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Safety Culture and Risk Management in Agriculture

Sacurima Cost Action CA16123 Highlights and Conclusions

Jarkko Leppälä, Pat Griffin, John McNamara and Risto Rautiainen (eds.)

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Executive summary

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Agriculture is one of the most hazardous industries in the European Union (EU. Statistics and studies show great differences in national injury and illness rates, as well as approaches and support systems for the prevention of these adverse outcomes. Only a few successful interventions have been found in systematic reviews. Understanding the determinants of safety culture is generally poor and consequently there is generally a lack of well-informed actions to improve health, safety and risk management. This COST Action explored the reasons why agriculture lags behind other sectors, and why some countries have been more successful than others in reducing agricultural injuries and illnesses.

The Sacurima COST Action had five active Working Groups (WGs 1–5), eight short term scientific missions, several conference presentations and one training school to address different aspects of the topic. WG1 explored health and safety programmes and approaches on the national level. WG2 identified knowledge, attitudes, behaviours and priorities among farmers in relation to safety, health and risk management. WG3 identified vulnerable populations and measures for training and integrating vulnerable workers safely into the agricultural workforce. WG4 explored EU and national statistics and the means & indicators for monitoring progress. WG5 produced policy recommendations to inform and guide EU and national initiatives and efforts. The policy recommendations were discussed at meetings with various stakeholders and communicated to policy makers, the scientific community, administrative and insurance personnel, farmers and practitioners working towards better social sustainability and safety culture in agriculture. The policy recommendations presented by the Sacurima COST Action were to 1. Integrate Occupational Safety and Health (OSH) into current and future agricultural policies, 2. Establish a European Network for agriculture safety and health, 3. Allocate specific funding for Agriculture OSH research in Horizon 2020/Horizon Europe, 4. Develop and implement OSH education and skills programmes for farmers and workers in the agriculture sector and 5. Improve statistics to reflect the true levels of agricultural workplace fatal and non-fatal injury and ill health.

Keywords: Agriculture, Safety, Health, Safety Culture, Risk Management

Contents

1. Need for safety culture and risk management in agriculture

Authors: *Risto Rautiainen, Jarkko Leppälä and Pat Griffin*

EU statistics show decreasing farm numbers, increasing farm sizes, increasing ages of farmers, and reducing agricultural labour force overall as mechanization and new technologies replace manual labour (Rural Development in the European Union, Statistical and Economic Information, Report, 2013). Farm growth requires hiring workers beyond the farm family, but recruiting young people has become difficult, and agriculture relies increasingly on migrant and immigrant labor. In the past years, Europe has experienced an influx of refugees who should be integrated into the society to avoid social exclusion and poverty (Kingsley, 2016). Many refugees are young without special education or work skills. With training and support, agriculture could offer suitable employment and contribute to the integration of refugees and young people in rural areas. However, agriculture is one of the most hazardous industries in Europe. A report of the European Communities (2004) described high rates of injury, occupational disease and exposures in agriculture. Each year there are about 6 reported accidents per 100 workers and 12 reported fatal accidents per 100,000 workers in agriculture. Over 40% of agricultural workers feel unsafe at work. More than half report exposure to musculoskeletal conditions. Over 15% report exposure to skin and respiratory diseases. About 4% suffer from work-induced respiratory illnesses. Over 20% suffer from noise exposure, and more than 40% suffer from too rapid pace of work. Foreign workers have a higher risk for occupational injuries than native workers (Ahonen et al., 2007), and employees' national culture affects their safety-related perceptions and compliance (Casey et al., 2015).

A European Agency for Safety and Health at Work report (2007) recognizes working in high-risk sectors (incl. agriculture), as well as language, cultural background and time lived in the country as issues of concern for foreign workers. Young people are also less experienced and more likely to suffer injuries and illnesses at work. Many new workers lack agricultural background, and they are unfamiliar with modern machinery and equipment. Mechanization and size of farms also differ, and many COST target countries, in particular, suffer from safety, health and environmental problems. Knowledge of risks and safety measures is often lower on family farms compared to larger industrial operations.

Figure 1. Agricultural work settings differ within and between EU countries ranging from working with old dangerous machinery to using robots and automation of arduous work. Photos: Risto Rautiainen.

This COST Action investigated why agriculture lags behind other sectors in terms of occupational safety and health (OSH), and why some countries appear to be more successful than others in reducing injuries, illnesses and deaths in agriculture. The focus was on safety culture, which has been the single greatest indicator for reducing injuries, illnesses and deaths in previous studies (Zohar, 2010; Colémont and Van den Broucke 2007). It involves norms, beliefs, attitudes, values, myths, motivations, buy-in, priorities, policies, procedures, training, responsibilities, actions/inaction and accountability. It includes the behaviors of everyone in the organization and it is strongly influenced by top-level management (EU OSHA, 2016). While these principles have been applied effectively in other industries, it has been unclear how they can be applied on family farms where similar regulations, organization structures and lines of command do not exist. New research is needed on the opportunities to influence safety culture on farms by the efforts of governmental, research, education, health care, agribusiness, insurance, media and farmers' organizations, as well as other formal and informal influencers in rural communities.

This Action aimed to produce evidence-based recommendations that inform and guide new initiatives and actions to improve education and training, and strategies to improve health, safety and risk management, including indicators for measuring their success. A successful response to this OSH challenge will over time reduce the societal burden caused by injury and illness, improve the working conditions on farms, attract younger generations to work in agriculture, integrate migrant and immigrant populations into the workforce, and thereby enhance the future outlook and viability of agriculture and rural areas.

1.1 Objectives in the Sacurima COST Action Network

The long-term goal of this COST Action was to reduce the burden of work-related deaths, injuries and illnesses in agriculture. This Action had five objectives that contribute to achieving the main goal:

1. Identify and evaluate health and safety programmes and approaches on the national level;
2. Identify knowledge, attitudes, behaviours and priorities among farmers regarding safety, health and risk management;
3. Identify effective models for training and integrating vulnerable populations (including refugees and young workers) into the agricultural workforce;
4. Develop means and indicators for monitoring progress and evaluating impact of interventions on injuries and illnesses in agriculture; and
5. Disseminate results to stakeholders and the agricultural community.

This COST Action was coordinated at three levels; Action Chair (AC), Management Committee (MC) and Working Groups (WG's). Action Chair with Vice-Chair and Scientific Representative were responsible for administration and coordination. The Management Committee with members from 32 countries were responsible for planning and monitoring work in this Action. Five Working Groups planned and conducted work in the five objective areas. The specific research coordination objectives were as follows:

1. Identifying and evaluating health and safety programmes and approaches on the national level. WG1 of interested experts was established in the MC's kick-off meeting to coordinate work in this area. WG1 reviewed preliminary data, gathered and analyzed new information and reported progress at the MC meetings. Short-Term Scientific Missions (STSMs) were used to collect data from participating countries.
2. Identifying knowledge, attitudes, behaviours and priorities among farmers regarding safety, health and risk management. Interested members joined WG2 to coordinate research in this area. The work included developing uniform data collection methods, coordinating data collection, and analyzing results. STSMs were utilized for data collection, synthesis and reporting to the MC.
3. Identifying effective models for training and integration of vulnerable populations (including refugees and young workers) into the agricultural workforce. WG3 was established in the MC kick-off meeting to coordinate research in this area. Investigations included identifying five categories of vulnerable workers in agriculture, specific risks they are facing and possibilities to train and integrate vulnerable workers into the agricultural workforce.
4. Developing means and indicators for monitoring progress and evaluating the impact of interventions in agriculture. WG4 was established to coordinate work in this area, which involved evaluating Eurostat statistics of agricultural enterprises, labour force, and accidents and occupational diseases in EU agriculture. Information on national data sources and challenges in data collection, and suggestions for further action were developed.
5. Disseminate results to stakeholders and the agricultural community. WG5 included Action Chair, Vice-Chair, Communication managers and representatives from each working group. WG5 developed a communications plan, including content, target audiences, media selections and timeline. WG5 developed and managed the Sacurima website, Facebook content and general communications. WG5 in consultation with the Action members developed and delivered policy recommendations at the EU and national level.

1.2 Safety culture and risk management: Action approach

The Sacurima COST Action investigated contributing factors and strategies to enhance Safety Culture and Risk Management at three different levels: EU level, National level and farm and worker level. EU policies and financial support for risk management play an important role in guiding national policies and efforts and funding research for the development of evidence-based interventions. National organizational structures and policies for regulations, agriculture, health services, education, social insurance, research etc. provide a framework for supporting the development of safety culture on farms. On the farm level, safety culture is influence by the existing financial, natural and human resources, regulations, influencers, agricultural support policies, and models and expectations set by neighbors, agricultural community, and society.

The Sacurima COST action explored existing policies and supports and potential ways the EU could take a stronger role in guiding policies that improve the health, safety and wellbeing of farmers and agricultural workers. This Action also explored differences between national approaches to health, safety and risk management in agriculture; organizations involved, actions taken; and examples of potentially effective approaches that could be considered for wider dissemination across borders. This Action also studied cultural and sociological aspects that hinder

or motivate farmers and workers to apply good safety and health practices and reasons for reluctance to change working conditions on farms.

Previous studies show that farmers often blame themselves for accidents while the underlying causes could be prevented by systematic risk management (Leppälä, 2016).

This COST Action aimed to produce new evidence-based knowledge and recommendations to support social sustainability and safe working conditions in agriculture. Information collected and generated by Action members and WGs aimed to generate new strategies and a framework for promoting national policy development. The WG5 and Action members disseminated information to stakeholders at the EU and national level in member countries, aiming to make measurable progress in reducing the burden of injury and illness in agriculture. WG3 focused on vulnerable workers, including refugees, and the special challenges in COST Target countries. Action members engaged with policy stakeholders and farmer's organisations to apply new policy and intervention initiatives that can be implemented to create safer workplaces for all workers in agriculture.

At farm level, it is important to consider how new tools and methods for farm health and safety management are linked with the general farm business risk management. A novel Farm Risk Map tool (Figure 2) was used for putting safety and health risks in perspective, considering all risk areas on and off the farm. While the EU and national agricultural risk management policies have focused on assets, finances, production, and environmental risks, this Action aimed to strengthen the management of human risks as part of a comprehensive approach for managing all risks that are critical for sustainability in agriculture (Leppälä, 2015).

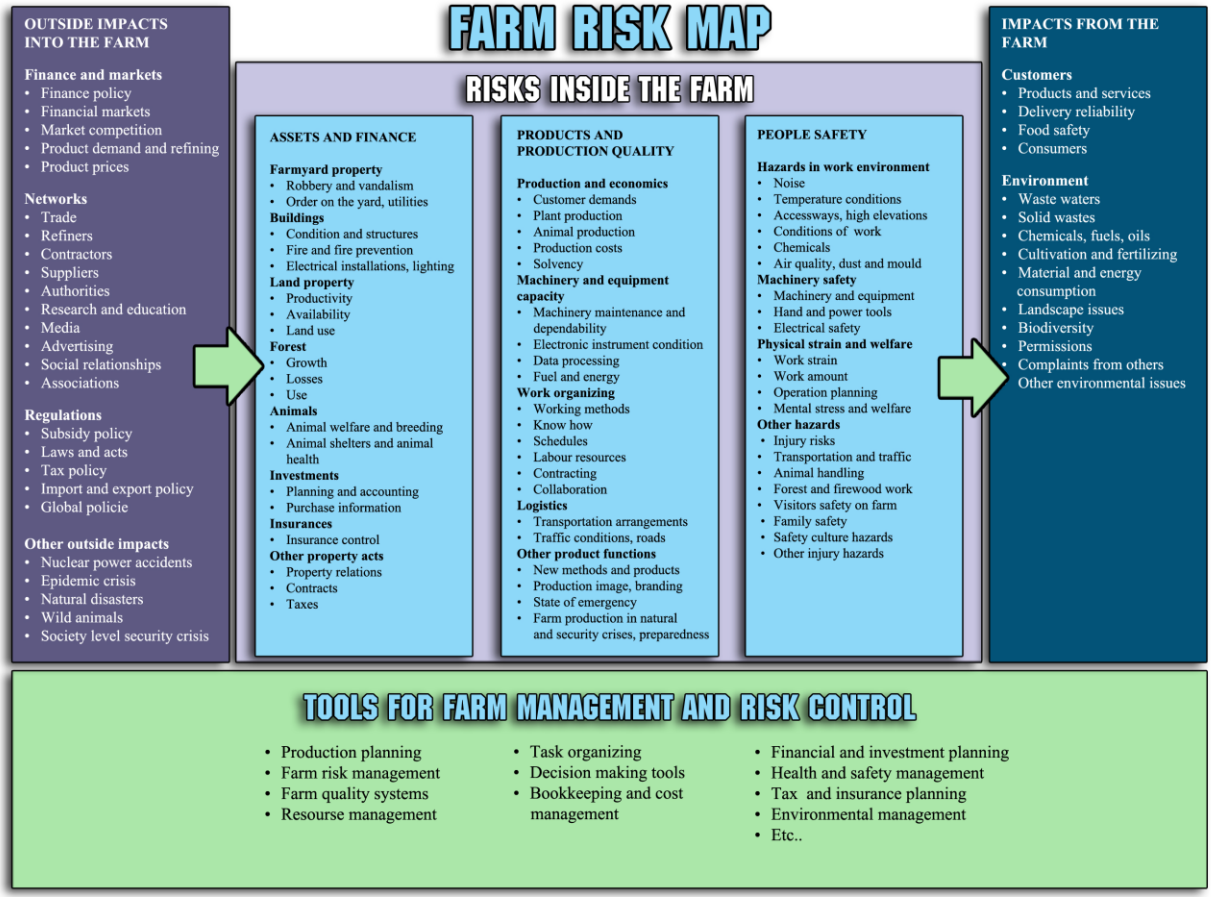

Figure 2. The Farm Risk Map (Leppälä, 2016).

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2. Activities to advance safety culture in agriculture

2.1 Identify and evaluate health and safety programmes and approaches on the national level

Authors: *Martina Jakob, Peter Lundqvist, Kari Anne Holte, Dushica Santa, Catherine Laurent, Inger Johanne Sikkeland and Björn Hilt*

This chapter focuses on national occupational safety and health approaches and programmes and practices in European agriculture. Reviews of the literature and a survey among Sacurima member countries were conducted to identify and compare agricultural safety and health organisations, programmes and practices in participating countries.

Available Eurostat and national statistics indicate that agriculture is among the most hazardous industry sectors in Europe. The Sacurima COST Action aimed to gain a better understanding of the countermeasures taken to reduce the high rates of injuries and illnesses in agriculture among Action member countries. The Working Group (WG1) conducted a survey of national agricultural safety and health programmes and approaches in 2018 where 25 network countries replied to the online questionnaire. The responses included information on descriptive statistics in agriculture, authorities and regulations dealing with agricultural safety and health, inspections and controls on farms, occupational accident and social insurance schemes, occupational health services, farm relief services, pension schemes, as well as extension, education, and other programs to promote occupational safety and health in agriculture (OSHA).

Regulatory authorities, regulations and enforcement

The EU directives constitute the legal framework for all EU members and associates. The most important directive 89/391 obliges all employers to carry out risk assessments, document risks and inform workers to prevent accidents and diseases resulting from work activity. Several other directives are also relevant for the agricultural sector as farm workers are exposed to a wide range of hazards.

Authorities and regulations applying to the agricultural industry are organized and operated in different ways throughout Europe. The primary responsibility for safety and health at work at the national level is commonly delegated to a ministry of labor or a labor inspectorate. Specific descriptions of these bodies are given on the EU OSHA webpage for each member country (EUOSHA, 2021). The WG1 survey showed that large European countries with a large agricultural sector, such as Germany, Poland, France, Italy and Spain have a number of national and regional regulatory bodies, regulations and organizations dealing with health and safety. Smaller countries in general have less fragmented national systems, legislation and control bodies governing the OSH issues in the agricultural sector.

Implementation of regulations requires enforcement through inspections, audits and controls. One of the survey questions addressed whether there are inspections on farms both with and without employees. All countries reported having systems for inspections on farms with employees, but self-employed farmers are excluded from inspections in most countries. The administrative authorities, and extent and frequency of such inspections differ widely. One critical issue where member states differ is if self-employed farmers are covered by OSH regulations, and if these regulations are enforced on small family farms. This is important as self-employed family labour represents a major proportion of the annual work units (AWU) in EU agriculture: 75% on

average with a wide range from 27% to 97% in member countries (Merisalu et al., 2020). Exclusion of farmers from regulatory compliance has many reasons, including resistance to regulation among farmers, and the significant administrative resource required for enforcement on large numbers of small enterprises in wide geographic areas. Inspections can be effective in ensuring that appropriate OSH rules and practices are followed on farms. However, in the absence of regulatory authority enforcement or resources for inspections, voluntary consultation services are offered to farmers in some countries, conducted by farm advisory or occupational health service personnel (e.g., Finland). Self-administered risk assessment programmes have also been developed for farmers in some countries (e.g., Ireland).

