) who harvested up to 95% of commercial yields (Singh et al. 2021; Piha 2022). Without them, most berries would remain unharvested (Tikkanen 2015). Meanwhile, fewer than a quarter of berries are picked by Finns through organised trade channels (Finnish Food Authority 2021). This dependence on migrant labour and the push for technological solutions are intertwined responses to the same efficiency-driven imperative. Recent reductions in Thai seasonal labour further expose the imaginary's fragility. In 2024, Thai picker numbers declined sharply, reducing the total volume of berries purchased by organised trade, despite the higher involvement of Finnish pickers (Helsinki Times 2025). This shift challenges assumptions about a stable migrant workforce and forces a reevaluation of whose labour, and relationships with the forest, are supported by technological interventions.

Despite requiring no cultivation, only about 10% of wild berries are harvested annually in Finland (Turtiainen 2021; Steensig 2021). This underutilisation is often cited to justify optimisation efforts, framed as bolstering food security and reducing reliance on imports during crises. However, this narrative conflates commercial value with national resilience, neglecting the broader socio-cultural significance of foraging. Many Finns view commercial wild berry picking as overly structured, clashing with the ethos of Everyone's Right, which values open access and unstructured nature experiences. It applies to visitors from abroad and covers berry picking not only for personal use but also for commercial purposes (Ministry of the Environment 2016; Yle News 2023). The introduction of AI-enabled and drone-assisted systems risks deepening these tensions by further systematising the practice.

Facing labour shortages, stakeholders confront a choice: increase reliance on foreign workers or embrace automation to reduce human demands. Drones promise to boost productivity by supporting pickers with mapping, heavy lifting, and improved safety, potentially attracting new local actors, such as hobbyists or hikers, into commercial foraging and expanding harvest volumes (Finnish Food Authority 2021). However, this will not be easy: "*I have a friend. She's a professional picker and every summer she has someone who comes and wants to train to also be a picker. And they are there two weeks and then like "I'm done!", it's too much hard work. So you need to also have a passion for being in nature and for the picking in general*" (P5FO, forager educator).

The promises of AI-enabled and drone-assisted systems further depend on accessibility and affordability. The STS researcher said: "*If you have a lot of this technology, it still will be very expensive to use them on a large scale and then in the end companies will profit from it, and the small parties in the market will disappear. I think that is an economic law*" (P2AC). If drone systems remain costly, they risk reinforcing inequalities and deepening the commodification of natural commons. These dynamics also create new business opportunities for EU companies to industrialise wild foraging under the guise of "sustainable" productivity. The FEROX project illustrates that the pursuit of efficiency is not just technical but a social project shaping visions of the future. It privileges economic gain, standardisation, and control, while sidelining cultural practices, ecological relationships, and non-commercial values. Attending to these dynamics helps us understand how technological interventions in wild foraging actively reshape the social and ecological landscapes they enter.

4.2 Cultural practices and community dynamics

In Finland, wild berry foraging is deeply woven into cultural traditions, embodying values of freedom, self-reliance, and intimate connection with nature. For many recreational pickers, foraging is not simply a means of obtaining food but a way to sustain family customs and nurture personal solitude in the forest. As one participant described it: "*Nature is a place where we want to be in peace. We want to be there in quietness. We want to listen to the sounds of the nature. […] I think that we Fins are forest people, so the forest is kind of a sacred place for us. So maybe we don't want man-made things there*" (P5FO, forager educator). From an STS perspective, the introduction of AI-enabled and drone-assisted technologies disrupts these culturally embedded practices by inserting external control, surveillance, and efficiency-driven logics into an activity traditionally defined by spontaneity and individual intuition. Many participants feared that such technologies risk undermining the "spirit of foraging," transforming it from an experiential, self-directed practice into a commodified and regulated process.

Generational tensions illustrate how technological imaginaries co-produce cultural meanings. Younger foragers expressed some openness towards AI-enabled and drone-assisted technologies if they enhanced safety and exploration: "*Because they like to play games and stuff on their computers. And that will be a nice way to, like, combine exercise and computing and something with that, like, electronic*" (P9FO, recreational forager), while older foragers often viewed them as an infringement on autonomy and ecological knowledge. This divergence underscores how technological interventions reshape social worlds and reconfigure relationships to local ecologies.

