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A participatory research approach in the development of safety and well-being in horticultural enterprises

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Abstract. The process of improving the health, safety, and well-being of workers in the horticulture and agriculture sectors requires new effective means. The aim of this study was to conduct a qualitative evaluation of a participatory co-creative consultation process in order to improve occupational health and safety in horticultural businesses. The study was conducted across twenty-four small-scale enterprises (totalling eighty-two entrepreneurs and workers) from five different horticultural subsectors in Finland. Each business engaged in the development process, starting from the identification of development needs through to individual interviews and process analysis, and continuing with co-creation and the implementation of solutions. The results indicated that participatory consultation, when combined with a process analysis, was perceived as being very productive, particularly in terms of identifying development needs, but also in inspiring the co-creation of solutions and applying them to specific tasks and the working environment. Whilst long-term effects could not be measured, participation in the development process improved subjective well-being and the competence of entrepreneurs in managing well-being in their work setting. The findings suggest that participatory consultation can facilitate improvements in working conditions, which in turn can help to reduce workplace injuries and improve health conditions. The findings also highlighted the need for having a multidisciplinary consultation team, the effective cooperation of all involved parties, and facilitating peer discussions when it comes to resolving identified challenges.

Key words: agriculture, ergonomics, health and safety intervention, social sustainability.

INTRODUCTION

Horticulture is a diverse sector, one which includes the production of edible and ornamental plants, nursery production, landscaping, and food potato production. Although horticultural production has been mechanised in many ways, the sector is still very manual labour-intensive. By some assessments, labour costs in greenhouse production account for an average of twenty-eight percent of total production costs

(Economydoctor, 2023). This means that the skilled and effective management of human resources is essential for financial performance and the competitiveness of the business in question. The expectations and demands of society and stakeholders are also increasing: the latest 'Common Agricultural Policy' reform (abbreviated to 'CAP') by the European Union underlines the importance of a safe and healthy working environment as a required part of responsible food production (European Commission, 2023). The EU's strategic framework on health and safety aims for zero work-related deaths (European Commission, 2021). Achieving this in the agricultural and horticultural sectors means entrepreneurs and working communities should be better prepared to identify and manage work-related health and safety risks.

Although there are limitations in reporting the true number and rate of occupational injuries and illnesses in Europe, agriculture and horticulture are well known as being hazardous occupations (Merisalu et al., 2019). Two hundred and ninety fatal accidents were reported in 2021 (EU27, 'Agriculture without Forestry and Fishing') (Eurostat, 2024). In addition to high injury rates, the risk of musculoskeletal diseases is higher in the agricultural sector than it is in the population as a whole (Karttunen et al., 2015; ETK, 2023). Agriculture is also a high-risk sector for occupational asthma and rhinitis, contact urticaria or protein contact dermatitis, lateral epicondylitis (tennis elbow), and noise-induced hearing loss (Koskela et al., 2022). Even in large and advanced farm businesses, safety and well-being are not optimally managed (Karttunen, 2014).

Occupational health services (abbreviated as 'OHS') in Finland have been amongst the main preventive strategies when employed in relation to the agricultural sector. Such services include advising, providing periodic health checks, and on-farm safety assessments. The system has shown beneficial effects for farmer work ability (Mattila et al., 2020), but no reduction in occupational injury and disease insurance claims (Karttunen & Rautiainen, 2013). Kaustell et al. (2017) suggested that part of the challenge may be unfamiliarity on the part of OHS staff with the specific working environment and work processes in terms of agricultural production. Personnel training is required where agricultural work and contextual knowledge is concerned, along with a level of expertise in well-being, health, and safety, all of which needs to be specific for agricultural work. Creating new solutions, as well as eliminating, isolating, or protecting against occupational health and safety hazards, requires an understanding of work processes and the context within which solutions are to be implemented. As employees and business owners have the best levels of knowledge of the required work processes, their involvement is essential in any workplace development processes. Another critical issue is the fact that risk management and any improvement of the work environment is a continuous process, and sustained development requires competence and commitment in the work organisation at all levels.