Injury data collection

The availability and reliability of data concerning agricultural working populations, accidents and ill health is a persistent concern in European agriculture. Eurostat statistics provide estimates of the agricultural workforce including the regular labour force and family labour's portion of the labour force. Estimates are provided for numbers of workers and numbers of annual work units (AWU). However, there are concerns that the Eurostat data does not provide accurate information on casual workers who do not have contracts of employment.

European Statistics on Accidents at Work (ESAW) provide guidelines for data collection for workplace accidents and illnesses, but implementation of these guidelines is limited due to lack of national reporting systems in relation to agriculture in most member countries. Relatively complete reporting is achieved in countries where regulatory and accident insurance functions are combined (e.g., Germany), or where accident insurance is compulsory for self-employed farmers and for hired workers (e.g., Austria, Finland). In the absence of strong regulatory or insurance systems, there are great difficulties in establishing accident reporting systems at the national level.

Occupational health services

A specific occupational health service for agriculture is not common; 14 out of the 25 responding countries do not have specialized preventive health services for people working in the agricultural sector. Seven countries have a specific occupational health service, and three respondents did not answer this question. Germany, France, Poland, Finland, Austria and Greece reported having specific social insurance systems dealing with health, pensions, workplace accidents and occupational illnesses. Sweden used to have specific occupational health service clinics for farmers, but this system ceased due to elimination of government support for the system. North Macedonia has a preventive program aimed at health and work ability assessment of agricultural workers. It covers preventive medical examinations and questionnaires to collect data on health status and occupational hazards in order to plan and implement preventive activities. Only four countries have some kind of specialized preventive health service for people working in the agricultural industry. Three of them are in the Nordic countries, Denmark, Finland and Norway.

Figure 3. Agriculture health and safety programs aim to support farmers' well-being and productivity. Photo: Pat Griffin.

Extension programs

Extension/advisory services are widely available to farmers in Europe, and most extension services include advising on safety and health issues (Figure 3). There are numerous kinds of extension programs; in many cases these initiatives are offered for limited periods of time with limited budgets. Some major longer running programs were identified such as the Swedish "Safe Farmers Common Sense" and a comprehensive Norwegian approach. In Norway the Food Branding Foundation (in Norwegian called "Matmerk"), is responsible for the Norwegian Agricultural Quality System (KSL, 2019), offering a quality system that all registered farmers have access to. In Ireland, the food quality assurance system has integrated farm safety into their programs and the Agriculture and Food Development Authority (Teagasc) has a strong focus on health and safety. The leading agricultural knowledge and innovation center in Denmark, SEGES, offers consultancy services for farmers, which include Health and Safety topics. Farmers own SEGES and it provides professional knowledge to the benefit of all farmers and the farming industry, and it is part of the Danish Agriculture & Food Council.

Discussion and conclusions

The WG1 survey shows great variability in regulatory frameworks, social insurance systems and prevention programmes for farmers in Europe. The survey also showed a variety of practices regarding the existence of occupational health services and extension programs across countries, although very few of these initiatives were permanent. This variety adds to the large differences found across Europe (EU) in regulatory frameworks and supports. A key finding is that the majority

of farmers are not covered by OSH regulation and enforcement. Accident insurance schemes that provide medical care, lost time benefit, and other benefits and statistics of accidents and occupational diseases for self-employed farmers are also lacking in most countries. Specific occupational health services designed for farmers are only provided in a few countries. The lack of these basic regulatory protections, social insurance and occupational health services results in the lack of reliable statistics and preventive services that could contribute to better safety culture and better safety performance in the agriculture sector. Farmers primarily rely on voluntary prevention programmes to help with questions and needs regarding OSH. Future developments and good practice examples have been discussed in a "Review of the future of agriculture and occupational safety and health (OSH) - Foresight on new and emerging risks in OSH" in which SACURIMA experts were co-authors.

Information box:

Review of the future of agriculture and occupational safety and health (OSH) - Foresight on new and emerging risks in OSH

The report has been commissioned by the European Agency for Safety and Health at Work (EU-OSHA) with the objectives of, first, examining future developments in the agriculture sector and, second, considering the implications of these trends for occupational safety and health (OSH). It is available for download here: https://osha.europa.eu/en/publications/future-agriculture-and-forestry-implications-managing-worker-safety-and-health/view.

This report addresses future trends in agriculture and forestry, such as new technologies and climate change, identifies the resulting technological and organisational changes in the sector and defines the implications for OSH among farmers, foresters and other workers in this sector. The report looks at a number of potential emerging risks, particularly those that are most imminent: risks linked to digital evolution in the agriculture sector and risks related to climate change. The review aims to inform policy makers at the European and national levels in their options for strategies, regulations, enforcement, guidance and support measures.

Authors: Alun Jones – CIHEAM (International Centre for Advanced Agronomic Studies), Martina Jakob PhD – Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB) (Sacurima member), John McNamara PhD – Teagasc (Irish Agriculture and Food Development Authority) (Sacurima Vice Chair), with contributions from Dr Andrea Teutenberg (Kuratorium für Waldarbeit und Forsttechnik e.V.) and Sacurima COST Action network.

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Sacurima Working Group 1: Meetings, workshops and presentations. https://www.sacurima.eu/activities/workinggroups/working-group-1/.

Information Box:

Working Group meeting in Montenegro
On January 22, 2020, a workshop meeting on "Structure of OSH and legislation in selected EU member countries" was held in Podgorica, Montenegro. A total of 19 representatives from different countries participated. The meeting was opened by a representative of the Ministry of Science and the Deputy Director of the Institute of Public Health in Montenegro (IPHMNE). They welcomed the participants and emphasized the importance of this workshop and the need to strengthen the scientific cooperation between the COST Action countries. The workshop was structured to include presentations in which different WG1 members and guests presented their results. OSH activities, structures and OSH legislation of Montenegro and North Macedonia were presented by the representatives Zlatko Popovic and Dr. Dushica Santa. Enisa Kujundžić from IPHMNE gave a presentation on Specialist course programs for persons who use plant protection agents. Dr Kari Kjestveit gave a presentation on Norwegian agriculture and OHS through a system lens. Senior Researcher Kari-Anne Holte from Norway presented her research on OSH training to farmers. Dr. John McNamara from Ireland led the group discussion on H&S advisory systems and their integration into country policies. The workshop provided a forum for fruitful discussions on the main challenges for OSH in agriculture and the identification for further activities for WG1 and the full COST action. The meeting participants were: Zlatko Popovic (ME), Dushica Santa (MK), Enisa Kujundžić (ME), Kari Kjestveit (NO), Kari-Anne Holte (NO), John McNamara (IE), Catherine Laurent (FR), Stephan Van den Broucke (BE), Martina Jakob (DE), Jarkko Leppälä (FI), Inger Johanne Sikkeland (NO), Born Hilt (NO), Kristin Svendsen (NO), Sonja Srbinovska (MK), Milena Milonjic (ME), Senad Begić (ME), Mladenka Vujosevic (ME), Dijana Djurovic (ME) (Figure 4).

Figure 4. Meeting participants in Podgorica, Montenegro. Photo: Martina Jakob.

2.2 Tools and measures for safety culture in agriculture

Authors: *Stephan Van Den Broucke, Jarkko Leppälä, Dushica Santa and John McNamara*

Objective

The second objective of COST Action 16123 Sacurima was to identify the knowledge, beliefs, attitudes, norms, competencies and perceptions of farmers regarding safety, health and risk management, to investigate the factors that determine their safety behaviours and practices. To achieve that objective, it was considered important to develop an adequate tool to measure these concepts in a reliable and valid way. While indeed previous research has addressed some of these factors in specific geographic areas using different methodologies, the unique contribution of Sacurima was to develop and use a uniform method to measure these attributes among farm operators, family members and employees, based on well-tested conceptual models of health and safety behaviour. A validated quantified measure of safety culture can be used for benchmarking national performances and informing interventions to guide farmers to act in a safe and healthy way. Within the Sacurima COST Action network there is a wide understanding that the development of safety culture on farms increases the potential for more effective overall management and better safety practices.

Background

Agriculture is one of the most dangerous occupations. At least 170,000 agricultural workers are killed worldwide each year (ILO, 2015). Of the nearly 3,500 workplace fatalities that are recorded annually within the European Union, approximately 20–25% are related to agriculture (Eurostat, 2021). The non-fatal accident rate is approximately 1500 accidents per 100 000 workers (Merisalu et al., 2019). More detailed statistics for farm accidents in the EU are given in Information Box 1.

Figure 5. Machinery maintenance reduces the risk of accidents and property damage. Photo: Jarkko Leppälä.

Information Box:

Statistics for farm accidents in the EU

- Agriculture has the worst fatal accident record of all major employment sectors
- Over 550 fatal accidents in the agricultural sector occur across the EU each year and many go unreported
- The stated fatal accident rate for the EU15 in 2,000 was 12.6 /100,000 workers
- The rate for non-fatal accidents with more than 3 days absence is more than 6,000/100,000 workers
- 30% of injuries in agriculture happen during machinery maintenance and repair
- The average compensation cost for farm machinery injuries is 3,796 € and the average lost work time is 32.6 days

Tractor accidents are the most common cause of machine-related injuries on farms. A third of the tractor injuries are the result of jumping, slipping or falling from the tractor

To tackle these accidents and injuries on farms, there are two basic approaches. One is to address the *consequences* of accidents through organising rapid emergency interventions to save lives and adequate follow-up to help the victims cope with the medical and psychological consequences of the injuries. The other is to address the *root causes* of the accidents, by identifying and acting on the behavioural and environmental determinants of health and safety problems through preventive interventions (Figure 5).

In general, there are two kinds of factors that can cause accidents (Figure 6): structural and behavioural ones (Gielen and Sleet, 2003). Structural factors are those that exist in the environment in which one works. They include the work environment, equipment and technology, the work processes and volumes, etc. Behavioural factors refer to unsafe practices performed by workers that can lead to an accident, such as unsafe handling of machines or animals, not wearing protective gear, or not adhering to safety guidelines. To improve the safety of farmers and reduce the incidence of accidents, both types of causes need to be addressed (Leppälä 2016; Reason 1997). While over the past decades risk management practices have made great progress in addressing the structural risks, by increasing the safety of equipment through engineering and improving the conditions of work through organizational or legal measures, unsafe behaviour remains a challenge, as the decision to perform a behaviour ultimately resides with the individual. Nevertheless, prevention science has demonstrated that unsafe behaviour can also be influenced. This can be achieved in three ways that are commonly described as the "3 E's" of health and safety: Engineering, Enforcement and Education.

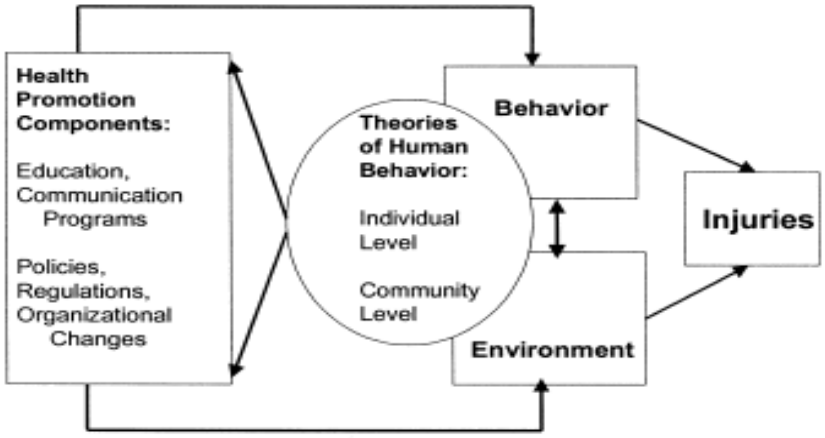

Figure 6. Structural and behavioural factors that cause accidents (Gielen & Sleet, 2003).

Of the three E's, education is the most widely applied strategy to change farmers' risk behaviour, and the most underestimated one. Systematic reviews (De Roo & Rautiainen, 2000; Burke & Ng, 2006; Coman et al., 2020) have shown that farm safety education programs can be effective in promoting safety-enhancing behaviour, but only if they meet certain quality conditions. One of these conditions is that they need to go beyond mere information giving and skills training and address the whole range of factors that influence farmers' decisions to behave in a way that is safer and avoids risks, such as attitudes, perceived norms, perceived competence, habits, or the safety culture of the farmers' community. These (mainly psychological) factors are elucidated in health behaviour models. Yet it turns out that only very few farm safety education programmes are based on such models (Colemont & Van den Broucke, 2006). This lack of theoretical grounding reduces the effectiveness of farm safety education.

To address this issue, the Sacurima COST network decided to develop a questionnaire to measure the determinants of farmers' safety behaviour as proposed in a state-of-the art conceptual model and apply this questionnaire in a uniform way in the participating countries, so as to obtain a mapping of the main factors that influence health and safety related behaviour of farmers. The results of this mapping can provide a basis for the development of more effective educational interventions promoting occupational health and safety among farmers.

Theoretical models of farmers' safety behaviour

Behavioural (or theories) have been developed to explain behaviours of people in specific situations. One of the most well-known and widely used of these models is the Theory of Planned Behaviour (TPB), developed by Ajzen (1991). As an example of the broader group of expectancy-value theories of psychology, the model has been proposed to explain intentional behaviour, i.e., behaviours which a person chooses to perform, based on a cognitive reflection process involving various beliefs. Specifically, the theory states that people's health and safety behaviour is based on their intention to perform that behaviour. This intention is in turn influenced by attitudes towards the behaviour (based on the expected outcomes and their subjective value), subjective norms (or the belief of what other people think about the behaviour or do themselves), and subjective control (or the subjective belief whether or not one is capable of performing the behaviour). The TPB has been widely used to explain various types of behaviours and found effective in explaining and predicting health related behaviours such as smoking, healthy eating, engaging in physical activity, or participating in health screening. A small number of studies have also applied the model to safety behaviour in agriculture (Colemont & Van den Broucke, 2006), leading to the

conclusion that the use of this model allows better predictions of intentions and/or of the safety behaviours of interest and thus can contribute to a better understanding of the determinants of health and safety related behaviour of farmers.

However, the TPB only considers individual determinants of safety behaviour, it does not take account of influences of the social and physical environment that can also influence safety behaviour. Some authors have therefore suggested extending the model by adding other variables such as habits, moral norms or contextualized knowledge (Rezaeia et al., 2018). Others have pointed to the importance of physical or social barriers that may impede the performance of safe behaviours, even when the person has the intention to act safely. In addition, safe behavior can be stimulated by "nudges" or "cues to action", i.e., elements in the environment that may act as a stimulus to act on an intended behaviour.

Information Box:

Definitions of Safety Culture
"The way in which safety is managed in a workplace. It is the combination of beliefs, perceptions and attitudes of employees toward the safety of workers and the overall safety of the work environment. Cultivating a safety culture is a key aspect in maintaining workplace safety." "A positive safety culture is the culture of a workplace in which all the employees think of safety as an important thing and behave in a way that prioritizes their own safety as well as the safety of those around them. This includes using proper personal equipment, following the safety laws and just generally being conscious of safety and safe practices at all times." (Source: Safeopedia)

Photo: Risto Rautiainen.

An important potential contributor contributor to safety behaviour that is often neglected in efforts to prevent injuries in agriculture is *safety culture* (McNamara et al., 2018). As a quality of the social environment, safety culture refers to the way in which safety is managed in a workplace. It represents the combination of beliefs, perceptions and attitudes of employees toward safety and the overall safety of the work environment (Edwards et al., 2013), and is considered to include values, perceptions, competencies, and patterns of behaviour that are stable over time (Cox and Flin, 1998). Organisations with a positive safety culture are characterized by communications founded on mutual trust, shared perceptions of the importance of safety, and confidence in the efficacy of preventive measures. While the concept of safety culture is typically applied to well-structured and regulated working environments like industry or commercial companies and seems less obvious for smaller semi-independent entities like farms, as applied to farms it could refer to the behaviour, attitudes, norms and practices of the *community* of farmers, which can influence an individual farmer's safety behaviour. Having a good safety culture on a farm also brings about a more positive and attractive image, a better understanding of the value of farm work in food production, better farmer welfare, better farm business value, better farm management and better risk management (Figure 7).

Figure 7. Good safety culture is part of good farm management. Photo: Luke.

Measuring the determinants of farmers' safety behaviour

A first step towards enhancing safety behaviour among farmers is to identify the behaviours that are unsafe, as well as the factors that determine their safety behaviours and practices. To that effect, there is a need for empirical data (Coman et al., 2020; Colemont & Van Den Broucke, 2005; 2008), and this requires having an adequate tool to measure these concepts in a reliable and valid way. Working Group 2 of the COST Action of Safety Culture and Risk Management in Agriculture (Sacurima) took on this task and developed a uniform measure of safety behaviour and its determinants among farmers, based on a state-of-the-art integrated conceptual model of health and safety behaviour.