Foraging is not merely a recreational pastime but part of national identity and cultural heritage (Hall 2013). Historically driven by necessity and closely intertwined with farming, hunting, and fishing, foraging has transformed since the industrial and green revolutions into a lifestyle practice valued for its connection to nature and the joy of "the hunt" (Giraud et al. 2021). Today, many rural Finnish berry harvesters are older individuals who pick primarily for personal or community use rather than for sale (Piha 2022). "*Senior citizens are so eager to pick berries because they have a lot of time yeah, no small kids, no career anymore*" (P12AC, forest scientist). Whilst professional pickers benefit from tax exemptions (Tikkanen 2015), Finnish nationals often perceive commercial berry prices as too low to justify the strenuous work involved (Piha 2022). Payment rates are a key factor in encouraging domestic harvesting, with price identified as central to increasing participation amongst Finnish pickers (Helsinki Times 2025).

Despite its declining economic necessity, foraging supports local food self-provisioning, low-impact lifestyles, and ecological resilience (Smith and Jehlička 2013). Wild foods are often more nutritious and less environmentally burdensome than industrially farmed alternatives. However, participants argue that as traditional foraging practices fade, so too does the tacit ecological knowledge accumulated over generations: "*Identifying the right berries, you can imagine that someone's trained 20 years to be able to do that, and it's almost an art. And I worry that workers might feel they've been replaced rather than facilitated*" (P1AC, AI ethics expert). Kalle and Sõukand (2016) describe this loss as "unlearning debt," where knowledge remains in living memory but is no longer practiced or passed down. Knowledge that was once place-based and experiential, taught through observation and imitation, is increasingly transmitted through abstract sources like books and online guides (Schunko et al. 2021). This erosion of practical ecological knowledge risks unsustainable harvesting practices, especially as new, inexperienced foragers may concentrate on single species or overexploit particular sites (Teixidor-Toneu et al. 2023; Schunko et al. 2021). Sustainable harvesting depends on respecting ecological renewal capacities and applying what many foragers describe as "common sense" to avoid depleting resources (Giraud et al. 2021; Teixidor-Toneu et al. 2023). Whilst definitions of sustainable practices remain subjective, experienced foragers emphasise restraint and long-term care: "*We cannot take everything from all the places, and what I teach at my foraging events is that we only pick a maximum one-third of the species in one location*" (P5FO, forager educator).

At the same time, foraging fosters stewardship and deeper relationships with local ecosystems. Studies highlight how foraging reinforces a sense of ownership and responsibility towards nature, enhances environmental awareness, and provides shared social experiences (Hall 2013; Schunko et al. 2021; Aziz et al. 2024). As Giraud et al. (2021, 21) put it, "Foraging can facilitate respectful relationships between humans and nature, thereby contributing to nature conservation in general."

New technologies such as AI-enabled systems and drone-assisted mapping could play an ambiguous role in this context. On one hand, they may support newcomers by providing detailed information about berry locations and conditions, potentially democratising access to foraging knowledge. On the other, they risk intensifying commodification pressures and further disconnecting foraging from its embodied, place-based cultural roots. The challenge, then, lies in ensuring that such technologies complement rather than replace the relational and ecological dimensions of foraging. By situating drone adoption within these cultural and community dynamics, we see that technological interventions actively shape, and are shaped by, existing social practices and cultural values. In doing so, they redefine what it means to participate in and care for local ecologies.

4.3 Privacy, surveillance, and trust

Privacy concerns around AI-enabled and drone-assisted systems reveal fundamental tensions between technological innovation and cultural values of autonomy and trust. Across stakeholder groups, pickers voiced strong worries about surveillance and loss of control. Many feared that drones could capture images, track movements, or expose treasured foraging locations. The personal and often secretive nature of foraging emerged strongly in participants' reflections: "*It's very important for Finnish people, like a cultural thing, that you have like your own spots where you go to pick berries and you don't tell no one where they are*" (P8FO, forager entrepreneur). One picker shared a striking example of how closely guarded certain berry-picking locations can be: "*I know there's a family who had a friend coming over and they were 'OK. Let's go berry picking.' They had to blindfold her, the friend, so she would not… And she had no idea where they were because it wasn't a forest that she'd ever been. And she would never find it. But it was a secret for the family, for like generations*" (P5FO, forager educator). Another participant highlighted the deep emotional connection that can form over time: "*This is connected to psychological ownership, you don't own the land, but you have been picking berries there for 10 years and you probably have spent a lot of time to find them. You have this psychological connection, and you start to feel that this is my place*" (P12AC, forest scientist). Such accounts reveal how foraging is not just about resource collection, but about place attachment and tradition. Introducing drones into this context risks turning a deeply personal and autonomous practice into a monitored, datafied process. The forest, once a space of solitude and self-directed engagement, becomes a site of potential surveillance, undermining its role as a refuge from social and technological oversight.