The potential of participatory approaches has been recognised in terms of improving safety, health, and productivity, where personnel at all levels of the organisation are engaged in planning, implementing, and maintaining technical improvements and organisational changes, and in taking other actions (Hignett et al., 2005; Rost & Alvero, 2020). A systematic review by Rivilis et al. (2008) concluded that participatory ergonomic interventions could achieve a decrease in poor health symptoms, injuries, and costs involved in sick leave, lost workdays, and insurance claims. A particular strength of the participatory ergonomic approach is the ability to focus on workplace-specific situations and needs.

The current study's objective was to create and implement a bottom-up developmental process which could identify specific occupational safety, health, and well-being challenges in horticultural businesses, and co-create solutions which could improve well-being and productivity. From this point of view, we applied the participatory process which was described by Vaughn & Jacquez (2020): research which 'encompasses research designs, methods, and frameworks which use a systematic enquiry in direct collaboration with those affected by an issue which is being studied for the purpose of initiating action or change. Participatory research (abbreviated to 'PR') engages anyone who is not necessarily trained in research but who is associated with or represents the interests of those people who are the focus of the research'. Achievements in connection with the process were assessed using feedback from participating businesses.

The aim of this study was to conduct a qualitative evaluation of a participatory co-creative consultation process in order to improve occupational health and safety in horticultural businesses. The main research question was framed in this format: 'Does a participatory approach offer opportunities to enhance labour productivity, safety, and overall well-being in the workplace?'.

MATERIALS AND METHODS

This study was based on case information which was collected between 2018 and 2020 from Finnish potato and horticultural businesses (see Table 1). We had twenty-four case businesses and twenty-five business premises, of which twenty-two underwent the entire process, while three project processed were shortened or modified due to business owner challenges in their private lives. Geographical coverage was good given the fact that horticultural production is rare in Lapland, a region from which we generated no cases at all (Table 1), and the fact that Åland was outside our main funder's target region. Participation activity was weaker for those businesses which were located in eastern Finland, although this is a major strawberry production area in Finland.

Table 1. Number of case premises by subsector and geographical location

Case premises	Number
Case subsector	
potato and field vegetables	7
greenhouse production	7
berry and fruit production	5
nursery production	3
landscaping	3
Geographical location[1]	
southern Finland	8
south-western Finland	6
western and inland Finland	7
eastern Finland	1
northern Finland	3
Lapland	0
TOTAL	25

[1] Based on the official division of regions by 'Regional State Administrative Agencies'.

The entire project lasted nearly three years (totalling thirty-three months). Multichannel forms of communication were used to recruit participating businesses, including a press release, newsletters, farming magazines, emails, phone calls, and other personal contact methods. The goal was to get at least three businesses from each of the five subsectors (potato and field vegetables, nursery, greenhouse, berries and fruit, and landscaping) (see Table 1). Each

participating business underwent a development process in which challenges and good practice were identified, possible solutions were ideated, discussed, and implemented with employers and employees, and the benefits of the process were assessed (Fig. 1).

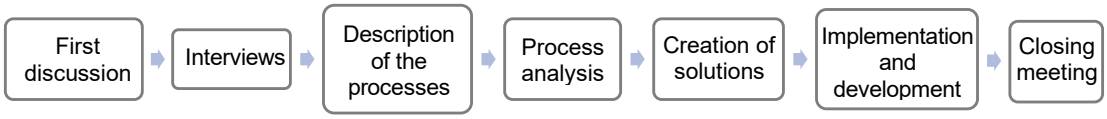

Figure 1. Steps in the development process for businesses.

The research team consisted of seven researchers and experts from three organisations, with expertise in horticulture, applied entomology and zoology, knowledge management, agricultural economics, agricultural sciences, agricultural engineering, and work science. Research team members worked in pairs with businesses, aiming to achieve effective information exchange, a fluent process, good documentation, and overall risk management activity. Pairs represented different organisations in order to complement each other's knowledge, matching the development needs in participating businesses.

Development process in participating businesses

First discussion: in the first meeting the business owner introduced their business and explained the expectations and needs they had for the project. Each business owner also named those individuals who would participate in the development team. The research team introduced themselves and their backgrounds, the project process and aims, and a rough estimate of the time schedule. A commitment agreement and forms for funding organisations were also completed.