Specifically, the measure was a self-report questionnaire measuring farmers' safety practices with regard to four key risk behaviours which, according to international research (Rautiainen et al., 2010; Karttunen et al., 2015; Leppälä et al., 2013, 2016; Donham et al., 2016; Moradhaseli et al. 2020) are the main causes for accidents, injuries and health problems among farmers (i.e., falls prevention, machinery handling, handling chemicals and pesticides, and animal handling), and the socio-cognitive and contextual determinants underlying these practices. For the latter, use was made of an extended version of the Theory of Planned Behaviour, where in addition to constructs of attitudes (based on the expected outcomes and their subjective value), subjective norms (based on normative beliefs and motivation to comply) and subjective control (based on beliefs of one's own capacity to perform the behaviour) the dimensions of physical barriers, cues to action and safety culture were added (Figure 8).

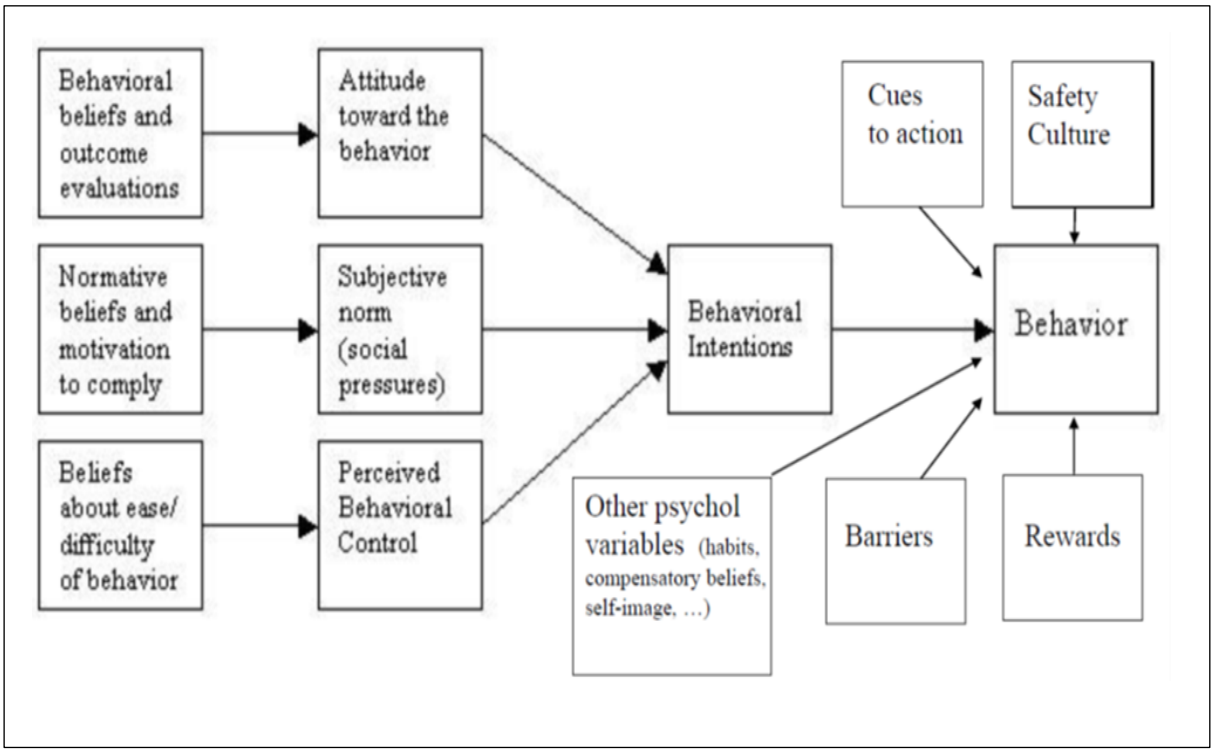

Figure 8. An extended model of determinants of farm safety behaviour.

Photo: Risto Rautiainen.

Preliminary study of farm safety behaviour and its determinants in 12 European countries

The survey instrument consisted of 81 questions, 8 of which measure demographic characteristics, 3 on the respondent's injury history, 17 on the farmer's safety practices with regard to the four key risk behaviours (fall prevention, machinery handling, handling chemicals and pesticides, and animal handling), 35 on the socio-cognitive determinants underlying these practices (expectancy based attitudes, perceived norms, perceived control, behavioural intentions), 5 on the perceived safety culture, and 7 on the importance of physical obstacles to safety practices. The questions regarding behaviour and their determinants had to be answered using Likert-type scales (1 = never, 5 = always for the behaviours, and 1 = strongly disagree, 5 = strongly agree for the socio-cognitive and safety culture items). For three of the four safety practices and their socio-cognitive determinants, the questions were preceded by a filter question (Do you work with machines/chemicals and pesticides/animals on your farm – yes/no), which allowed farmers for whom these questions are not relevant to skip parts of the questionnaire and thus save time.

The questionnaire was developed in English standard format and was translated into the national languages of the participating countries. This translation process involved three stages. First, a forward translation into the national language(s) was performed by the Sacurima member who was responsible for performing the survey. In a second stage, the translated version(s) was back-translated into English. In case of differences in translation, a consensus process decided on the most appropriate translation. In a third stage, a focus group was organised to check the comprehensibility of the translated version of the questions. In case of severe translation or comprehensibility problems, the WG2 leaders were contacted to help decide on any changes in wording of the questions considered necessary, to ensure comparability of the questions across countries.

The resulting questionnaire was applied in a pilot study involving participants from twelve countries: Belgium, Croatia, Finland, Germany, Greece, Ireland, North Macedonia, Portugal, Romania, Serbia, Sweden and Turkey. Data were collected and analysed during the years 2019 –2021. Participants were recruited by the Sacurima member using convenience sampling, and, following informed consent, were asked to complete the questionnaire in their own language. The data collection procedure varied between countries and could be either online survey (via an online survey software), on paper, by telephone, or face-to-face. In the case of telephone or face-to-face interviews, the interviewers underwent a training prior to starting the data collection.

In countries where national regulations foresee a review of ethical conduct requirement (e.g. through ethics committee within universities), it was ensured that these countries met the requirements. Where such requirements and ethics committees were not in place, national ethical guidelines concerning population surveys were followed and the protocol was submitted to a relevant board at national level. Furthermore, each country participating in the survey ensured compliance with the applicable national data protection legislation. EU-Member States additionally ensured compliance with the EU General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679, 2016). Furthermore, it was guaranteed that all participants were fully informed about the research and procedures in place to enable them to withdraw from the study if requested, were informed of the ways in which confidentiality and anonymity was assured and given details with regard to who can access the data and how it is stored and used. At the beginning of the survey, participants were informed that they could decide whether or not to participate and that they did not have to answer questions if they preferred not to. The actual data collection was preceded by a field test of the (translated version) survey questionnaire in each country on 5 participants, using purposeful sampling for the field-testing to ensure equal distribution of participants in terms of age, gender and region.

Results of the survey study*

A total of 1.642 valid questionnaires were returned. Table 1 gives the characteristics of the study participants, showing that the number of participants per country varied widely, between n=16 for Romania to n=599 for Finland. Roughly one third of the respondents (31%) were female. The majority (69%) were full-time farmers, the remaining third worked part-time as a farmer. Farm owners accounted for 77% of the respondents, the remaining 23% were farm workers. The most common farm production types in the sample were livestock production (34%), dairy production (32%), and commercial grain farming (29%), whereas commercial plantations (15%), subsistence farming (14%), pig or sheep farming (13%), and horticulture (8%) were less represented.

Table 1. Participants' characteristics and experience with accidents.

Country	Number of respond-ents	Gender % M/F	Full-time farmer %	Farm owner %	Employing others %	Personally involved in injury %	Others in-volved in injury %
Belgium	55	69/31	73	84	53	33	26
Croatia	202	57/43	63	32	10	16	19
Finland	599	59/41	81	91	22	47	35
Germany	107	88/19	77	85	39	29	42
Greece	36	89/11	58	81	58	42	19
Ireland	226	85/15	46	74	17	23	13
North Macedonia	47	77/23	53	79	49	34	17
Romania	16	63/37	75	63	44	13	0
Serbia	79	92/8	54	84	22	27	9
Sweden	26	62/38	54	73	54	35	31
Turkey	224	75/25	70	75	25	25	22
Portugal	27	89/11	63	85	74	4	30
Total	1,642	69/31	69	77	25	32	26

Involvement in farm accidents

A third of the participants (32.3%) declared having been personally involved in a farm accident causing an injury, and a quarter (25.9%) had seen others on their farm get involved in an accident, of which 11 had a fatal outcome (Table 1). Approximately 28% of the accidents caused more than four lost days in work. The incidence of farm accidents differed significantly between countries, with the highest percentages of personal involvement in farm accidents reported for Finland (47%) and Greece (42%), and the lowest for Portugal (4%), Romania (13%) and Croatia (16%). For witnessing others involved in an accident on the farm, the highest incidences were reported for Germany (42%) and Finland (35%), and the lowest for Romania (0%) and Serbia (9%).

Table 2. Accident rates by type of farming.

	% accident	*B*	*Wald*	*OR*	*p*
Personally involved in an accident with injury					
dairy farming	43.9%	0.616	28.529	1.852	<0.001
livestock	30.1%	-0.167	2.067	0.846	0.150
pigs or sheep farming	28.4%	-0.113	0.434	0.893	0.510
subsistence farming	31.8%	-0.167	0.808	0.860	0.369
commercial plantations	34.2%	0.176	1.226	1.192	0.268
horticulture	15.0%	-0.992	15.355	0.371	<0.001
commercial grain farming	25.3%	-0.380	53.285	0.488	<0.001
Others involved in an accident with injury					
dairy farming	39.3%	0.951	60.970	2.587	<0.001
livestock	25.1%	-0.030	0.058	0.970	0.810
pigs or sheep farming	31.3%	0.448	6.702	1.565	0.010
subsistence farming	21.5%	-0.542	7.729	0.582	0.005
commercial plantations	28.3%	0.277	2.650	1.319	0.104
horticulture	20.3%	-0.140	0.371	0.870	0.542
commercial grain farming	21.7%	-0.229	2.757	0.796	0.097

Table 2 shows the probability of being involved in an accident by the type of farming. As the table shows, the risk of being involved in an accident with injury is nearly twice as high for dairy farmers (OR=1.852, p<0.001) than for other types of farming, whereas farmers working in horticulture (OR=0.371, p<0.001) or commercial grain farming (OR=0.488, p<0.001) are less likely to be involved in an accident. The probability of others on the farm getting involved in an accident is also by far the highest for dairy farming (OR=2.587, p<.001), followed by pigs or sheep farming (OR=1.565, p<0.010), and the lowest for subsistence farming (OR=0.582, p<0.005). Furthermore, for the whole sample, farm accidents leading to an injury are significantly more likely to happen to farmers who received training in agriculture (OR=1.369, p<0.001) and who employ others (OR=1.372, p=0.023), but less likely to those who are full time farmers (OR=0.518, p<0.001) (not in the Table). Age, gender, or farm ownership did not influence the probability of having an accident.

Safety behaviour

To measure the safety behaviours of the farmers who participated in the study, four scales were constructed from the 17 items measuring the farmer's safety practices regarding the four key risk behaviours, using reliability analyses (Cronbach's alpha statistic) to check internal consistency. After removing the items that reduced the internal consistency, fall prevention was measured with 4 items (Cronbach $\alpha = 0.74$), machinery handling with three items (Cronbach $\alpha = 0.53$), handling chemicals and pesticides with five items (Cronbach $\alpha = 0.72$), and animal handling with three items (Cronbach $\alpha = 370$). The latter scale needs to be interpreted with caution, given the low reliability.

The mean scores on the safety behaviour variables for each of the participating countries are presented in Table 3. It is noted that on average the scores are relatively high (all scores $\geq$ 3.37 on a 5-point scale), but there are differences between the countries. Belgium, Croatia, Germany, North Macedonia, Romania, Serbia and Turkey score higher than the overall average for fall prevention. For safe machines handling, North Macedonia, Portugal, Romania and Turkey score the highest, and for chemicals and pesticides handling Croatia, Germany, Ireland, North Macedonia, Portugal, Romania, and Serbia. Safe handling of animals gets comparatively higher scores in Belgium, Germany, Ireland, Portugal and Sweden. Across countries, safety measures in the handling of chemicals and pesticides and of animals are best adhered to, and in machines handling the least.

Photo: Risto Rautiainen.

Table 3. Mean scores on four farm safety behaviours per country.

Country	Fall prevention	Machine handling	Chemicals and pesticides handling	Animal handling
Belgium	4.07	3.67	3.93	4.30
Croatia	4.24	3.37	4.41	3.67
Finland	3.63	3.79	4.27	4.25
Germany	4.06	3.98	4.38	4.44
Greece	3.92	3.67	3.77	3.79
Ireland	3.90	3.76	4.31	4.57
North Macedonia	4.01	4.03	4.30	3.98
Portugal	3.92	4.37	4.62	4.42
Romania	4.39	4.14	4.93	4.04
Serbia	4.25	4.04	4.34	4.13
Sweden	3.70	3.54	4.09	4.32
Turkey	4.24	3.93	3.93	4.16
Total	**3.93**	**3.80**	**4.23**	**4.23**

Table 4 shows the contribution of the four safety behaviours to the prevention of farm accidents leading to an injury. For three of the four behaviours, a higher mean score is obtained by those respondents who were not involved in a personal accident, although the difference is not significant for machine handling. For animal handling, the scores for those who did or did not have an accident are similar. A forward discriminant function analysis including falls prevention, machine handling, chemicals and pesticides handling as predictor variables produced a significant discrimination between farmers who did or did not experience an occupational injury (Wilks' lambda=0.979, χ^2 (4)=14.544, p=0.006, R^2=0.144). The structure matrix showed falls prevention (0.847) and chemicals and pesticide handling (0.605) to be the two behaviours that contributed mostly to this discrimination.

Table 4. Contribution of safety behaviours to the occurrence of a farm injury.

	INJURY		NO INJURY		F	P	DISCRIMINANT FUNCTION
	M	*SD*	*M*	*SD*			
Fall prevention	3.78	0.727	3.99	0.722	30.174	<0.001	0.847
Machine handling	3.77	0.797	3.81	0.823	1.100	0.294	0.229
Chemicals and pesticides handling	4.13	0.804	4.27	0.690	8.836	0.003	0.605
Animal handling	4.25	0.664	4.22	0.715	0.526	0.468	-0.024

Similar results were found for the contribution of the behaviours for the prediction of other people on the farm's involvement in an accident, with again a significant discriminant function (Wilks' lambda=0.978, χ^2 (4)=15.564, p=0.004, R^2=0.149). The structure matrix showed fall prevention (0.951) to be the main predictor of an accident involving others on the farm, with machine handling (0.381) and chemicals and pesticides handling (0.248) as additional contributors. In contrast, a discriminant function analysis looking at the impact of the four safety behaviours on the seriousness of accidents produced no significant results.

Determinants of safety behaviour

To measure the socio-cognitive and contextual determinants of the four safety behaviours investigated in this study, a series of scales were constructed based on the responses on the 47 questions on socio-cognitive determinants, perceived safety culture, and physical obstacles to safety practices contained in the questionnaire. For the creation of these scales, exploratory principle component analyses with Varimax rotation were used to identify the underlying dimensions of each set of questions related to the farmers' perceptions and beliefs regarding each of the behaviours with the number of factors to be extracted fixed at 4), as well as for the sets of questions related to safety culture and physical obstacles (with the number of factors to be extracted based on the eigenvalue = 1 criterium). Items with a low factor loading were discarded. Cronbach's alpha statistic was used to check the internal consistency of the scales.

As a result, for fall prevention four scales were created (attitudes, perceived social norms, perceived control, and intention) each consisting of 2 items (explained total variance=78.95%); for machines handling three scales were created (attitudes, perceived social norm and intention) each consisting of 2 items (explaining 74.90% of the total variance), while perceived control was measured by a single item; for chemicals and pesticides handling four scales were created, two of which (attitudes and social norms) consisted of 3 items and two (perceived control and intention) of 2 items (explaining 66.13% of the common variance); and for animal handling three two-item scales were created (attitudes, perceived social norm and intention, explaining 76.90% of the total

variance), while perceived control was again measured by a single item. Safety culture was measured by a scale of 5 items explaining 54.54% of the variance (Cronbach α =0.78), and perceived obstacles by two scales, one measuring personal obstacles (tiredness, stress, unavailability, lack of time, workload) with 5 items, and one measuring external obstacles (financial constraints, weather) with 2 items.

These scales were used to test the models explaining each of the four safety behaviours. For each behaviour, two multiple regressions were performed: one testing the prediction of the intention to perform the behaviour on the basis of attitudes, perceived social norms and perceived behavioural control, as proposed by the Theory of Planned Behaviour, and one testing the behaviour on the basis of intention, perceived control, safety climate and personal and external obstacles, as proposed in the extended model (Figure 2). The results of the regression analyses are shown in Table 5.

Photo: Risto Rautiainen.

Table 5. The contribution of attitude, subjective norm, perceived behavioural, safety climate and perceived obstacles to perform safety related behaviours and intentions.