Concerns about "being watched" speak to deeper issues of autonomy, dignity, and the right to engage with nature without oversight: "*It's also a privacy issue. It's like hey, someone is following where I'm going, even if it's not. But I get an uncomfortable feeling from that. I would not want to have drones flying in our forest.*" (P5FO, forager educator). Rather than purely technical barriers, these are socioethical concerns that challenge dominant technological imaginaries. They show that the expansion of surveillance capacities into forest spaces fundamentally reshapes relationships not only with technology but also with notions of public and private spheres. Trust in drone systems extended beyond technical performance to larger questions of governance and power. Participants questioned who owns and controls the data collected, who has access, and how it might be used, or misused, for commercial gains or governmental surveillance. These worries echo broader societal debates about data sovereignty and digital privacy, highlighting that trust in technology is always entangled with questions of power, ownership, and accountability.

STS scholarship emphasises that trust is not merely about system reliability but also about who controls the technological infrastructure, who defines acceptable uses, and who benefits from data flows (Jasanoff 2004; Nissenbaum 2009; Yeung 2018). The ambivalence voiced by participants signals a demand for more transparent, participatory governance processes, where affected communities have a say in technological design and deployment. "*In Lapland, you always have to speak with the reindeer herders that have some reindeers [sic] in that area. It's not like the thing you can just do like this. I think there has to be a lot of discussion before you can even start*" (P8FO, forager entrepreneur). Public acceptance is crucial: resistance can delay or prevent technological adoption.

Social acceptance refers not just to general approval but also to local, context-specific tolerances, illustrated by the NIMBY ("not in my backyard") effect. Whilst people might support drones in theory, they may strongly oppose them when facing the reality of camera-equipped drones flying over private homes or quiet forest spaces. In Finland, Everyone's Right allows free access to nature as long as activities do not cause more than minor disturbance. Privacy around private homes and sensitive spaces must be fully respected (Ministry of the Environment 2016). Drones, however, can introduce noise pollution and visual intrusion, disrupting the quiet and contemplative experiences sought by recreational foragers. Moreover, drone sensors and cameras are easily perceived as invasive, triggering legal and ethical concerns both for pickers and the wider community: "*You know when you are a worker and you are in the field and you know you've got that flying over your head, let's say you cannot stop and have a cigarette*" (P4AC, agricultural economist) and "*I mean, assume that you want to sit naked in your garden in the sun. You won't feel that comfortable if the drones…*" (P2AC, STS researcher). Users and designers of drone systems must consider these ethical implications and community perspectives from the outset. In the FEROX project, plans for new products and services involve prototyping and testing that explicitly examine societal acceptance, including local concerns about privacy and trust. Previous studies suggest that while *general* acceptance of technology might be relatively high, *local* acceptance, especially where privacy is at stake, tends to be much lower (Baur et al. 2022).

Ultimately, these dynamics underscore that AI-enabled and drone-assisted technologies embed and enact particular values, reshaping social practices and redefining boundaries between private and public life. By attending to issues of privacy, surveillance, and trust, we see how technological imaginaries interact with and sometimes undermine the relational and experiential dimensions of practices like foraging.

4.4 Environmental impacts and ecological ethics

The environmental concerns voiced by participants highlight the need to see forests not merely as resource reservoirs but as dynamic, co-constituted spaces involving humans, non-humans, and technologies. Whilst some participants saw AI-enabled and drone-assisted technologies as potentially supporting sustainable harvesting by reducing trampling and enabling more precise guidance, many expressed deep apprehension about noise pollution, disruption of wildlife, and unforeseen ecological consequences.

A major worry was that drones could make berries too easy to locate, intensifying harvesting pressure and threatening regeneration and wildlife food sources. These fears illustrate contrasting ethical frameworks: one driven by efficiency and extractivism, the other centred on interspecies ethics and viewing the forest as a living, shared entity. Concerns also emerged about "technological debris", what happens when drones crash or are abandoned "*If you have crashes. In many cases, by experience, you may not be able to find the drone if it's in the middle of the forest, so that means that the drone is left there. And they are leaking. So you are contaminating*" (P13AC, environmental engineer). The question of responsibility for drone crashes and the resulting wreckage underscores the need for clear accountability protocols and sustainable waste management strategies (Nentwich and Horvath 2018). Before deploying drones in natural spaces, agreements must ensure that operators bear responsibility for crash site cleanup and ecological restoration. Beyond immediate operational impacts, the sustainability of AI-enabled drone systems themselves requires scrutiny. This includes examining battery life cycles, potential shifts to renewable energy sources like solar or wind and addressing the energy-intensive processes involved in AI training, including associated CO_2 emissions and water use. This issue raises questions of accountability and stewardship, reflecting broader STS insights that technological systems are never purely technical but deeply entangled with ecological and social responsibilities (Nentwich and Horvath 2018).