Interviews: semi-structured theme interviews were conducted to get individual views on needs where improving work well-being is concerned. The aim was to involve as much as possible the staff in the process - especially long-term workers - and family members if they had an active role in the enterprise. Interviews were conducted one-on-one in Finnish, Swedish, Russian, or English in quiet places at each business premises. The interview themes consisted of background information, work tasks, motivation, physical and social work context, straining factors, and developmental needs. No personal health information was collected.

A description of the operational process(es): operational processes were described and documented using the Microsoft Visio Professional program. The level of detail varied by basing this on the main problem as seem by the business owner, along with their wider aims as described in the first meeting.

Process analysis: this was conducted in the form of a workshop in which the employer, employees, and research team analysed the operational process on a phase-by-phase basis, identifying barriers against fluent work, straining factors, injury risks, and other developmental needs. Good existing practices were also discussed and documented. The description of processes from the previous phase served as a road map for discussion. The role of the research team was to move the discussion forwards, ask activating questions, and document the discussion. The role of the employer and employees was to make experiential observations. During this phase any development

needs were identified and documented without stressing whether solutions for them could be created. However, in some cases discussions generated ideas which were already put into practice before the next meeting could take place.

The co-creation of solutions: at the next meeting the identified developmental needs were discussed in detail, with a focus on solutions. The few weeks between meetings enabled ideas to be rethought and to mature. At this meeting, the employer, employees, and researchers considered alternative solutions, but did not attempt to nail down all of the details. While the research team normally worked in pairs, in some cases other research team members were added in this phase in order to broaden the available expertise in a larger group discussion.

Implementation and the further development of solutions: in this phase advancement was primarily the responsibility of the businesses, and they were given time to put ideas into practice. Researchers supported the development teams when requested by sending information and holding meetings for further discussions. The Covid-19 pandemic began to limit opportunities to meet in person in this phase, and in most cases further discussions were carried out only in the closing meeting.

Meetings between businesses: seven joint meetings were arranged during the project, and between two or more businesses. The number of participants from each business was not limited but, typically, only an employer or an employer and one employee from each business tended to participate. Each meeting had its own theme, something which was identified from the development processes in businesses in order to address shared interests between participants. The 'Appreciative Enquiry' method (Cooperrider et al., 2008) was applied at four meetings, while three meetings were based on an introductory presentation and multiple discussions, and two were based on preliminary tasks and discussions. The last meeting was organised via Microsoft Teams due to pandemic restrictions.

Closing meeting: implementation, challenges, and the further development of solutions were all discussed and analysed at the final meeting for each business. The businesses were given a written report in which the process was described as a whole. Feedback was collected through structural forms and discussions. Official forms were filled in for funding organisations. The Covid-19 pandemic caused some difficulties and delayed the time schedule.

An evaluation of the process and the classification of findings

Feedback from twenty-two participating businesses, those which went through the entire process, was collected by means of a short, simple enquiry which covered two main themes: 1) project activities (ten questions which were related to project practices and the performance of project staff); 2) impact and results (ten questions which were related to the ability of the process to produce the intended benefits). The business owners were asked to rate the project's success in terms of its key tasks by using a five-point rating scale, where a score of one meant very poor, and five meant very good. The evaluation focused on how well the project achieved the aims of identifying development needs, creating solutions, putting them into practice, and improving the capacity of participating businesses to improve well-being and safety at work. Moreover, feedback was collected concerning the project's activities.

Those development needs which were identified in the interviews and during the process analysis were analysed by reading through the material several times, after which they were categorised into those themes which emerged from the data (Beyer & Holzblatt, 1998). Classification was first made by subsectors and was then combined into broader themes.

Co-created solutions were categorised by applying the value creation model which was engineered by De Jong and Van Ark and introduced in the EANPC Memorandum (2005). Both analysis and classification by themes were first made by using as a basis the view of one researcher, and were confirmed and further developed by another researcher.