	$R^2_{adjusted}$	β	t	p
Fall prevention				
Intention	0.291			
Attitude		0.269	12.961	< 0.001
Subjective norm		0.263	11.667	< 0.001
Perceived behavioural control		0.184	8.316	< 0.001
Behaviour	0.173			
Intention		0.310	12.133	< 0.001
Safety climate		0.165	6.913	< 0.001
Personal obstacles		-0.112	-4.520	< 0.001
External obstacles		0.100	3.976	< 0.001
Perceived behavioural control		-0.021	-0.877	0.381
Machine handling				
Intention	0.428			
Attitude		0.585	26.584	< 0.001
Subjective norm		0.153	6.936	< 0.001
Perceived behavioural control		0.000	0.015	0.988
Behaviour	0.207			
Intention		0.388	15.114	< 0.001
Safety climate		0.142	5.565	< 0.001
Personal obstacles		0.049	1.770	0.077
External obstacles		-0.090	-3.242	0.001
Perceived behavioural control		0.095	3.694	0.381

Photo: Risto Rautiainen.

Table 5 (continued)

	$R^2_{adjusted}$	β	t	p
Chemicals and pesticides handling				
Intention	0.189			
Attitude		0.244	8.483	< 0.001
Subjective norm		0.153	5.415	< 0.001
Perceived behavioural control		0.197	7.010	< 0.001
Behaviour	0.202			
Intention		0.225	7.764	< 0.001
Safety climate		0.314	11.199	< 0.001
Personal obstacles		0.085	2.793	0.005
External obstacles		-0,012	-0.406	0.685
Perceived behavioural control		0.082	2815	0.005
Animal handling				
Intention	0.253			
Attitude		0.314	12,687	< 0.001
Subjective norm		0.238	8,833	<0.,001
Perceived behavioural control		0.134	4,932	< 0.001
Behaviour	0.130			
Intention		0.191	6.282	< 0.001
Safety climate		0.161	5.507	< 0.001
Personal obstacles		0.238	7.,800	< 0.001
External obstacles		-0.267	-8.541	< 0.001
Perceived behavioural control		-0.070	-2.340	0,019

The results show that, as assumed by the TPB, the combination of attitude, subjective norm and perceived behavioural control contribute to the intention to perform safe behaviour. The model gives the best explanation for machine handling (adjusted R^2=0.428) and the least for chemicals and pesticide handling (adjusted R^2=0.189). For fall prevention, chemicals and pesticides handling and animal handling all three constructs of the model contribute significantly to the intention, whereas for machine handling, perceived control does not contribute significantly.

The results also show that behavioural intention, safety climate and perceived personal and external obstacles contribute to the performance of safe behaviour. This is the strongest for machine handling and chemicals and pesticides handling, where these factors account for 20% of the variance (adjusted R^2=0.207 and 0.202, respectively), less so for animal handling (adjusted R^2=0.130). Of the contributing variables, intention and safety climate consistently are significant contributors to all four safety behaviours, whereas for fall prevention and machine handling perceived control does not contribute significantly to acting on the intentions to perform the actual behaviour; for

machine handling personal obstacles do not contribute significantly either, and for chemicals and pesticide handling, this is the case for external obstacles.

Summary and discussion

Working Group 2 of the COST Action Sacurima network aimed to identify the knowledge, attitudes, norms, competencies, and perceptions of farmers regarding safety, health and risk management, as a way to investigate the factors that determine their safety behaviours and practices. To achieve that objective, it was considered important to measure the determinants of safe or unsafe behaviour of farmers. Therefore, a survey questionnaire was developed based on empirically defined and widely used models of health-related behaviour as applied to farm safety, and a survey was held among farmers in twelve European countries.

A total of 1,642 farmers participated in the survey. The biggest sample was from Finland (599 respondents) and the smallest sample from Romania (n=16), so the variation between respondent numbers of the participant countries was high. Moreover, the selection of the participants was done through a convenience sampling method, and different methods were used to collect the data, namely via internet, phone or personal contact. As such, one should be careful not to compare the findings with regard to the incidence rates of farm accidents in the different countries. Nevertheless, it is important to note that approximately a third of the respondents had been personally involved in accidents on a farm causing an occupational injury, and that one out of four had seen other persons get injured on their farm. This underscores the fact that farming remains a dangerous profession, and that enhancing farm safety should be a priority.

One of the factors that lead to farm accidents is human behaviour. In the survey we focused on four specific behaviors that are often linked to (avoidance of) farm accidents: fall prevention, machine handling, chemicals and pesticides handling, and animal handling. Of these four behaviours, fall prevention, chemicals and pesticides handling and, to a lesser degree, machine handling were the most strongly related to farm accidents and injuries in our sample. The study also revealed that all these behaviours are to a significant extent determined by socio-cognitive factors such as attitudes, perceived social norms and perceived control, but also by factors in the social and physical environment, notably the safety culture within the farmers' community and perceived obstacles.

In conclusion, the results of the survey confirm the hypotheses that behavioural and nonbehavioural factors determine the behaviours of farmers that can lead to, or avoid, the occurrence of accidents on farms, and that these determinants can best be understood and explained by relying on well-evaluated theoretical models of human behaviour. As such, this pilot study offers guidance for improving safety training and education of farmers. Further research along the lines of this survey, involving more representative samples, could add to the understanding of what drives farmers to behaving safely, to further improve prevention efforts, and thus help reduce the unacceptably high level of farm injuries and fatalities in Europe.

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Photo: Risto Rautiainen.

2.3 Vulnerable Workers in Agriculture

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This chapter aims to identify effective models and methods for training and recommendations on integrating vulnerable populations (including refugees and young workers) into the agricultural workforce. Activities in the Sacurima Working Group three (WG3) followed steps to achieve this objective: a literature review on vulnerable population concepts in the EU and surveys related to vulnerable populations, followed by discussion and recommendations.

Challenges of vulnerable worker groups in agriculture

The literature review was conducted to define, what kind of vulnerable populations are working in agriculture (Figure 9). The review included a holistic approach of human risk in agriculture. This Working Group's tasks included identifying approaches for dealing with vulnerable populations in agriculture, exploring the agricultural employers' willingness to hire vulnerable workers, as well as vulnerable workers willingness to work in agriculture. The assessment included special cases in COST target countries.

Figure 9. Foreign-borne migrant and immigrant workers are an essential part of the agricultural workforce. Photo: Katrine Alexandra Leirmo Heiberg.

The existing literature offers programs and models describing good practices when working with vulnerable populations in agriculture. In the review produced by SACURIMA these vulnerable worker groups were identified as immigrants, migrants, refugees, young and older persons, women, persons with disabilities, and minority workers (Ramos et al., 2020; Girdziute, 2020). Agriculture has specific problems related to hiring workers: farm work is not prestigious; shortage of qualified human resources in rural areas; young and old farm family members and employees leaving the farm to work in urban areas or foreign countries; farmers have personal or financial obstacles in hiring employees, employees are not capable or skilful enough for farm work and stereotypes about agriculture work.

Vulnerable populations may have different meaning in different regions (incl. Africa, Europe, America) and different countries. The European understanding of the vulnerable population groups in agriculture could be divided as follows (Figure 10):

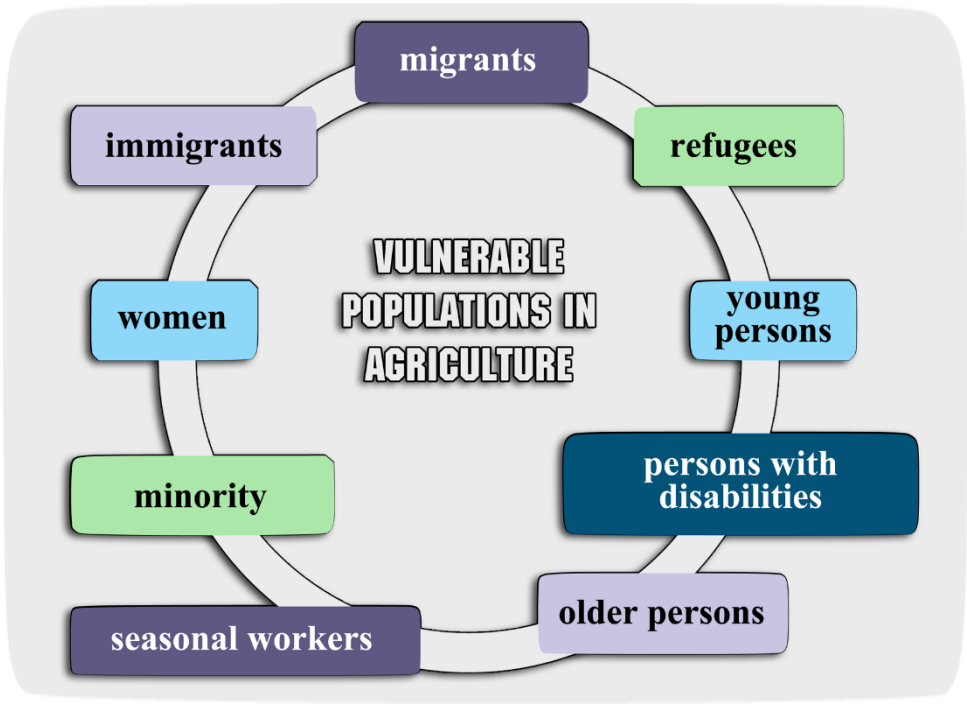

Figure 10. Vulnerable populations in agriculture (Sacurima).

Table 6 introduces the main findings in the literature review. In general, the main difficulties among vulnerable working groups in agriculture are limitation of information and data, higher risk of occupational injury because of lack of training and communication problems, ignorance of pregnancy vulnerabilities and cultural differences. Above all, the lack of the employers' management knowledge is a limitation when dealing with vulnerable worker groups, who have different abilities than the farm manager or employer. Agriculture involves many types of work tasks that vulnerable workers are capable of doing; however, the main managerial consideration should be on ensuring that all tasks are done in a safe manner. Every worker must have knowledge, information, training and tools to do their work safely. The goal of the WG3 was working to form a good understanding of vulnerable populations' working conditions, work challenges and management challenges in EU agriculture.

Table 6. Vulnerable populations in EU agriculture and their main vulnerability challenges.

Vulnerable populations	Vulnerability challenge
Migrant and seasonal farmworkers	• Limited official data • Work is occasional, depends on weather • Differences in agricultural work practices • Limited safety training • Limited protections
Foreign-born farmworkers (including both immigrants and refugees)	• Limited official data • Communication challenges, language barriers • Cultural differences • Differences in agricultural work practices • Limited formal safety training • Limited reporting of hazardous conditions
Beginning farmers (those with less than five years' experience)	• Less experience and skills to identify risks • Limited safety training and emergency preparedness skills • Economic pressure with little access to capital • Limited experience in production, finance, and labour management
Individuals who have physical or mental disabilities	• Potential higher injury risk • Necessitates the need for assistive technologies, rehabilitation services, or adapted work practices
Farm family members	• Lack of health and safety regulations and formal inspections • Presence of children and older adults resulting in age and developmental differences in physical abilities and cognitive reasoning • Exposures to family members who are not "working" • Women may experience reproductive risks due to chemical, zoonotic and veterinary pharmaceutical exposures • Off-farm employment leading to stress and limited focus on safety

A major challenge related to the safety and health of vulnerable agricultural workers in COST member countries is related to the uncertainty regarding how much the officially reported worker numbers differ from the actual numbers. While the statistics of fatalities, injuries and occupational diseases are incomplete for the farmers and workers with an employment contract, even less is known about the injuries and illnesses of undocumented seasonal workers.

Temporary employment of poorly paid and untrained agricultural workers for temporary jobs, especially immigrants and refugees who lack work license and insurance, poses significant challenges in Europe. Clear culturally sensitive and linguistically appropriate training for migrant workers is needed to educate vulnerable workers regarding OSH risks. Low level of education may also

result in literacy problems and lack of knowledge, which may lead to increased safety risks. Lack of knowledge of labour rights and fear and reluctance to speak up about unfair treatment and hazardous conditions could lead to problems both for the farm worker and farm manager.

Ageing of the agricultural workforce has been a trend in recent years in Europe. This may cause problems in the future, if fewer young people are willing to work on farms. Girdziute et al. 2021 found that many youths are unwilling to work in agriculture; they dislike nature and animals and think that work in agriculture is dangerous. For those that do work in agriculture, the major motivational factors are associated with skills obtained in agricultural training and loving animals and the natural environment. Mattila et al. (2020) found that foreign farm workers were motivated by their social networks, better living conditions, better working conditions, proper working tools and good training and orientation, which provide better working skills. These motivational factors can be helpful in finding ways to attract young people and other vulnerable population groups to work in agriculture.

Finding methods and tools to integrate vulnerable populations into the agricultural workforce

Education is the most typical method to integrate people into the agriculture workforce. Work in agriculture involves many different activities and various skills are needed. In the survey among the Sacurima participants, a practical training method for vulnerable workers is to combine theoretical and practical training with risk specific information, which have been tested in Finland in several studies (Leppälä 2019; Leppälä 2016; Leppälä 2011).

Agriculture was traditionally an occupation where skills were handed down from parents to children, but current farm work is more demanding and complex, particularly on farms using advanced technologies. Agricultural tasks such as operating tractors or applying pesticides may require mandatory courses or certificates. Dedicated safety training for farmers, agricultural employers and employees and vulnerable worker groups is important for building a good safety culture and securing sustainability in the agriculture sector. It would be important to have courses for employers on pertinent relations and employee management. Safety courses should include guidance on farm safety and risk management for employers, including tips to support vulnerable worker groups in agricultural work. Continuous attention and discussion with the workers about safety is also needed. According to occupational health and safety management standard all employees should be oriented to a new job or new activities, which include training for the tasks, but also safety information and managing the potential risks (ISO 45001).

To establish "Safety Culture" on farms, more safety education, guidance and material for various training courses is needed. Considering the risks to vulnerable workers on farms, developing short, instructive agriculture training materials covering the main safety issues on farms is essential. Specific guidance and training may be needed for different vulnerable groups working on farms; foreign workers, refugees, old and young family members, workers with disabilities and beginning farmers. The material must be simple enough to understand and focus on safety related to the main work tasks.

Discussion

Education courses, OSH training and task specific safety training requires expert trainers or institutions, which need monetary support from governments, foundations or sponsors to ensure that high standards are achieved. In general, society and government must understand the importance of social responsibility in agriculture and how safety and security in food production needs incentives and supports to ensure the quality and sustainability of the food systems. Institutional controls are needed to ensure maintaining an adequate workforce in food production. Vulnerable groups like foreign agriculture workers and refugees, who like to work in agriculture, may need collaboration between different authorities and stakeholders. These programs need organized planning and policy management in collaboration with all stakeholders working for the same goal. Subsidies and tax reductions motivate employers to hire agriculture workers. Sometimes farms in some regions may experience a lack of farm workers, which may cause food system disturbance and food supply problems in the area. Using vulnerable populations' skills and abilities to work in some farming tasks, could be an important option for agriculture and farms to ensure their production in the future. Programmes to increase the attractiveness of farm work, ensuring a safe working culture on farms, particularly among young people and other vulnerable groups, is needed and should be promoted.

Information box:

SACURIMA COST Action workshop

In SACURIMA COST Action workshop organized on April 25–26, 2019 at Vytautas Magnus University Agriculture Academy, Lithuania aimed to find solutions for improving safety culture and risk management for vulnerable populations in agriculture. Scientists and experts from Denmark, Finland, the Netherlands, Portugal, Turkey, Serbia, Estonia, Slovenia, Latvia, Lithuania and USA (Figure 11) attend this meeting and shared their experience and knowledge in the fields related to agriculture worker vulnerabilities, risk management and safety in agriculture. In the two-day workshop the five main vulnerable populations groups were defined and their main OHS risks identified. These were; Migrant and seasonal farmworkers, Foreign-born farmworkers (including both immigrants and refugees), Beginning farmers (those with less than five years of experience), Individuals who have physical, mental, or intellectual disabilities and Farm Families (children, pregnant women, older people).

Figure 11. Photos from WG 3 workshop: How to improve safety culture and risk management in vulnerable populations in agriculture? Photos. Laura Girdziute.

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2.4 Health and safety risk management indicators in agriculture

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This chapter presents indicators and methods for monitoring progress and evaluating impacts of interventions on reducing injuries and illnesses in agriculture. Sacurima Working Group 4 (WG4) participants set out to identify the strengths and weaknesses of existing data collection mechanisms and propose improvements on the national and European level (Figures 16, 18, 19). WG4 also carried out research to find effective surveillance systems and indicators of health & safety and risk management in the agriculture sector.