Berry picking in Finland has long been a cultural practice that preserves traditional ecological knowledge and strengthens public connections to forests. It fosters conservation values and reinforces stewardship, thereby supporting a more relational, care-based approach to environmental sustainability. In this context, drones and AI-enhanced mapping are framed as double-edged tools. Whilst they may contribute to environmental sustainability by providing geospatial data, indicating ripeness, and supporting targeted harvesting, they also risk undermining ecological resilience if they encourage overharvesting or disrupt animal habitats: "*Because I'm scared that people are greedy and they'll want to have too much, take too much of nature in that way*" (P5FO, forager educator). The stakes of these technological interventions are especially evident in the case of culturally and nutritionally significant species such as cloudberries (*Rubus chamaemorus*), lingonberries (*Vaccinium vitis-idaea*), and bilberries (*Vaccinium myrtillus*). These berries are not only embedded in traditional practices but are also valued for their potential health benefits. For example, bilberries have been associated with anti-inflammatory and metabolic protective effects (Turtiainen and Nuutinen 2012; Kilpeläinen et al. 2016). In 2011, 54% of Finnish households engaged in berry picking, highlighting the practice's continued relevance and the extent to which such ecosystems are culturally and ecologically embedded (Vaara et al. 2013).

Overharvesting, while currently unlikely given the low percentage of berries harvested, remains a potential risk if technological interventions dramatically increase collection efficiency (Giraud et al. 2021). Drones' ability to generate dynamic, real-time maps could help mitigate this by distributing foraging pressure more evenly, thereby supporting natural regeneration and food availability for wildlife. The FEROX project aligns with the EU's "do no significant harm" principle and aims to ensure that sufficient berries remain in the forest to sustain ecological functions and species interactions (Regulation EU 2020/852 2020). Additionally, data generated by AI-enabled drone systems could inform policy measures, such as temporary foraging bans in vulnerable areas.

Nevertheless, the use of drones also raises serious concerns about wildlife disturbance (Rebolo-Ifrán et al. 2019). As Frąckiewicz (2023) notes, drones can disrupt animal behaviour and negatively affect population dynamics. Studies have shown that noise and visibility from drones can cause wildlife to scatter, abandon nests, or leave young behind (Christie et al. 2016; Mulero-Pázmány et al. 2017; Lyons et al. 2018). The berry-picking season overlaps with the breeding season for many birds and game animals, intensifying these risks and raising ethical challenges under the Everyone's Right: "*There might be concerns there that you're disturbing wildlife, particularly in being intrusive. So I'm not sure how small animals and birds respond to drones being flown around, particularly in a fairly dense canopy where you wouldn't expect things, how does that affect their sort of fight and flight?*" (P3AC, safety researcher).

These environmental concerns show that technological visions often focus on efficiency and resource extraction, while overlooking the complex relationships between humans, animals, and forest ecosystems. By paying attention to these overlooked aspects, we can think about designing and using drones in ways that protect and support the health of the forest, instead of just maximising it for economic gain.

4.5 Labour relations and governance conflicts

Local pickers expressed concerns that the adoption of AI-enabled and drone-assisted technologies might further centralise control of berry resources in the hands of large companies, intensifying economic inequalities and sidelining small-scale and independent pickers. As one participant noted, "*I would believe that only the companies would have the benefit from them. I don't think that it would be accessible [to people]*" (P5FO, forager educator).

These anxieties highlight deeper tensions around the distribution of value and decision-making power. Questions about fair benefit sharing, wage disparities, and the risk of monopolisation surfaced repeatedly. One fair price entrepreneur explained that a company tried to arrange large berry orders (8000 kg of lingonberries and 10,000 kg of bilberries) from local foragers at slightly lower prices, but most foragers refused to accept less than €10/kg. Even after reducing internal costs, the final price (€13–14/kg) was still too high for the buyer, who was used to paying only €5–6/kg for berries picked by Thai workers. This highlights the tension between fair local wages and market price expectations: "*Finnish people don't pick the berries as cheap as the Thailandish [sic] people, but we for example, our foragers, they clean the berries for us, ready so that they don't have any sticks on or leaves with them, and we pay €10 for one kilogramme of blueberries or bilberries*" (P8FO, forager entrepreneur).