The study was conducted by Natural Resources Institute Finland ('Luke'), a government research institute for agriculture, forestry, and fishing (FINLEX, 2014), which is committed to complying with the ethical principles of the 'Finnish National Board for Research Integrity', abbreviated as 'Tenk' (Finnish National Board for Research Integrity, TENK, 2012).

RESULTS

A total of eighty-two business owners and employees were interviewed in the participating businesses, forty-nine of whom were women (sixty percent of the total) and thirty-three were men (or forty percent of the total). Average ages of the interviewees were forty-one years for women and thirty-nine years for men. Both men and women had worked in the industry for a long time, with the women at an average of fifteen years of service, and men at sixteen years. Women had worked for the current company for an average of eleven years, and men thirteen years. Of the women, thirteen (27%) were business owners, one was a supervisor (2%), and thirty-five were employees (71%). The same categories for men produced figures of fifteen (45%) for business owners, six (18%) for supervisors, and twelve (36%) for employees. Despite the physically strenuous work involved, almost 75% of the workers were women. Women also accounted for 14% of supervisors and 46% of business owners.

Descriptive statistics on feedback are presented in Table 2. For the project's requirements, average ratings varied between 4.0/5 and 4.5/5. The project was carried out partially during the Covid-19 pandemic, and time schedules were delayed in some businesses. This can be seen in ratings for the process schedules (with a minimum of two and a maximum of five).

Based on feedback, the participatory process was perceived as being very effective, particularly in the identification of development needs (4.7/5), and also in finding solutions (4.2/5). The implementation of solutions in practice was viewed positively (4.1/5), while the effect on well-being at work was felt more weakly (3.7/5). Further, participants felt that the process developed their competence in the area (3.9/5), and they felt they were able to take on board ideas about how well-being at work could be improved (4.5/5).

Table 2. Feedback from participating businesses in terms of project activities, impact, and results

Project activities	Average	Min	Max	Mode
Information about the project and its stages	4.2	2	5	5
The development process was appropriate for the development of our business	4.3	3	5	4
The working community had opportunities to participate	4.2	3	5	5
Staff interviews provided important information for the development of operations	4.2	3	5	5
The joint discussions were an effective way of highlighting areas for improvement and good practice	4.5	4	5	5
Joint discussions were a good way to brainstorm solutions	4.3	3	5	4
The business pair or group meeting was useful	4.0	2	5	5
The process schedule proceeded at a suitable pace	4.0	2	5	5
Cooperation went smoothly between the businesses and the project experts	4.5	3	5	5
We received support from project participants during the development process	4.4	3	5	5
Impact and results				
The development process provided ideas for improving the work community's well-being and productivity.	4.5	3	5	5
The development process improved capacity and competence when it came to developing activities within the workplace	3.9	3	5	4
The development process improved cooperation within the work community	3.7	3	5	4
Areas were identified where improvements could be carried out	4.7	4	5	5
Solutions were found for areas of improvement	4.2	3	5	4
Solutions have been put into practice	4.1	3	5	5
The development process has improved well-being at work	3.7	3	5	4
The development process has improved the workflow	3.8	3	5	4
Participating in the development process was useful for me	4.4	4	5	4
Participation in the development process was useful for our company	4.3	3	5	4

Identified development needs

Using the interviews and process analysis, a range of between 7–105 development needs were identified during the process for each business, an average of forty-six per case, and amounting to 1,103 in total. Identified development needs in the thematic analysis were grouped together under fourteen main themes, which are summarised in Table 3. These themes highlighted the role of the work environment, injury risks, and exposure to chronic health conditions, as well as high stress and sleep deprivation during high seasons, and weaknesses in data management and information flows, which caused cognitive overload for employers and supervisors in particular. The case data revealed that well-being at work in small businesses was also related to a balanced family life, an ability to develop the business, finding financial advice, and receiving support for strategic planning.

The process analysis produced information about details which hindered or slowed production processes in terms of skills shortages, and shortages in tools, logistic arrangements, and dataflow.