Introduction to agriculture health and safety indicators

Agriculture is a dynamic ecosystem where normally very little is structured, in contrast with industrial sector, where work tasks occur within a relatively stable and structured environment and objects (Benos et al., 2020; Bechar and Vigneault, 2017). Agriculture sector is vulnerable to inherent heterogeneity, uncertainty and unforeseeable situations (Figures 12 and 13) (Bechar & Vigneault, 2017). Farming is estimated to be among the most hazardous industries in terms of number of fatalities, fatality rates, number of non-fatal injuries and non-fatal injury rates (Rautiainen and Reynolds, 2002; DG SANCOS, 2004; Rautiainen et al., 2004; OSHA 2019; Benos et al., 2020). In EU agriculture and forestry there has been over 500 registered deaths over 150,000 non-fatal accidents annually on average (Eurostat, 2017).

Figure 12. Slips and falls from tractors steps is a common source of injuries. Farm visit, Ireland, 2018. Photo: Eda Merisalu.

The incidence of fatal accidents in agriculture and forestry is already the second highest of all sectors at 6.1 per 100,000 workers, after mining, which is only slightly higher at 6.8 per 100,000 (Eurostat, 2019a). The incidence of fatal accidents in forestry alone is 24.5 per 100,000, making

forestry work one of the most dangerous professions in Europe. In Ireland too there are twice as many fatal accidents in agriculture as in construction (15 per 100,000) (Griffin, 2013). A similar pattern occurs for non-fatal accidents, which number 2,813 per 100,000 for forestry and logging (second most dangerous sector) and 2,019 for crop and animal production, hunting and related services (fourth most dangerous as in fatal WA cases).

Figure 13. Safe animal handling requires good fences. Farm visit, Ireland 2018. Photo: Eda Merisalu.

Terminology and indicators

Eurostat data on accidents at work uses the harmonized "European Statistics on Accidents at Work (ESAW)" methodology. ESAW uses the NACE Rev. 2 system for the 'Statistical Classification of Economic Activities in the European Community', managed by Eurostat (NACE Rev 2, 2008). Changes to sub-groups in economic sectors were made in 2013/14; and the last changes in Eurostat statistics categorizations were in 2020/2021.

Eurostat publishes data on fatal accidents (FA) and non-fatal accidents (NFA) by economic sector using the NACE methodology. Sector A includes agriculture, forestry and fishing (AFF); Sector A.1 includes agriculture alone, consisting of crop and animal production, support activities and hunting (CAPH).

An accident at work is defined as 'a discrete occurrence in the course of work which leads to physical or mental harm'.

A fatal accident at work is defined as an accident which leads to the death of a victim within one year of the accident.

If the accident does not lead to death of the victim, it is called a 'non-fatal' accident. Eurostat data includes non-fatal work accidents involving 4 or more calendar days of absence from work.

Work related diseases are defined as multi-factorial diseases among a working population, which are partly caused by work, and/or aggravated, accelerated or exacerbated by occupational exposures, and/or are the cause of impaired work capacity (WHO).

An occupational illness is taken to mean any illness that is exclusively or predominantly due to harmful substances or certain tasks (which are listed) at work and other illnesses which prove to have been caused exclusively or predominantly by the exercise of an occupation.

An occupational disease is a long-term medical condition and the main cause of it is a physical, physiological, chemical or biological hazard related to work. An Occupational Health Physician diagnoses an occupational disease, usually related to an insurance claim.

The variables collected on accidents at work by Eurostat include: Economic activity of the employer and size of the enterprise, Employment status, occupation, age, sex and nationality of the victim; Type of injury, body part injured and the severity of the accident (number of full calendar days during which the victim is unfit for work excluding the day of the accident, permanent incapacity or death within one year of the accident).

Variables on causes and circumstances of the accident include: workstation, working environment, working process, specific physical activity, material agent of the specific physical activity, deviation and material agent of deviation, contact – mode of injury and material agent of contact.

'The Eurostat Farm Structure Survey (FSS) provides a wide range of information on agricultural holdings, including data on the farm labour force characteristics. The FSS is carried out in the form of an agricultural census every 10 years and as a sample survey every 3 or 4 years.

EU INDEX is calculated as the median of country indexes and is expected to be disseminated through the 'data navigation tree' on Eurostat's dissemination database, and through the occupational diseases (OD) dedicated page, as part of Experimental Statistics, on Eurostat's website. The EU INDEX will be complemented by the national country profiles, which will show the national situation in relation to the 'core-list' of occupational diseases. The dissemination of national country profiles is subject to national agreement.

The data on recognized cases of OD's reflect not only the occurrence of such diseases, but also the way in which the concept of OD has been integrated into the national social security systems.

The existence of different legal systems and procedures for the recognition of OD's in Europe makes a comparative exercise difficult, noting that a low number of recognized cases of an OD in a given country is neither a sign of the absence of such a disease nor necessarily a clear proof of successful prevention.

In the same way, well-established detection systems and large-scale information campaigns could explain the high numbers of reported and recognized OD cases in some countries.

Due to the comparability issues, the current dissemination has been limited and consists of one indicator called EU INDEX that shows the evolution of the diseases in the 'core-list' over time, at the EU level.

Overview of work accident statistics in European Agriculture

In the past decade the incidence rate of non-fatal accidents (NFA) in *agriculture, forestry, and fishing (AFF) and in *crop and animal production, support activities and hunting (CAPH) showed a steady increase (Table 7; Appendix 2). In 2010, the highest rate of NFA in CAPH was reported by Italy (3.943:100,000), with a decreasing trend in later years. In 2013 the highest NFA rate was reported in Finland at (5,330:100,000) but showed a steady decrease over the following 7 years. In 2016 the highest NFA rate in CAPH was in France (5.325:100,000); and even higher in 2019 (5.532:100,000). Potential reporting errors in the zero cases in France in 2012 and extremely high NFA rate in Czechia in 2019 remain under discussion (Table 7).

Photo: Risto Rautiainen.

Table 7. Incidence rate (per 100,000 annual work units) of non-fatal accidents in crop and animal production, support activities and hunting in EU countries 2010–2019 (Eurostat 2021).

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
EU-28	1,169	1,214	1,553	1,501	1,730	1,754	1,817	2,019	1,863	
Belgium	560	1,914	1,387	1,612	1,586	588	1,763	1,732	1,493	
Bulgaria	67	48	61	54	57	62	38	43	28	39
Czechia	280	2,136	2,034	2,020	2,011	2,126	1,929	1,928	2,343	40,139
Denmark	1,403	1,439	1,561	1,583	1,551	1,306	1,266	1,093	1,608	2,638
Germany	1,838	2,298	2,279	1,858	1,897	1,747	1,860	1,695	1,528	1,421
Estonia	2,383	1,382	1,182	1,914	2,050	2,256	1,992	1,115	1,613	2,175
Ireland	1,116	408	541	1,848	1,317	1,511	856	711	855	726
Greece	11	8	12.	5	5	45	17	28	6	7
Spain	1,549	1,852	3,307	3,524	3,750	3,929	3,836	4,053	4,011	3,805
France	126	14,68	0	3,494	5,114	5,153	5,326	5,591	5,608	5,531
Croatia	616	768	733	483	616	533	814	943	695	1,818
Italy	3,944	4,058	3,614	3,621	3,549	3,868	3,559	3,431	3,176	2,950
Cyprus	226	349	513	171	295	218	256	251	525	259
Latvia	74	326	192	278	291	233	436	315	615	201
Lithuania	77	92	401	101	330	273	298	307	326	483
Luxembourg	1,787	1,543	1,553	2,170	1,928	1,676	3,895	3,026	3,026	3,684
Hungary	445	673	348	287	487	462	605	414	429	457
Malta	912	943	894	359	679	423	466	558	485	413
Netherlands	122	575	1,471	1,892	3,004	688	427	1,488	2,401	860
Austria	3,044	2,519	2,172	2,117	2,230	1,912	4,514	5,005	2,563	2,289
Poland	167	50	52	49	50	49	51	169	155	45
Portugal	629	605	530	654	998	1,279	1,166	984	1,111	1,147
Romania	2	67	63	54	49	79	79	77	85	5
Slovenia	400	1,689	147	121	1,478	1,441	1,259	1,318	1,282	647
Slovakia	1,048	810	791	910.	699	879	886	970	1,144	956
Finland	678	5,289	744	5,331	4,931	4,679	4,528	4,793	5,357	

Sweden	695	638	685	554	629	715	502.45	621	749	753
Norway	350	464	719	324	614	478	646	613	530	216
Switzerland	897	2,611	2,956	3,410	2,898	3,303	4,722	2,916	3,563	
UK	1,677	1,873	1,909	1,949	2,158	1,845	1,695	1,784	1,725	

Note: EU-28 (2013–2020)

In the past decade, the incidence of fatal accidents (FA) in AFF and CAPH in EU countries shows a steady increase. However, several countries regularly report a zero rate for CAPH FA's: Belgium (2012, 2014, 2016–2017), Estonia (2012–2013, 2015–2016, 2018–2019), Greece in most years except for 2014, 2017–2018), Croatia (2014–2016), Lithuania (2018), Luxembourg (2013, 2015, 2017), Netherlands (2017), Slovenia most years, Slovakia and Switzerland (both in 2017). At the time of writing the data is unavailable for 2019 – EU total, Belgium, Finland, Switzerland, and UK. (Table 8; Appendix 2)

When summarising FA rates through the (2010–2019) decade, Austria, Luxembourg, Norway, Ireland, Czechia, and Latvia have reported the highest rates in CAPH (Table 8). The FA rate in CAPH (cases per 100,000 agricultural workers) remains below 10 per year in most EU countries. From 2010 to 2016, a sharp increase was registered in Luxembourg (65.5:100,000), Austria (59.6:100,000) and Latvia (47.4:100,000) but decreased again in 2019 in these countries. In Czechia an extremely high FA rate was reported in 2019 (91.2:100,000) (Table 8).

Photo: Risto Rautiainen.

Table 8. Incidence rate (per 100 000 annual work units) of fatal accidents in crop and animal production, support activities and hunting in EU countries 2010–2019 (Eurostat 2021).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
EU-28	3.62	3.41	4.68	4.02	4.30	4.07	4.63	4.50	4.91	
EU-27	3.61	4.35	4.81	4.03	4.32	4.10	4.66	4.51	4.92	
Belgium	1.59	18.36	0	5.12	0	5.84	0	0	4.25	
Bulgaria	10.53	6.86	13.16	3.19	7.74	9,04	2.94	5.78	6.19	1.62
Czechia	6.91	9.17	10.84	10.30	6.04	7.64	6.89	9.71	9.65	91.16
Denmark	9.03	9.61	14.12	12.72	4.85	4.75	14.36	5.85	6.36	14.35
Germany	2.37	2.94	3.36	2.33	2.50	1.64	2.03	1.77	2.27	2.84
Estonia	8.47	15.42	0	0	6.17	0	0	11.67	0	0
Ireland	24.09	25.58	23.41	12	24.34	14.13	19.87	22.14	13.7	17.37
Greece	0	0	0	0	0.22	0	0	1.01	0.22	0
Spain	1.62	1.97	5.29	4.38	4.03	4.86	3.85	3.47	4.24	3.81
France	0.96	33.98	0	8.67	6.91	6.52	13.71	8.08	9.68	9.30
Croatia	5.80	3.95	4.07	3.07	0	0	0	2.76	3.67	5.81
Italy	10.03	11.72	10.71	10.94	9.90	10.10	9.01	7.14	8.14	10.42
Latvia	6.49	10.87	5.34	23.80	15.31	5.19	47.36	5.94	18.35	9.86
Lithuania	9.55	4.04	9.55	4.19	15.96	5.01	10.73	7.94	0	8.78
Luxem-bourg	13.34	13.41	14.25	0	15.06	0	65.46	0	58.75	32.03
Hungary	5.21	14.99	3.91	3.53	3.57	0.82	9.66	3.67	5.73	3.90
Nether-lands	8.70	0.43	0.39	1.85	1.52	0.28	0.25	0	1.27	0.70
Austria	39.01	23.23	24.34	26.14	31.10	27.45	59.58	30.46	31.60	19.54
Poland	1.85	0.56	0.55	0.24	0.42	0.62	0.26	0.60	1.09	0.15
Portugal	2.35	2.01	3.45	2.59	2.20	4.73	3.06	3.59	1.86	3.63
Romania	0.52	10.36	12.87	13.22	11.05	17.58	18.64	17.70	12.84	1.10
Slovenia	0	0	2.10	0	7.07	0	7.36	14.17	0	0
Slovakia	1.82	7.30	6.97	13.25	3.42	6.03	2.14	0	8.33	11.52
Finland	1.13	4.86	1.27	5.27	7.65	6.45	8.12	2.82	4.97	
Sweden	3.73	19.22	6.62	0	8.98	10.78	7.82	10.13	17.13	0
Norway	8.31	6.47	11.06	19.20	47.70	30.01	24.40	18.06	30.25	10.32
Switzer-land	2.27	2.22	7.17	2.59	9.58	7.32	10.73	0	2.71	
UK	10.49	12.59	12.15	14.59	8.79	8.80	9.11	12.54	11.48	

Abbreviations: FA – fatal work accident; CAPH – crop and animal production and hunting and related service activities.

Countries reporting zero fatalities in CAPH have also zero as their fatality rate in AFF. AFF tab-les are seen in Appendices. The highest rates of FA in AFF in 2010–2019 were reported in Austria, Romania, Norway, Ireland, Luxembourg, and Latvia. The annual FA rate is highly variable in AFF but remains below 10:100,000 in most EU countries (Appendix 2).

WG4 members carried out farm accident and farm occupational disease surveys in 2019 as part of the Sacurima COST Action. The surveys were sent out to all SACURIMA members and substitutes. After the surveys, WG4 compared this national data with Eurostat numbers, to identify differences and opportunities for improvement in data registration and reporting. The Sacurima survey showed significant differences between in Eurostat statistics and national statistics for both FA and NFA rates in CAPH 2013–2015–2017 (Figures 14 and 15).

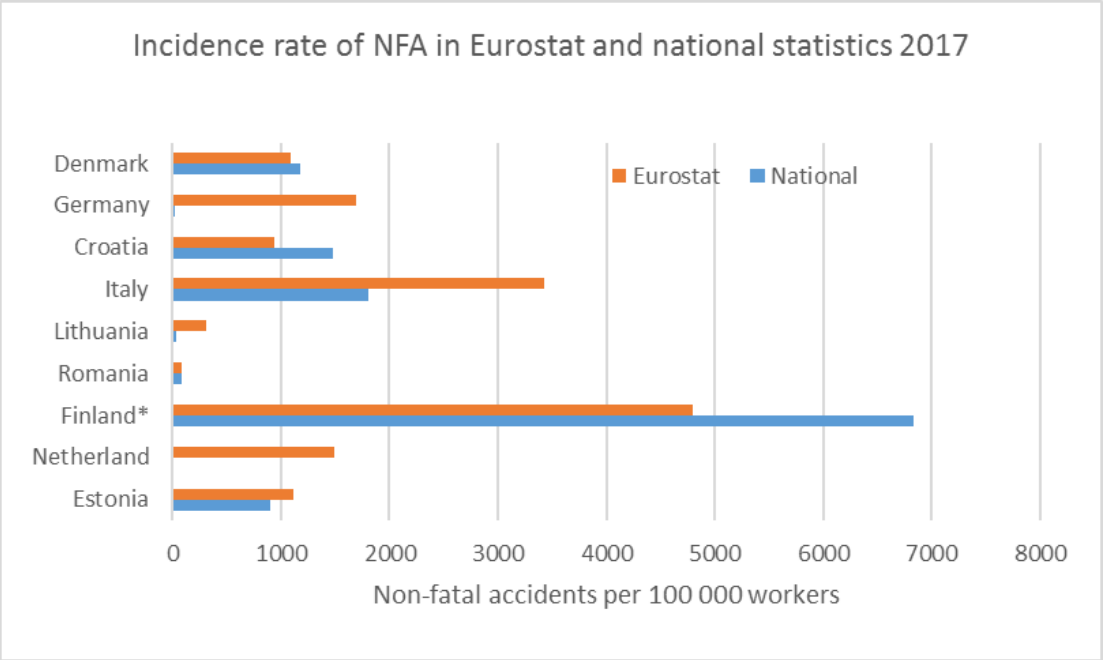


Figure 14. Comparison of 2017 non-fatal accident rates reported in Eurostat vs. national statistics based on a Sacurima survey (2019).