Some participants worried that AI-enabled systems could become instruments for consolidating profit and control, rather than tools for supporting diverse, community-based livelihoods. At the same time, a few saw potential for drones to democratise access to information and reduce physical risk, but only if governance structures explicitly prioritise equity and collective stewardship. Without transparent, participatory oversight, technological interventions risk reinforcing existing hierarchies rather than alleviating them.

From an STS perspective, this theme underscores how technological systems embed specific labour politics and governance visions. They reflect and shape broader societal struggles over control, value distribution, and access to resources. The reduction in migrant labour further exposes the fragility of efficiency-driven models that depend on undervalued and precarious human foundations. By foregrounding these tensions, we see that technological futures are not merely about improved productivity but also about whose futures are enabled, whose work is valued, and who holds power in defining how resources are managed and shared.

5 Discussion

This study reveals how the FEROX AI-enabled and drone-assisted system embodies a sociotechnical imaginary originally built around efficiency, productivity, and the support of Thai seasonal workers. By promising to optimise berry harvesting and improve worker safety, the system was designed as an AI-enabled automation solution under the assumption of a steady migrant labour supply and a focus on economic gain. However, policy changes drastically reduced the availability of Thai workers, creating a fundamental misalignment between the system's envisioned future and emerging social and cultural realities. This misalignment exemplifies what might be called "technological orphaning": a system designed for one world that finds itself out of place in a rapidly shifting context (Barbonis 2006). As migrant labour declined, local foragers with different values, emphasising autonomy, cultural tradition, and peaceful connection to nature, became central actors. These actors often resist productivist logics and see foraging as an activity that is intimate and experiential rather than purely economic. This misalignment can be understood as a disruption of the efficiency-driven sociotechnical imaginary that underpins the FEROX system. Whilst this imaginary envisions a future of optimised, data-driven foraging supported by a stable migrant workforce, the empirical findings show how it becomes unsettled when confronted with shifting labour conditions, local cultural practices, and ecological considerations.

To illustrate these tensions more concretely, we introduce a vignette from the FEROX fieldwork. Before the 2025 summer field tests, two researchers from the project's end-user association, with practical experience of berry foraging, travelled to Valkmusa National Park in search of cloudberry peatlands for the project's field studies. Their approach reflected an understanding that berry availability is contingent on variable ecological conditions, including peatland characteristics and seasonal variation. Without specialised expertise or guidance from experienced local foragers, they returned empty-handed. As one of the researchers explained in an email to the consortium:

> "In Finland, we have learnt that we have to respect nature: we are happy if the nature gives us, for example, cloudberries in a certain year and in a certain area. But we can't demand that there must be berries in a certain area. I guess that foreigners do not understand this, and it has been a problem in FEROX project."

This episode reveals more than logistical difficulties related to fieldwork. It illustrates a tension between different ways of understanding and engaging with forest

environments: one grounded in situated, experience-based ecological knowledge that acknowledges uncertainty, and another oriented towards prediction, optimisation, and control. The challenges encountered highlight how project-level expectations, such as identifying suitable sites within predefined parameters, may not align with the variability and unpredictability of ecological systems.

These tensions should not be understood as a simple contrast between national groups, but rather as reflecting different forms of expertise, experience, and ways of valuing and interpreting the forest. What may initially appear as a practical difficulty instead points to deeper epistemic misalignments within the consortium. This example underscores that engaging with local ecological knowledge is not only a matter of inclusion but also a practical requirement for effective collaboration in such contexts. The interaction between optimisation-oriented technological approaches and situated ecological practices highlights broader tensions within the FEROX project, challenging assumptions about predictability, efficiency, and governance, and shaping how the system can be meaningfully implemented in practice.

From an STS perspective, these findings show how AI-enabled technological systems are co-produced with particular labour assumptions, power dynamics, and cultural values. The original imaginary of FEROX embedded assumptions about migrant labour availability and prioritised AI-enabled efficiency over local traditions, environmental ethics, and collective governance. The unintended consequence was a system without its intended users, encountering uncertainty and open questions amongst local pickers, alongside emerging ecological and social challenges.