Table 3. Main themes for identified challenges where these are related to occupational safety and well-being in horticultural case businesses when using a participatory bottom-up approach

Identified challenges	Examples of causes
Physical workload	Bad working posture, repetitive work, manual carrying, the use of force, awkward work equipment, peak seasons with sleep deprivation, overload, weak recovery
Mental workload	Multitasking, peak seasons, cognitive and social overload, information breaks, long-term vigilance, problems in production causing stress, administrative tasks, lack of skills, sleep deprivation, fatigue, loneliness
Natural conditions	Weather, pests
Challenges related to buildings and premises	Weaknesses in functionality, tidiness, and order, and the layout and logistical planning of the farmyard, field plots too small, distances, a large variation of soil types, adequacy of fields, and uncertainties in connection with rented land
Challenges related to machinery and equipment	Old machines and equipment causing disturbances and uncertainties, incompatible systems, the capacity of machines and equipment too low, limited suitability for the purpose, the need for more adjustable characteristics, the need for a redesign of mechanisation, organising maintenance, lack of professional skills, wear-and-tear in basic hand tools
Injury risks	Hazards in the work environment, unsafe arrangements, working alone, sleep deprivation, weak recovery, lack of skills, weaknesses in guiding, attitudes, shared worksites
Work exposures	Physical: noise, thermal environment, limited illumination, vibration Chemical: dust, exhaust, fumes, plant protection agents Biological: insect stitches, wet peat (mould)
Weaknesses in smooth processes running	Lack of tools for comprehensive management, unclear distribution of responsibilities, laborious procedures, logistical weaknesses, technical challenges, the handling of interruptions
Weaknesses in data management	Inadequate data collection, documentation, and the utilisation of data, the weakness of user interfaces
Weaknesses in concept planning	Difficulty in assessing the demands and consequences of business and production decisions for work processes
Weaknesses in recruitment and the management of human resources	Difficulties in finding the workers at the right time, finding a skilled workforce and business partners, organising substitutes, supporting seasonal worker work ability, optimising between contractor work and paid workers, engaging workers
Weaknesses in work leading	Weaknesses in communications, orientation, and meeting practices, common actions, maintaining work quality, motivating the workforce, safety management
Weaknesses in skills	Challenges in maintaining and developing professional skills, sharing knowledge in work community, maintaining and the effective utilisation of existing expertise
Challenges related to the work community	Lack of skills in terms of handling conflict situations in the work community, strengthening team spirit

The functionality of farm buildings was found to be critical. Weak planning in terms of side processes resulted in difficulties in some businesses: even if the main production process were to be well-planned and running smoothly, maintenance or side-product flows may remain undeveloped, resulting in manual handling and laborious work phases. Weaknesses in functional planning may be difficult and costly to repair afterwards. The process analyses also revealed weaknesses in the planning and management of any changes. For example, processing line capacity was too low for scaled-up production levels, which resulted in disruption such as blockages or breakages which then led to overload, safety risks, and delays.

Identified physical straining factors included awkward postures and repetitive work in greenhouse production, the processing and packaging of products, planting and harvesting open field plants, and manual stonework in landscaping. Lifting and carrying loads caused a level of strain, often for extended periods. Hands and joints became overloaded and numb in cutting. Also noteworthy was the use of knives, squeezing pieces together, and lifting and unloading potato seed boxes and washed peeled potato buckets. Some work tasks, such as moving heavy loads, required considerable strength. Standing on a hard concrete floor or metal grating for a long period of time such as, for example, when handling seedlings or packaging products, may also lead to strain. Work in horticultural businesses also involved long periods of sedentary work, especially in machine driving and office work in winter, causing musculoskeletal symptoms.

Discussions also brought up failures and weaknesses in the recruitment, timing, training, or organisation of the workforce. Horticulture is a typical entry-level job for workers who have limited language or professional skills, such as young trainees or foreign workers, which increases orientation challenges. Moreover, false assumptions and misunderstandings can lead to conflict, which may have a severe long-term effect on well-being and productivity.

Solutions for identified challenges

Following the model which was created by De Jong and Van Ark (2005), identified solutions contributed towards improvements in productivity, pricing, or production activities, all of which can be linked to value creation. Typically solutions were aimed at improving productivity, either through technological progress or through improvements in operational efficiency.