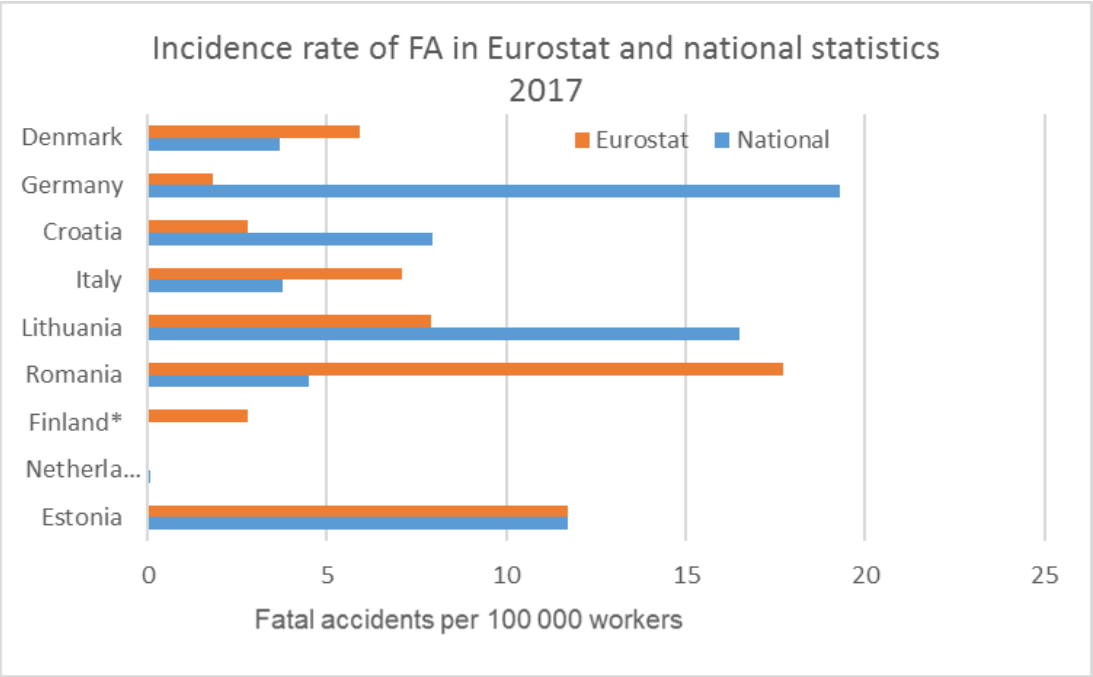


Figure 15. Comparison of 2017 fatal accident rates reported in Eurostat vs. national statistics based on a Sacurima survey (2019).

Comparisons of Eurostat and national accident rates indicate a challenge in calculating accurate accident statistics in agriculture. The differences are partly due to ESAW reporting guidelines regarding the inclusion/exclusion of self-employed farmers, irregular or temporary workers, active retirees and family members. This inaccuracy is a major concern as the majority of the agricultural and forestry working population is included in these categories. In many instances, national rates are considerably higher and place agriculture and forestry at or nearly the top among industry sectors (OSHA, 2019).

Potential accident risk indicators

In micro enterprises — those with no employees (self-employed and unpaid family workers) — AFF represents 12.7% of all non-fatal accidents at work registered in EU-27 in 2018 while about 50% of the AFF information is lacking (Eurostat, 2018). Further, the highest share of fatal accidents (20.0%) among industry sectors was recorded for agriculture, forestry, and fishing (Eurostat, 2020).

Figure 16. Management Committee participants getting to know the farm ergonomics on a farm in Croatia. Photo: Risto Rautiainen.

Information box:

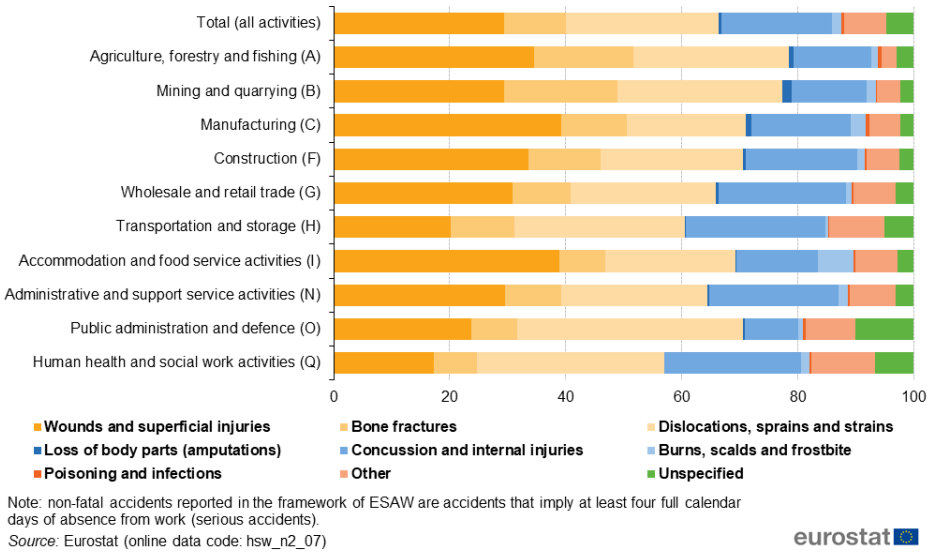
The top eight killers in agriculture are (IAMZ 2011):
Transport accidents (being run over by or overturning of vehicles) Falls from height (through roofs, from ladders, trees) Being struck by falling or moving objects (machinery, buildings, bales, tree trunks) Drowning (in water reservoirs, slurry tanks, grain silos) Handling livestock (attacked or crushed by animals, zoonotic diseases) Contact with machinery (unguarded moving parts) Entrapments (under collapsed structures) Electricity (electrocutions) (OSHA, 2019).

Much of the agriculture work is still carried out by hand and the stress on hands, shoulders and upper back is reflected in statistics (Figure 16). Injury analysis in agriculture work by body part shows that for all activities combined, the most common body parts injured in non-fatal work accidents in the EU-27 in 2018 were the upper limbs (shoulders, arms and hands) at 39.3%, followed by 29% for lower limbs. The back accounted for 11.3% of all injuries. Injuries to the torso and organs were relatively common in agriculture, forestry and fishing (6.4%) compared with an average for all economic activities of 3.5%. Head injuries made up 9.4% of non-fatal accidents in agriculture, forestry and fishing, compared with 6.3% in all sectors combined. The analysis of fatal work accidents in agriculture, forestry and fishing, highlights that around one third of fatalities in

the EU-27 in 2018 related to injuries of the whole body or multiple sites (32.9%), and nearly one quarter (23.9%) were head injuries and (13.4%) were injuries to the torso and organs (Eurostat, 2018).

Statistics on non-fatal accidents in 2018 showed two particularly common types of injuries in the EU-27, namely, wounds and superficial injuries (29.3%) and dislocations, sprains and strains (26.4%). The next most common types of injuries were concussion and internal injuries (19.1%) and bone fractures (10.7%); none of the other types of injury accounted for a double-digit share of the total number of non-fatal workplace accidents. Bone fractures were relatively common in agriculture, forestry and fishing (17.0%) compared with the average for all economic activities (10.7%). The loss of body parts (amputations) was also relatively common in agriculture, forestry and fishing (0.7%) compared with the overall average (0.4%). Burns, scalds and frostbite were 3.6 times as common in accommodation and food service activities (6.0%) as the average for all activities (1.7%), while poisoning and infections were relatively common in agriculture, forestry and fishing and in manufacturing (both 0.6%) compared with the average for all economic activities (0.4%) (Figure 17). (Eurostat, 2020)

Non-fatal accidents at work by type of injury and economic activity, EU-27, 2018
(% of non-fatal accidents for each activity)



Note: non-fatal accidents reported in the framework of ESAW are accidents that imply at least four full calendar days of absence from work (serious accidents).
Source: Eurostat (online data code: hsw_n2_07)

Figure 17. Non-fatal accidents (%) by type of injury and economic sector in 2018 (Eurostat, 2019).

There are two particularly common types of injuries in fatal accidents in the EU-27 in 2018, and these were different from those observed for non-fatal accidents. Multiple injuries accounted for almost one quarter (22.9%) of all fatal accidents, while concussion and internal injuries accounted for one fifth (20.0%) of the total. The next most common fatal injury type was bone fractures (11.9%). In the EU-27 bone fractures were a relatively common type of injury among fatal accidents for agriculture, forestry and fishing (17.5%) (similar to construction 17.6%). Wounds and superficial injuries were relatively common within agriculture, forestry and fishing (8.4% of fatal accidents) and in accommodation and food service activities and public administration and defence (both 7.5%), compared with the average for all economic activities (5.4%). (Eurostat, 2018).

It should be noted that both fatal workplace accidents and non-fatal accidents with over 3 days absence from work for employed workers are reportable under EU OSH directives. However,

within the over 3 days category, there can be a range of serious consequences and accident types on farms. For example, in Finland agriculture had the highest incidence of over 30 days serious injury accidents (Karttunen et al., 2006). Gender differences are commonly reported among many industries, where males have a higher incidence of injuries compared to women. This is also true in agriculture, but this may be caused by difference in working hours performing dangerous tasks on farms (Appendix 3). Differences in injury risk have been found by production type, farm size and income factors, and cultural differences may also affect injury reporting (Figure 18). In Finland, Swedish speaking farmers had a significantly lower farm accident incidence rate than Finnish speaking farmers (Karttunen and Rautiainen, 2013). Also working with heavy machinery is a major source of serious accidents in agriculture. One third of the farm injuries with machinery were associated with maintenance and repair in Finland (Leppälä et al., 2016).

Figure 18. Talking about cultural differences on farms. Hurdal, 2018. Photo: Eda Merisalu.

Occupational disease and health problems in agriculture

Eurostat (2010) has reported that work-related health problems occur more often in the 'agriculture, hunting and forestry' sector along with in the mining and quarrying sector than in any other occupational sector. This may be related to less favourable job characteristics, such as manual work and atypical working hours, in these sectors. According to an EU survey from 2012, workers from the agriculture sector were more likely than those in any other sector to report that their work affected their health (Eurofound, 2012). Over 60% of agricultural workers reported having a limiting chronic disease or high levels of cardiovascular disease (CVD). Pesticide-related risks, musculoskeletal disorders (MSD), zoonoses, skin cancer, stress and psychosocial issues are all either major continuing or emerging risks in the sector. These have either not been adequately addressed or have been underestimated owing to lack of accurate data over the years. (EU-OSHA, 2019).

Limited availability of European data sources on health and well-being makes it difficult to compare the agriculture and forestry sector with other occupational sectors. According to one European study, over 60% of agricultural workers report a limiting chronic disease, and agriculture is the second highest occupation reporting chronic disease in general. In a 2007 EU survey 61.3% of respondents from the agriculture and fishing sector reported that their work affected their health; significantly higher than the construction sector, which was the next highest at 44.3% (Eurofound,

2007). Individuals with a chronic disease have reduced employment and earnings prospects, partly because they are more likely to leave the labour market early or because they find it difficult to re-enter employment after an absence due to disease (Eurofound, 2019).

Agricultural work often involves a worker's whole family (including children and the elderly) and parents often take their children with them into fields, thus exposing both to occupational hazards (ILO 2000). Exposure to poor working conditions has serious repercussions on children's growth, development and health, as well as on women's pregnancy and worsening pathologies brought on by old age (Tibone, 1989). Women and men working in agricultural industries and women living on farms have a higher risk of infertility. Other birth defects related to the use of agrochemicals include oral and facial clefts (Hoppin et al., 2006; McCauley et al., 2006) A number of studies on women's health in agriculture have revealed the relationship between occupational hazards and iron deficiency and anaemia in pregnant women as well as complications in gestation, foetal disorders, physical and development disorders in new-borns and infants. The risk of miscarriages, premature deliveries and spontaneous abortions has been directly related to work in unfavourable conditions, such as microclimates in greenhouses and exposure to pesticides (Molina-Guzman and Rios-Osorio, 2020; Beane-Freeman et al., 2011; Delaney et al., 2009).

The Sacurima Working Group 4 literature study found that a wide range of reviews on specific agricultural exposures and health effects have been published, especially on pesticide exposure and long-latency effects such as different types of work-related cancer and degenerative neurological diseases. Other important indicator categories for risk monitoring include respiratory diseases associated with agricultural dust, musculoskeletal disorders, zoonoses and noise-induced hearing loss.

Within European countries, existing data collection systems on work-related diseases in agriculture vary widely. In most countries only compensated occupational diseases are reported. However, in some countries self-employed farmer incidents or only farm employee incidents and diseases are reported, because of differences in social security systems. Underreporting about social factors associated with work related diseases is a universal problem among farmers and farm workers. Added to this, health surveillance of migrant workers includes many socially unknown factors.

In Ireland, farmers have been shown to have higher levels of cardiovascular disease and cancers than other occupational groups. It is fair to say that farmers in most countries face significant health challenges (Van Doorn et al., 2020; EU-OSHA 2019).

A survey conducted by Sacurima WG4 confirmed the supposition that national and Eurostat statistics have wide variation and many gaps and are not satisfactory as acceptable information sources for making 'evidence based' decisions related to policy making to improve accident and occupational ill health prevention in the European agriculture sector (Figure 19).

Figure 19. Farm visit, Croatia 2017, discussing better well-being on farms. Photo: Eda Merisalu.

Discussion

In this chapter the means, indicators and examples for monitoring progress and evaluating impact of interventions on injuries and illnesses in agriculture were explored. The agriculture sector in Europe is estimated to be among the most hazardous industries in terms of the numbers and rates of fatalities and non-fatal injuries. Notably, the level of seriousness of injuries in agriculture is higher than for other sectors. Fatal and non-fatal accident statistics provide risk indicators that can be used to evaluate the effect of structural changes in the agriculture sector in Europe. Eurostat statistics and national statistics related to agriculture and ill health in agriculture should be developed to get more reliable comparisons between different countries and to track progress over time. In conclusion, WG4 makes the following recommendations: 1. improve OSH reporting systems, 2. Statistics need to be detailed enough to provide data for separate sub-sectors within the agriculture sector, 3. develop analysis for socioeconomic background data (e.g. farm size, land size farmed, number of enterprises in each country, demographic characteristics of the farming population including proportion of family members and self-employed farmers; insurance systems in place) and 4. research required to analyse OHS situation in microenterprises and self-employed people in agriculture and 5. Monitoring of serious accidents (over 30 days sick leave) should take place in agriculture statistics.

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3. Disseminating the measures and tools of safety culture and risk management to agriculture stakeholders

Authors: *Pat Griffin, Anne Marie Heiberg, Helle Birk Domino, Jarkko Leppälä and, Risto Rautiainen.*

Sacurima Working Group 5 (WG5) disseminated Sacurima Action networking results, participants' research findings, published papers, conferences, events and other items of interest and recommendations to authorities, stakeholders and the wider agricultural communities in all participating member countries. The **SACURIMA.eu** web and **SACURIMA Facebook** site were designed and developed during the Action for spreading the message of safety culture and risk management in agriculture. Information about the Action Management Committee, Core Group, COST Association, Grant Holder organization, Objectives, Activities, Meetings and other deliverables such as Presentations & Papers, Press Releases, Policy Recommendations and ongoing research can all be found on the web site (Figure 20).

SACURIMA facebook site has had 85 members and the web site has had significant numbers of visitors. The SACURIMA Logo was designed placing the farmer at the center of our work and used on the web site, Facebook page and on all Sacurima presentations and documents (Figure 21).

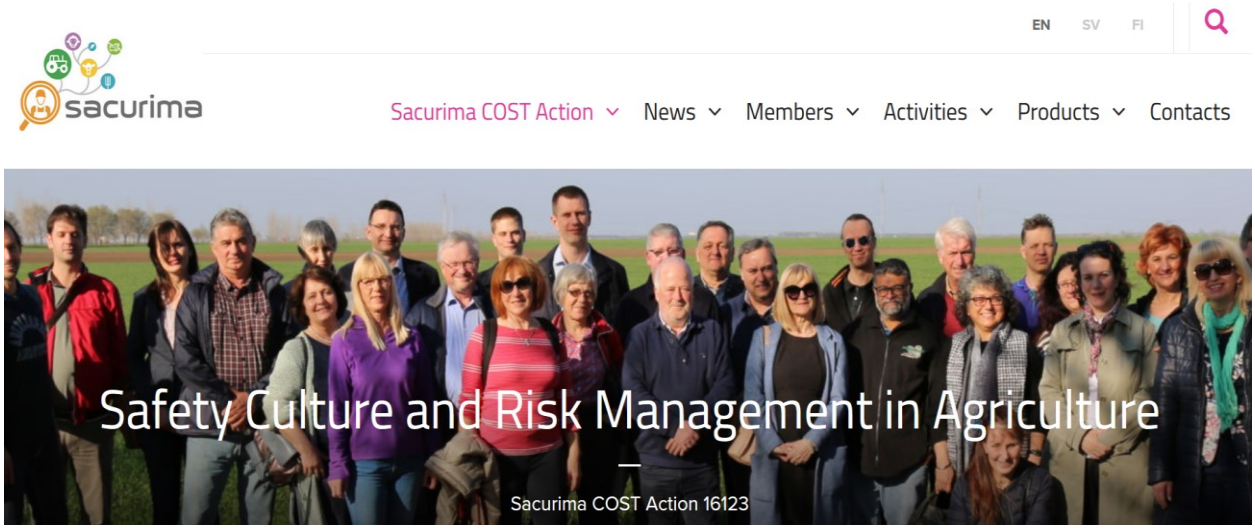


Figure 20. Sacurima website front page.

Web site content

Lots of work went into making the web site functional and attractive showing photos of EU agriculture, Core Group meetings, Working Group meetings and hosting Sacurima network outputs such as ongoing research, policy recommendations, videos and published papers. The web site featured the Kick-off meeting and Action Objectives followed by all Working Group meeting Agendas and Minutes to allow Action Members and interested parties follow the Action activities (Sacurima 2018). The website address has been shared and referenced in every presentation and publication presented during the Action.