Moreover, this case highlights how focussing narrowly on efficiency can obscure and destabilise other important dimensions of socioecological systems. Instead of creating universally beneficial outcomes, the AI-enabled system risks exacerbating inequalities, concentrating power among large berry companies, and deepening tensions over access to forest resources. The concerns raised about privacy, surveillance, and environmental impacts further illustrate the risks of ignoring knowledge and values.

The shift from a migrant workforce to attempts to "relocalise" berry picking has revealed new governance questions: who defines what counts as "good" or "productive" foraging, and at what price? Who decides how value is distributed, including whether higher berry prices are acceptable to support fair local labour? Who controls the data and resources, and whose voices shape future visions? The challenge, therefore, is not just technical but deeply political, economic, and ethical.

This analysis suggests the need for participatory, adaptive, and culturally informed AI and automation design. Rather than imposing top-down, efficiency-oriented solutions, future technologies should be co-produced with local communities, environmental stewards, and cultural actors. AI-enabled technologies such as FEROX must support, rather than overwrite, local practices and ecological relationships. Designing for context, and with context, is essential.

In sum, the tensions revealed here are not simply obstacles to be overcome but reflect ongoing negotiations amongst different actors about what futures are possible and desirable. By foregrounding these dynamics, we can better understand the social work required to align technological systems with diverse social, cultural, and ecological contexts.

6 Conclusion

This paper has examined the FEROX AI-enabled and drone-assisted system as a case study of how sociotechnical imaginaries both shape and are disrupted by evolving social, cultural, and political contexts. Originally envisioned as an AI-enabled technological fix to labour shortages in Finnish berry foraging, FEROX was grounded in an efficiency-oriented imaginary that presumed the continued availability of Thai migrant workers. Policy changes and shifting cultural dynamics have since exposed the fragility of this vision, rendering its core assumptions misaligned with the realities now facing the sector. This disjuncture highlights not only the limitations of narrowly instrumental design approaches but also an opportunity to rethink the role of AI-enabled automation in culturally and ecologically embedded practices. Although situated in Finland, the case reflects broader challenges in governing automation across sectors that depend on migrant labour, raising questions about fairness, sustainability, and technological sovereignty.

Through an STS lens, this study has shown how AI-enabled technologies such as FEROX are carriers of specific labour politics, environmental assumptions, and governance logics. The narratives of local foragers underscore a deep attachment to forest autonomy, experiential knowledge, and equitable participation. These values are frequently marginalised by AI-driven automation frameworks built around standardisation and productivity. These frictions illustrate the importance of reorienting technology design processes towards inclusive, context-aware forms of co-production that recognise diverse ways of valuing work, nature, and knowledge.

Importantly, while the FEROX system was developed with the intention of improving worker safety and access to forest resources, it also sought, at least in part, to take local knowledge into account. Our findings suggest that such efforts must move beyond surface-level consultation toward deeply participatory and iterative engagement. Culturally co-produced automation requires not only attention to technical function but also to the power relations, labour arrangements, and ecological ethics that shape how

AI-enabled technologies are received, resisted, or reimagined in practice.

Rather than rejecting automation outright, this study argues for its reconfiguration. AI-enabled and drone-assisted systems may support sustainable, just, and culturally aligned forms of forest work, but only if they are designed with, rather than merely for, the communities they affect and if their economic implications, including pricing, wages, and the distribution of value, are made explicit and open to contestation. Future research should explore governance models that centre equity, examine how traditional ecological knowledge might be embedded within AI-enabled and data-driven technological infrastructures, and develop participatory design frameworks that explicitly acknowledge the political, cultural, and economic dimensions of automation.

In reimagining what AI-enabled technological futures are possible, and for whom, this paper contributes to ongoing debates about the co-production of science, society, and environment. The case of FEROX demonstrates that sociotechnical systems do not simply reflect social realities; they actively participate in shaping them. Attending to the sociotechnical imaginaries embedded in AI-enabled systems is therefore essential for guiding technological futures that prioritise not only efficiency, but also fairness, cultural relevance, and ecological responsibility.

Author contributions Both authors contributed to the study conception and design. Material preparation and data collection were performed by A.O. The first draft of the manuscript was written by A.O., and S.F. commented on subsequent versions of the manuscript. Both authors read and approved the final manuscript.

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Data availability The interview data supporting this study are not publicly available due to confidentiality and ethical constraints. Participants were assured anonymity, and the qualitative data contain information that could enable re-identification if shared. In accordance with Cranfield University Research Ethics approval (CURES/17502/2022), the data cannot be made available.

Declarations

Competing interests The authors declare no competing interests.

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