The streamlining of material handling and reducing workloads was a common theme both for large and small horticultural businesses, and this provided an opportunity to make their operations more efficient. In order to avoid expensive and burdensome manual transportation, some businesses underwent a major remodelling of logistics and storage, while few others upgraded transport equipment. Discussions explored a wide range of options when it came to materials handling and the use of existing aids in nearly all participating businesses. Logistics-related themes included tidying warehouses and storage areas, and renovation work. Injury prevention was addressed by improving access roads, separating machine and pedestrian traffic, and improving the management of storage facilities and shipment/pickup areas. Systematic approaches for maintaining the cleanliness and order were discussed. A reduction in physical workload was gained by tools such as powered shears for cutting, for carts and transport equipment, and for

small loaders, workstation mats, remote and automated installations, upgrading personal protective equipment and adjustable tables, and changing weight recommendations in manual handling.

Work organisation was developed by means of rotating work tasks, balancing workloads, and gaining competence for managing complex work. Process charts made it possible for the overall picture to be seen, including how different tasks depended upon each other. Some businesses started to use process charts as part of their orientation for new employees or as part of the quality system. Supervision was developed, and a video of work tasks was tested as instructional material. Contingency planning and substitute staff arrangements were improved. Documentation was improved, and communications were developed through the use of whiteboards, Dropbox, and WhatsApp. Some business owners took courses to help reorganise their business activities and lighten their workload.

Several solutions concerning the reorganisation of tasks and information flows and, in some cases, a decentralisation of responsibilities were all suggested in order to reduce excessive mental workload during the long and stressful workdays in the growing season. Such solutions aimed to reduce the mental workload of the business owners and supervisors who usually serve as the hub of information flow and decision-making for activities. Operational solutions involved combining, separating, or changing the timing of work phases to improve workflow, increasing the diversity of work, and reducing haste and stress. New methods were developed in which some work phases were completely removed. Various aids were developed to support memory, such as task calendars, checklists, and task cards which could be used to assist work training. Cooperation and contracting services were also considered as being important in terms of managing the workload. Furthermore, the rules of cooperation and sales contracts were identified as area which required further developed.

Development ideas which are related to the workforce included a well-planned and well-established recruitment process, one which aimed to provide skilled employees at the right time, along with clear and effective orientation, and carrying out the task of training employees for positions with varying levels of responsibilities. A better allocation of work tasks and responsibilities provided improved employee self-direction, motivation, overall and management, and a reduced workload for business owners and managers in the long run. Agreed common rules and introducing health and safety policies and techniques were also discussed for all members of the work community. For example, this involved the efficient utilisation of machinery and other available technical aids, as well as pair or group work in certain tasks to improve safety or process flow.

When the solutions were ideated, not all development needs were always implemented due to limited time, and because some required longer planning. The solutions were not seen as final, as the workshop produced various solutions which were then introduced, processed, and prioritised, and some were also later abandoned. Businesses were encouraged to quickly adopt easy solutions and to continue discussions and planning with difficult ones.

DISCUSSION

This study focused on piloting the participatory bottom-up approach in terms of identifying challenges and solutions regarding occupational safety and well-being in horticultural businesses in Finland. The project was motivated by the need to find ways to improve the ability of business owners and farm communities to identify health and safety risks, co-create solutions, and make effective changes in work processes and the environment.

The applied participatory method, when combined with process analysis, was viewed by participants as being very productive, particularly in terms of recognising developmental needs but also in inspiring the co-creation of solutions and implementing them within the work phases and overall enterprise context. The method produced many opportunities to improve well-being and safety at work. Several investments and changes were carried out during the process. The conducted participatory process was promising in terms of identifying problems and in creating solutions. Subjectively experienced well-being at work was moderately improved (the average figure was 3.7/5). How effective were the produced solutions in producing safety and well-being improvements such as less sick leave in the long run remains an open question. The evaluation of ultimate effects would require a follow-up study. Our solution for assessing the possible long-term effects was to evaluate improvements within the competence of participants. Based on results, the development process improved capacity and competence when it came to developing activities in the workplace, suggesting that participants may be able to maintain the development process in the long run after the project has concluded. The kind of support and further education this would require is a question for further studies. Kaustell et al. (2024) also raised the question of repeated interventions, in terms of maintaining farm fire safety in their case.