Information box:

Sacurima kick-off meeting at the COST Association head office, 2017.

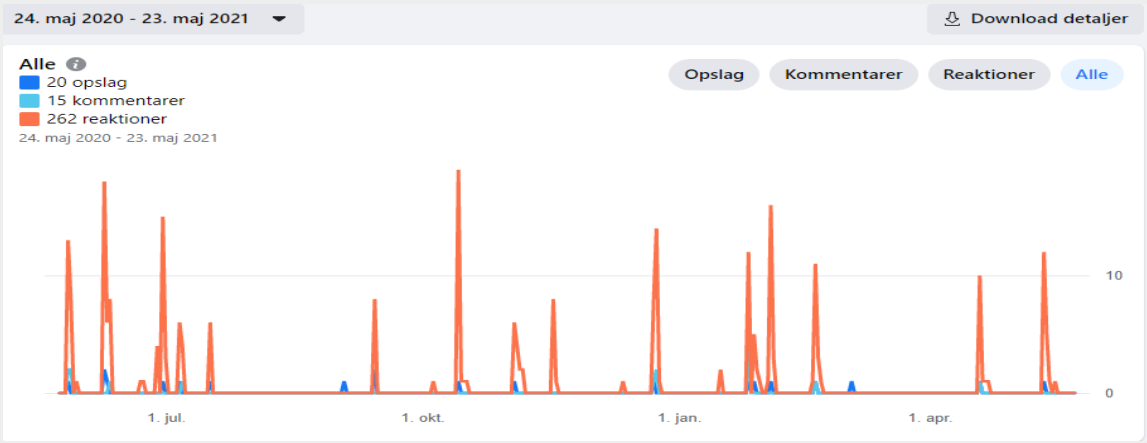
Facebook was used as the most appropriate social media platform for interaction within our group and our wider audience.

Facts about SACURIMA facebook site

- Created 4th of September 2017
- 84 members
- Total about 185 uploads (pictures, text, agendas, videos, statistics, posters, presentation, reports)

53 of 84 have been active in one way or the other for the last year (on facebook site)

Regular communication increased the reactions, upload and comment in the Sacurima network and between the other interest groups. In the facebook the Sacurima members have shared their latest research results, photos and background information, which is not available in other sources.



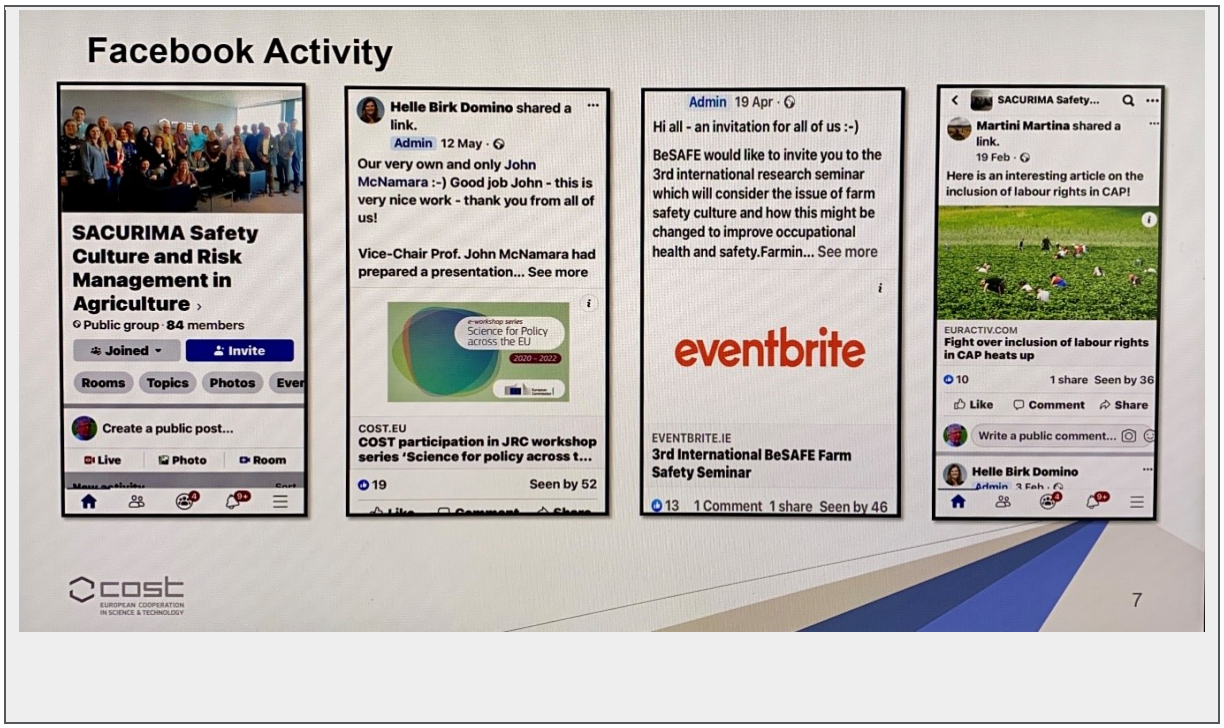


Figure 21. Sacurima facebook pages (Facebook pictures: Helle Brik Domino/Photo: Risto Rautiainen).

The Communication plan was developed to inform SACURIMA members and wider audiences throughout the Cost Action period. The Communication plan was approved by the Sacurima Management Committee to ensure regular networking among the Action members and participants. The communication plan asked the chairs of Working Group's to report back to the dissemination Working Group so that outputs and information could be shared.

Videos

The Sacurima COST Action put efforts and resources into visual media, particularly videos as a means of dissemination of the Action work and focus. The Sacurima members presented the videos in farmer events, stakeholder meetings, education events, conferences and shared the video links by email to other experts and stakeholders. The aim of the videos is to give strong and concrete examples of the meaning of safety culture and risk management in agriculture and why OSH is critically important to future generations in agriculture. Three videos were produced and delivering the messages of the Sacurima COST Action:

The first video is about a young farmer's thoughts on what Safety Culture means for him, and why this Cost Action on Safety Culture and Risk Management in Agriculture is important to create strong EU & National Policies that will support and encourage the right mindset and build a safety culture, to improve safety on farms (Figure 22).

(The first SACURIMA video was produced by Metafor AS, Norway and published in January 2019).

Figure 22. Sacurima video 1.

The second video talks about farm injuries and the importance of safety culture and risk management in agricultural work. Farming has to become a safer and healthier if we are to ensure the sustainability of food production. At policy level, we need to ensure that farmers have the skills and competence to make sure that they can achieve the highest standards of safety on their farms to prevent injury and ill health (Figure 23).

(This video was produced by Indiepicks, Ireland and published in March 2019).

Figure 23. Sacurima video 2.

The third video points out what can be done to improve health and safety for vulnerable groups defined as the very young and the very old, new farmers and farmworkers, foreign-, immigrants-, seasonal- and migrant workers and workers with traumatic injuries or disabilities. Also, the need for an established policy to improve health and safety for vulnerable populations in agriculture is highlighted (Figure 24).

(The video was produced by Indiepics, Ireland and published in April 2020).

Figure 24. Sacurima video 3.

One important mission for the Sacurima WG5 was to participate in meetings and conferences in the wider agriculture sector to bring strong messages to all stakeholders and experts. Sacurima Core Group and WG5 members participated in ENASP – European Network of Agricultural Social Protection System's conference in Berlin and networked with interested parties. In tandem with this conference, the dissemination group organized a Sacurima Core Group meeting and WG5 meeting to work on several important topics for the Action. These meetings produced; 1. Policy Recommendations on agriculture safety culture and risk management setting out important issues for consideration of the European Parliament, Committee on Agriculture and Rural Development, 2. An information letter was drafted to be sent to Agricultural Ministers, 3. Several presentations to EU-representatives on the policy recommendations and 4. A standard Power Point Presentation was developed for use by all Action Members.

Figure 25. Sacurima website policy recommendations. Photo: Risto Rautiainen.

An important part of the WG5 dissemination was to prepare and attend meetings with EU and national policy makers (Figure 25). The group held Policy Proposal Meetings in the EU Parliament Buildings in Brussels with EU Commissioner **Ms Mariya Gabriel** and DG Agri and Rural Affairs Cabinet Member **Mr Kevin Keary, Ann Marie O'Brian** on behalf of Mrs Mairead McGuinness, First Vice President of the European Parliament and member of the Committee on Agriculture and Rural Development. The group also held meetings with **Dr Miriam Dalli MEP**, Member of the Committee on the Environment, Public Health and Food Safety. **Daniel Buda MEP**, Vice-Chair of the Committee on Agriculture and Rural Development, **Dr Alfred Sant,** Member of the Committee on the Economic and Monetary Affairs and Committee on Budgets and met the management representatives of The European Voice of Farmers and Agri-Cooperatives (COPA*COGECA) in Brussels. The meeting documents can be found on the Sacurima website (www.sacurima.eu).

Photo: Risto Rautiainen.

Information box:

Policy recommendations

Proposed by members of the COST Action 16123, Safety Culture and Risk Management in Agriculture (SACURIMA).

1. Protect the safety, health and well-being of agricultural producers and workers in Europe by integrating OSH into all current and future agricultural policies. Update the CAP policy objectives to include workplace risk management using 'Safety Culture', 'Zero Vision' and 'One Health' principles.

2. Establish a European Network for Agricultural Safety and Health with regional and state affiliated organizations focusing on the safety, health, well-being and sustainability of people involved in agriculture.

3. Allocate specific funding for agricultural safety, health and well-being research in Horizon 2020 / Horizon Europe.

4. Develop and implement a safety, health and well-being risk assessment, education and skills program for primary producers, including self-employed farmers, family members, workers and students in agricultural schools.

5. Improve Eurostat and national statistics to reflect the true incidence and severity of agricultural workplace death, injury and ill-health.

Photo: Risto Rautiainen.

Another important meeting was organized virtually (due to Covid-19) in summer 2020 on June 30. This web meeting involved 23 participants including representatives from the EU Commission and Parliament, COST Association and Sacurima COST Action (See Sacurima website/other dissemination activities). The background and wide membership of the Sacurima COST Action was

presented, along with the Sacurima policy recommendations. The meaning of safety culture and risk management in agriculture was discussed and the video on "Vulnerable persons working in agriculture" was presented along with the Action Policy Recommendations developed from research carried out by the SACURIMA COST Action.

Conference sessions

Sacurima COST Action objectives and progress was presented at several international conferences. The first high profile conference session was organized in collaboration with the International Occupational and Environmental Diseases Congress, Antalya, Turkey on March 7, 2018 (See Sacurima website/other dissemination activities). The session title was "Promoting Health and Safety Culture in the Agricultural Sector" and it included discussions on the success factors in reducing agricultural injuries and illnesses. The result of the session was used in the work of Working Groups 2 and 4.

Another successful conference collaboration session was organized to coincide with the Nordic Meeting on Agriculture Occupational Health and Safety held in Hurdal, Norway on September 13, 2018. WG leaders presented the networking objectives, ongoing research, results to date and identified several ideas to consider in their work from the international panel discussion.

The Sacurima COST Action set out the objectives, research and update at the International Society for Agricultural Safety & Health (ISASH) virtual conference moderated by the University of Nebraska Medical Center. With this international high-profile conference in USA and many others, the work of the Sacurima COST Action is known to those with an interest in OSH in Agriculture all over the world.

Information box:

Handout item – Shine a light on Ag safety

Flashlights with Sacurima and COST Action logos and the slogan "**Shine a light on Ag-Safety"** were produced by WG5. The flashlights were distributed to all MC members for further distribution at meetings with farmers as a reminder of the importance of always considering health and safety. In dark winter night, this light may save lives.

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Greetings from the Working Group meetings on and off the farm!

Photos: Risto Rautiainen.

4. Effects of COVID-19 on agriculture and preparedness for future pandemics

Authors: *Jože Starič, Aurelie Berthet, Jarkko Leppälä, Natasa Janev Holcer, Federica Masci and Claudio Colosio.*

In Spring 2020 the world faced a worldwide pandemic caused by a coronavirus, SARS-CoV-2, which most likely originated from an animal source. The international evidence is that most resent epidemic treats originate from animal sources. This strong link between agriculture and public health emphasizes the need for promoting and enhancing risk prevention in its broadest terms in the agricultural sector, to detect and respond quickly to such diseases. The risk is higher in low- and middle-income countries, where medical, veterinary and animal production services are limited, and food safety control systems are not adequately implemented. COVID-19 has a significant effect on agriculture. Casual agricultural workers, landless farmers, small-scale farmers, and commodity producers were the most affected in this sector (ILO 2020). This chapter aims to identify some primary risk factors and the tools that could be used in agriculture to prepare for this kind of pandemic in the future.

During pandemics, consumers tend to practice panic-buying and food stockpiling which threatens food security. In addition, this may be exacerbated by national policy, which may impose some rules and limitations on exports. These may result in an increase in market price and destabilize the international markets (International Food Policy Institute 2020). The agricultural sector must continue to produce and ensure food supplies despite the pandemic challenges. To ensure agricultural production in a pandemic, the availability & maintenance of production machinery, sufficient quantities of raw materials and a resilient workforce should be prioritized. Protective measures for the safety and health of the farmer, the farm family, and all farm workers should be established with training organized to ensure occupational safety and health (OSH) is maintained at the highest possible level. This will help to reduce work-related injuries & illness and the need for medical services.

The main problems encountered in agriculture during a pandemic include:

- Labour supply and availability of relief workers
- Disruption to marketing / selling of products
- Disruption of supply chains including availability of machinery parts and maintenance services
- Increased prices of products
- Limited access to health services - Unstable health system (shortage of doctors and nurses)

Pandemics have a major impact on the agricultural sector, which was also seen during COVID-19. Farmers have to reorganize work, supply materials, focus on sanitary requirements but continue to be productive and to overcome the usual challenges due to the environmental factors (e.g., drought, floods, pests, plant diseases, zoonosis, etc.). In addition, they may also face labor shortages, due to workers becoming ill or because of travel restrictions on foreign seasonal workers. Figure 26 summarizes instructions and preparedness factors that had to be managed during a pandemic Spring 2020 in the agricultural sector (Leppälä 2020).

Information box (Jarkko Leppälä, Luke):

Sacurima COST Action network
The Sacurima COST Action network made inquiries about crisis management instructions on farms during the pandemic in different countries. Sacurima EU COST Action is an International expert network working on promoting better safety culture and risk management in agriculture. While the COST Action is mainly a European network it can also have international partner, countries involved in the network. The corona pandemic spread all over the world in Spring 2020. In April 2020 Sacurima network members from nine countries shared information on their countries Corona crises instructions for farms. Farms are essential units for primary food production and many farmers used these instructions on how the corona crisis could be managed during farm activities. In this small study several national instructions and risk management tools were collected and analysed (Figure 26).

Figure 26. Factors in the agricultural sector that were addressed during a Spring 2020 pandemic (Jarkko Leppälä, Luke).

Measures to prevent the spread of disease in the agriculture workforce had to be carefully considered and implemented. Farmers and farm workers had to be familiarized with the principles of infection control, including measures to contain the spread of disease, where it did occur and mitigate its impact on human health. The basis for this is the epidemiological triad of an infectious disease (Figure 27). It essentially states that a disease can occur in people who are susceptible to it and come into contact with the pathogen (e.g. a virus). Susceptibility can be reduced by strengthening the immune system, for example, by eating all the essential nutrients, exercising regularly, getting vaccinations (if available) and supporting a positive attitude. Living in good conditions in an environment that is not contaminated by pathogens and pollutants prevents the occurrence of disease and taking medication for the disease, if available.