Several different systems have been developed globally in order to identify and control health and safety risks on farms. Demonstrating positive effects in intervention studies is somewhat difficult however, and the results are conflicting. Hasheminejad et al. (2021) tested a participatory ergonomic intervention in pistachio farming but found that the prevalence of musculoskeletal disorders in the control and intervention groups showed no difference. A participatory ergonomic trial introducing new tools amongst female vegetable farmers in Gambia showed that while a new tool (a long-handled hoe) improved productivity, workers still preferred the old type to which they were used (a short-handled hoe) even after the trial. This result was probably influenced by the quality of locally-built new tools (Vanderwal et al., 2011).

The systematic ‘Certified Safe Farm’ review process in the US has resulted in several improvements in farm environments (Rautiainen et al., 2010), and farmers have found occupational health screenings and on-farm safety reviews especially beneficial (Kline et al., 2008). However, this programme has not become sustainable beyond the funded research period. A ‘Participative Hazard Identification and Risk Management’ toolkit (abbreviated as ‘APHIRM’), which was developed for the assessment and control of musculoskeletal hazards and risks (Oakman & Macdonald, 2019), was tested by Rothmore & Williams (2022) amongst outdoor workers in Australia. Their results suggest that the APHIRM toolkit may be beneficial over time in maintaining work ability. Its advantages included a comprehensive risk assessment and guidance for controlling risks (Rothmore & Williams, 2022).

Previous studies show that musculoskeletal symptoms and the physical workload are significant risks in the horticultural sector (Fathallah, 2010; Johansson et al., 2010; Kirkhorn et al., 2010; Mattila et al., 2021a; Mattila et al., 2021b). A review by Major et al. (2021) concluded that seasonal work such as farm work is characterised by demanding musculoskeletal conditions, organisational pressure, time constraints, long working hours, inadequate rest, and an unpredictable work context, which may heighten the risk of musculoskeletal disorders. Our study confirms these findings, highlighting the diversity between businesses in their health and safety challenges and opportunities for intervention.

Generally, ergonomic disadvantages can be reduced by eliminating work exposure (for example, this could be through the mechanisation of the process and the elimination of the need to manually handle heavy loads), by reducing levels or time of exposure, and by changing behaviour through training and other methods (Goggins et al., 2008). Some musculoskeletal problems can be resolved with new areas of technology such as automated harvesters, but related costs may be too high for small and medium-sized farms (Kim et al., 2018). The development of solutions which are suitable for a smaller scale should receive greater attention both in research and advisory messages. For example, direct sales can be attractive for small farms but laborious in practice when it comes to processing, packaging, delivering, and carrying out customer service processes. Where harvesting is concerned, especially strawberry harvesting, robotic technology is developing and will deliver ever greater future levels of assistance both to workloads and labour availability problems. Quick-fix interventions included different pickup platforms and the process of supporting employees with good facilities, teamwork, and work organisation. Berry farms identified several ways of improving work efficiency and well-being at work such as, for example, by developing logistics and storage and resolving dataflow challenges.

Many identified injury risks were similar to those in the farming sector in general, as described by Jadhav et al. (2015) and Jadhav et al. (2016), for example. The process analysis also identified specific exposures to chronic health conditions. Recent studies have found that greenhouse workers are at risk of sensitisation to tomato and cucumber, which increases the linked risk of work-related asthma and rhinitis (Suojalehto et al., 2021a). Moreover, sensitisation has also been reported in relation to pests and pest control organisms (Suojalehto et al., 2021b) and bumblebee venom (Lindström et al., 2022) in greenhouse workers.

Inadequate rest and recovery are associated in farmers both with mental and musculoskeletal symptoms (Mattila et al., 2021b; Du et al., 2022). Sleep deprivation and inadequate recovery lead to fatigue, decreased alertness levels, and diminished performance levels (Harrington, 1978), increasing the risk of cardiovascular disease, diabetes, and impaired physical health (Van der Hulst, 2003). Stress, fatigue, and haste are risk factors when it comes to agricultural injuries (Jadhav et al., 2015; Jadhav et al., 2016). Based on our findings it is likely that horticultural business owners and some workers are exposed to fatigue and inadequate recovery, particularly during the peak season. Overload in business owners and forepersons may also affect their ability to take care of productivity, well-being, and the safety of the work community, even though these are key factors in the company's performance, especially in the labour-intensive horticultural sector. Hired labour represents a major share of the overall production costs in horticulture such as, for example, thirty-nine percent for speciality crop farms in the

United States (USDA ERS, 2020) and twenty-five percent on horticulture farms in Finland, which is where this study was conducted (Economydoctor, 2022). Investing in human resources can be rewarding, as demonstrated in a study of health and safety interventions in Europe; eleven out of thirteen interventions showed a positive return on investment in a five-year follow-up (Targoutzidis et al., 2014). Interventions for better recovery from cognitive and physical workload have been addressed in previous studies (Verbeek et al., 2019). Some practical solutions, such as the reorganisation of work duties, were discussed in the current study. However, the financial situation of any particular business may limit usable options.

Those solutions which have been created were not difficult to achieve or completely unknown, something which raises the question of why they had not previously been adopted or largely implemented. Our findings suggest that the systematic recognition, documentation, and processing of development needs may require - or at least benefit from - external support and a multidisciplinary team. Achieving the goals which have been set by the CAP social conditionality reform and the EU's 'Vision Zero' strategy will require investment in business owner competence and advisory services in terms of managing health and safety and in creating the required solutions. Co-creation methods especially should be further developed. Based on our findings, participatory and co-creative methods offer high levels of potential, but they are laborious, and web-based solutions will be of interest in the future.

Strengths and limitations

The strengths of the study comprised a carefully planned and implemented participatory process which engaged participants in a bottom-up process in order to identify needs and develop solutions. The process involved repeated contact which facilitated the co-creation of solutions. Participants evaluated and provided feedback for different aspects of the process, which is something to be considered when attempting to replicate and further develop the use of similar approaches in participatory research and consultation. The project involved a multidisciplinary working group, something which proved critical for bringing diverse areas of expertise and a wide range of ideas into the process. Together with committed business owners and work communities, the process produced not only identified challenges but also possible solutions, some of which had already been partially implemented during the course of the project.

The limitations include a relatively small study size. Enterprises which self-selected to participate in this development project may not represent all businesses in the sector. A bias may exist in that the participating companies had a greater interest in investing in the well-being of their employees than did companies in the sector in general. Furthermore, the horticulture industry and work processes may vary greatly in different geographic and climatic regions, and challenges and solutions in this study may not apply in regions which have different growing conditions, products, workforce structures, and other features. The definition of 'horticultural business' covers a large variety of companies - from primary production to nurseries and landscape companies. Moreover, the business may include special services such as organising courses or hosting visiting groups.

Within the participatory approach, project personnel, their individual backgrounds, and professional competence were an element which may have influenced both the identified challenges and the produced solutions. This resulted in some challenges being highlighted, and others possibly being ignored. The influence of the research team on the process can be seen both as a limitation and a strength. It is likely that involving researchers and experts with varying backgrounds will improve the process and the production of solutions which could benefit businesses and workers.

CONCLUSIONS

The study suggests that a participatory approach can improve safety levels, health outcomes, and well-being at work in horticultural businesses. Participation in the development process was also a learning process, one which served to develop the capacity of business owners to maintain well-being at work. Long-term effects on sick leave and work ability, as well as estimates for payback times of investments on safety and well-being, all require further research.

The participatory method was productive but laborious; the approach is likely to require external support or training, particularly in micro businesses. Moreover, as challenges involved are multiple in number and multidimensional in nature, the requirement to be able to resolve challenges involves multidisciplinary competence and cooperation between researchers, experts, business owners, and workers. According to our observations, there was a clear need for peer discussion and the sharing of experiences in relation to common health, safety, well-being, and productivity issues. Moreover, the development of safety and well-being should be integrated into strategic planning and operational choices for any business.

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