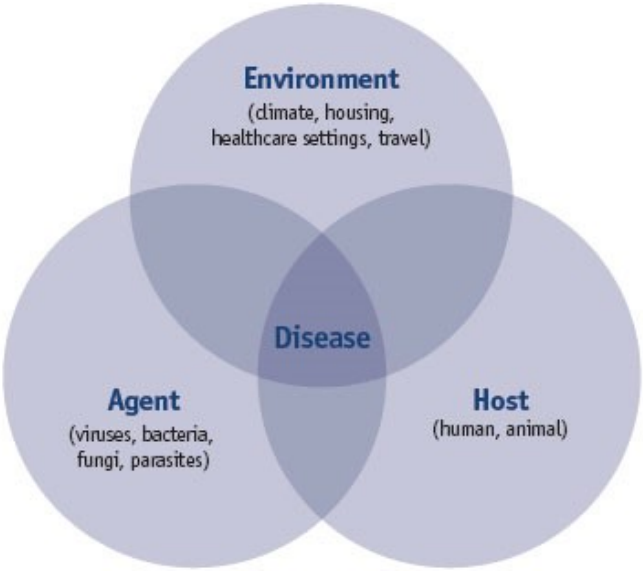
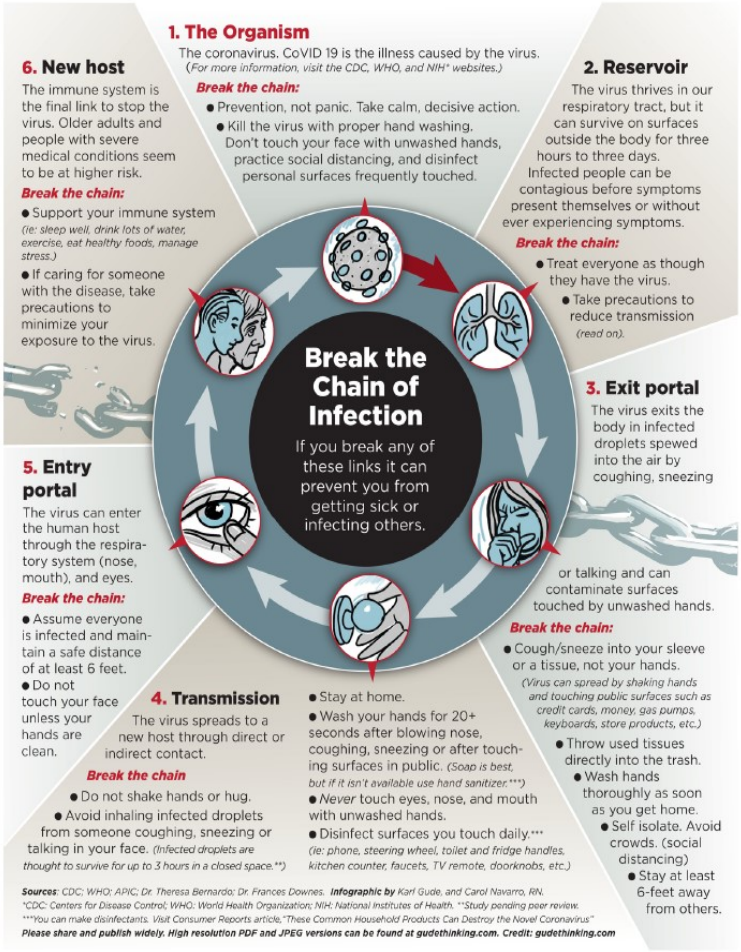


Figure 27. The epidemiological triad of an infectious disease.

A critical element is knowledge of disease transmission, the so-called chain of infection, which describes for each disease how the pathogen leaves the infected host (human or animal) and how it is transmitted to the susceptible host, including where it enters the susceptible host (Figure 28). Knowing this puts all infectious disease measures in perspective and encourages people to follow prescribed measures, such as washing hands regularly, keeping their distance from others, using face masks or coverings when in close contact with others, and staying home and isolated when sick.

On farms where livestock are kept, compliance with veterinary instructions and appropriate biosecurity and hygiene procedures are essential. Animals are responsible for more than 60% of all infectious diseases in humans, and approximately 75% of emerging infectious diseases are zoonotic; globally, at least 2.4 billion human cases of disease and 2.2 million deaths per year are attributable to zoonotic diseases, in addition to the burden of disease from arthropod vector-borne infections (Taylor et al. 2001; Grace et al. 2012). Recent outbreaks of infectious diseases, which include coronaviruses, are originally caused by animal pathogens (zoonotic diseases), and the World Organization for Animal Health (OIE) advises all livestock keepers to pay attention to hygiene when working with farm animals. With global warming, more arthropods are also expected to migrate from tropical regions to areas where they did not occur before, potentially bringing with them vector-borne zoonotic diseases that can cause major epidemics or even pandemics. Where farm workers or farm family members have COVID-19 symptoms, they should limit contact with animals to only what is necessary.



- **What kind of disease risk the organism is?**
- **Where it can stay alive?**
- **What kind of exit-entry transmission process it has?**
- **How fast it can spread?**
- **What kind of activities, equipment or behavior prevent the risk?**
- **How serious disease it is?**
- **Who have the biggest risk?**

Figure 28. The chain of infectious disease and risk procedure questions– example COVID-19 (Gude and Navarro/Sacurima).

In this context, a very important role is played by farm managers. They are in charge of the safety of farm visitors (e.g. veterinaries, suppliers, contractors and relatives) and have to provide the fundamental instructions to ensure their health and safety. In pandemic crisis farm managers have to take care of the farm finance and profitability and taking care of farm resilience in case of accidents. Farm managers have to take care of vulnerable subgroups: like the elderly farm people, those with disabilities, but also special groups such as expatriate workers with low levels of education, often present in the agricultural enterprises, as well as refugees. In fact, vulnerable agricultural workers are particularly at-risk during pandemics, due to limited access to health services, high dependence on daily labour, lack of information on support measures during the declared epidemic, COVID-19 prevention.

Following the recommendations given by institutions like ILO (2020) to mitigate COVID-19 safety and health risks in agriculture, include also: "providing access to adequate personal protective equipment; re-organizing work to ensure a safe physical distance between workers, especially by reviewing processes that normally require close interaction; implementing other control measures, including permanent access to health checks and medical facilities; ensuring access to clean water and adequate sanitation facilities with soap and alcohol-based hand sanitizer; disinfecting workplace amenities and equipment; and increasing the frequency of cleaning." (ILO 2020). ILO highlighted also the importance to provide all the relevant information on practices, personal

protection, sanitary recommendations, and hygiene in a clear and understandable language, including the own language of workers (ILO 2020), which was also clearly shown in surveys of Sacurima COST action. This also implies to policy to develop an effective occupational safety and health (OSH) management system in accordance with the Safety and Health in Agriculture Convention, 2001 (No. 184), and its accompanying Recommendation No. 192.

Discussion

Overall, zoonotic diseases have a major impact on human health, livelihoods, animals, and ecosystems, and future pandemics will most likely be zoonotic. To effectively prevent zoonotic diseases, it is important to adopt a holistic approach to health that involves human, animal and environmental health experts (a One Health approach) to address the biology of a disease, with strong support from the social sciences to effectively communicate the necessary measures to people and to mitigate the psychological burden associated with a pandemic. Collaboration of multidisciplinary experts from different sectors and sciences at the local, national and global level to achieve the best outcomes for the preservation of adverse impacts on human health is represented through the "One Health" approach (FAO, 2020; Janev Holcer et al., 2019). It's continued development, improvement and alignment with new challenges, in accordance with the generally accepted "One Health" initiative, is the only guarantee for the preservation of adverse impacts on human and animal health.

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5. Future safety culture and risk management work in agriculture

Authors: *Pat Griffin, Jarkko Leppälä and Risto Rautiainen*

Agriculture is one of the most hazardous industries in Europe, measured by work-related injuries, illnesses, disabilities and fatalities. Statistics and studies show great differences in national injury and illness rates, as well as approaches and support systems for prevention of these adverse outcomes. Only a few successful interventions have been identified in systematic reviews, and an understanding of safety culture determinants is generally poor. Consequently, well-informed actions to improve health, safety and risk management cannot be offered to farmers. In order to fill these gaps and have a better overview of hazards in European agriculture, the Safety Culture and Risk Management in Agriculture (Sacurima) COST Action was established. The main objective of the COST Action was to explore reasons why agriculture lags behind other sectors in terms of OSH, and why some countries have been more successful than others in reducing agricultural injuries and illnesses.

Specifically, the Sacurima COST Action 1) evaluated health and safety programmes on the national level in Europe, 2) identified knowledge, attitudes, behaviours and priorities among farmers regarding safety, health and risk management, 3) identified effective measures for training and integrating vulnerable populations safely into the agricultural workforce, 4) developed approaches and indicators for monitoring progress and evaluating the impact of interventions on injuries and illnesses in agriculture, and 5) disseminated results to stakeholders and the agricultural community. The Sacurima COST Action network involved 33 countries in Europe and four international partner countries outside Europe. A key finding of this COST Action is that the majority of farmers and farm workers, particularly on family operated farms, are not covered by OSH regulation and enforcement and social insurance schemes for retirement, disability and worker's compensation. A significant proportion of workplace fatalities, injuries and ill health goes unreported, un-investigated and lessons to establish prevention approaches are not learned.

The Sacurima COST Action produced recommendations and tools to inform the scientific community, OSH experts, policy makers, major stakeholders, educational institutions and farmers on improving social sustainability, safety culture and risk management in agriculture. Results of this COST Action network were disseminated through the Sacurima.eu website, at Management Committee meetings around Europe, meetings with EU policy makers, conferences, research papers and final report publication. This dissemination aims to promote the network recommendations and highlight solutions to improve safety culture and risk management in agriculture. The policy recommendations presented by the Sacurima COST Action were to 1. Integrate OSH into current and future agricultural policies, 2. Establish a European Network for agriculture safety and health, 3. Allocate specific funding for Agriculture OSH research in Horizon Europe, 4. Develop and implement OSH education and skills programs for farmers and workers in the agriculture sector and 5. Improve statistics to reflect the true level of agricultural workplace fatal and non-fatal injury and ill health. One principle in management, and indeed in risk management is that, if we do not identify the risks and do not set clear goals and objectives for improvement, no progress will be achieved. The same applies for changing and/or building a safety culture in any economic sector.

"Everybody knows that you cannot change the world. Those, who don't know this, have changed the world" - Francis Bacon.

Thanks to all involved with this SACURIMA COST Action!

Photo: Risto Rautiainen.

6. Appendices

Appendix 1. Working Group members and participants.

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Sacurima participants: https://www.sacurima.eu/frontpage/members/.

Appendix 2. Incidence rates of NFA, FA and in AFF in EU countries in 2010–2019

Total numbers of incidence rate of NFA in AFF in EU-28 countries show steady increase in 2010-2019. Salient increase of NFA rate in AFF was observed in France and with highest numbers in 2019 (5,521.2:100,000). In 2016 high NFA rate AFF was reported in three countries - Switzerland (4,885:100,000), Luxembourg (4,598:100,000) and Austria (4,846:100,000). From 2016 to 2019 high NFA rate in AFF was registered also in Spain (>4000) and Denmark (>3000). Unlikely high NFA rate in AFF (33,730:100,000) is reported by Czechia (2019). Furthermore, uncommonly low rates were reported in Romania from 2010 to 2019. In some countries (Estonia, Ireland, Portugal, UK) incidence of NFA fluctuated below 2,000 and in most countries below 1,000 (Table 9).

Table 9. Incidence rate (100,000) of NFA in AFF by the countries in 2010–2019 (Eurostat 2021). Abbreviations: NFA – non-fatal work accidents; AFF – agriculture, forestry, fishing.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
EU-28	1322.01	1359.82	1694.32	1645.55	1890.58	1864.47	1917.54	2096.91	1961.43	:
Belgium	582.5	2053.19	1341.86	1595.45	1722.9	625.57	1786.03	1765.78	1668.13	:
Bulgaria	79.66	69.73	71.39	70.7	72.56	76.86	43.72	68.31	33.95	55.43
Czechia	214.67	1936.54	1791.61	1831.37	1716.72	1925.95	1669.08	1685.89	2236.48	33 730.29
Denmark	1468.57	1615.11	1702.1	1848.26	1789.4	1 531.46	1520.69	1273.68	1856.26	3039.23
Germany	1960.57	2314.21	2281.51	1957.14	2009.12	1885.91	1977.78	1816.07	1637.17	1536.48
Estonia	1716.43	1160.38	932.04	1438.72	1559.56	1630.73	1594.26	1055.45	1423.1	1604
Ireland	1159.76	461.17	646.14	1933.2	1805.81	1811.47	1034.72	766.53	1039.98	922.98
Greece	40.27	43.01	60.68	40.77	18.55	197.68	73.9	96.92	24.7	21.45
Spain	1903.03	2247.85	3737.74	3976.75	4128.9	4366.52	4283.37	4446.8	4396.62	4154.46
France	154.11	16249.3	0,0	3627.76	5118.17	5223.01	5360.95	5312.04	5664.21	5521.17
Croatia	896.38	1092.29	980.99	688.82	933.71	834.12	1250.92	1325.98	1026.39	1949.82
Italy	4614.93	4691.23	4239.01	4141.93	4008.27	3689.31	3305.65	3174.96	3061.44	2867.03
Cyprus	306.55	454.77	540.79	238.15	344.44	298.64	311.65	388.7	767.68	345.55
Latvia	84.51	298.85	212.39	295,0	296.42	196.65	314.3	307.72	461.84	206.21
Lithuania	108.87	112.27	426.2	120.31	307.84	275.09	261.49	333.01	315,0	421.18
Luxembourg	2016.44	1783.41	1843.88	2533.33	2268.74	1979.32	4598.07	3429.39	3677.1	4101.22
Hungary	468.32	701.71	436.88	354.67	562.05	518.07	661.22	436.91	416.33	455.94
Malta	1428.57	1607.88	1247.6	1036.83	864.02	731.47	888.52	780.92	1154.71	1086.64
Netherlands	119.41	565.55	1444.76	1848.64	2853.27	670.9	418.13	1665.81	2471.34	1036.18
Austria	3055.52	2605.98	2252.37	2256.01	2347.11	2099.4	4846.39	5324.84	2770.94	2540.84
Poland	218.95	68.81	73.96	67.71	70.13	67.59	74.19	220.3	208.08	70.03
Portugal	961.7	1034.45	854.69	1052.19	1621.24	1913.4	1819.37	1575.54	1703.15	1814.51
Romania	4.43	117.12	113.68	104.55	96.9	109.85	115.05	121.37	121.81	9.12
Slovenia	727,0	2424.87	430.51	412.43	2229,3	2405.77	1990.36	1965.26	1860.2	962.67
Slovakia	911.54	738.37	766.83	730.5	579.61	871.19	840,0	918.62	1196.43	922.58
Finland	895.72	4449.81	1010.81	4466.42	4116.8	3761.92	3599.41	4004.31	4404.23	:
Sweden	692.66	641.73	578.95	559.5	635.5	585.78	548.47	508.36	634.68	629.17
Norway	459.58	505.72	931.98	422.91	563.25	652.8	646.39	607.92	624.77	350.86
Switzerland	1084.94	2835.48	3183.79	3341.42	2949.7	3232.38	4885.2	3316.97	4021.86	
UK	1837.03	2245.6	2163.72	2171.74	2457.26	2055.65	1979.71	2026.37	1912.28	

In the last decade the incidence rate of FA in AFF in EU countries show steady tendency to increase. In some years zero fatalities in AFF is reported in some countries as Belgium (2012, 2014, 20169, Estonia (2013, 2018, 2019), France (2012), Croatia (2014), Luxembourg (2013, 2015, 2017) and Slovenia (2010, 2019). The data 2019 are missing: EU total, Belgium, Finland, Switzerland and UK (Table 10). In 2010–2019 the highest summed rates of FA in AFF were reported in Austria, Romania, Norway, Ireland, Luxembourg and Latvia (Figure 4.1). The dynamics of FA rate in AFF (cases per 100,000 agricultural workers) shows that in most EU countries it remains below 20 cases per year. Sharp increase from 2013 to 2016 was registered in both Austria (65.2:100,000) and Luxembourg (64.3:100,000) and from 2010 to 2016 in Romania (35.5), Latvia (32.8), Norway (24.3) and Ireland (22.6). In 2019 Czechia showed extremely high FA rate (76.6:100,000), and it also was higher the other countries in Denmark (25.7:100,000) and Slovakia (13.2:100,000) (Table 10).

Table 10. Incidence rate (/100 000) of FA in AFF in EU countries 2010–2019 (Eurostat 2021).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
EU-28	4.71	4.55	5.75	5.00	5.78	5.62	5.81	6.12	6.31	
Belgium	1.52	17.70	0	4.55	0	7.47	0	0	4.19	
Bulgaria	11.38	8.54	14.54	3.79	9.84	9.61	2.30	8.10	8.89	6.45
Czechia	9.92	11.49	11.19	8.97	5.24	7.63	5.96	10.25	11.73	76.60
Denmark	8.18	14.30	17.23	16.14	10.41	4.38	15.77	9.61	8.55	25.69
Germany	2.70	3.15	3.36	2.68	2.92	2.22	2.33	2.29	2.61	3.25
Estonia	5.62	11.13	6.87	0	4.15	5.37	5.57	8.65	0	0
Ireland	30.59	30.17	30.30	15.92	23.86	19.19	22.63	22.65	17.71	19.47
Greece	0.36	0.39	0.20	0	0.42	4.34	0.91	3.73	0.64	0.25
Spain	2.77	3.90	6.33	6.31	8.67	6.50	6.98	6.06	6.88	4.83
France	0.84	59.63	0	7.17	6.99	9.64	14.39	9.00	9.42	9.60
Croatia	12.21	7.72	12.64	10.04	0	2.64	9.94	7.96	10.21	6.54
Italy	11.02	12.58	11.42	11.55	11.58	11.27	8.60	7.12	8.37	9.90
Latvia	15.21	21.73	18.31	20.00	22.46	17.10	32.84	11.99	35.87	8.77
Lithuania	12.87	5.52	20.96	8.27	23.38	7.54	15.61	10.03	2.05	6.65
Luxembourg	12.84	12.92	27.32	0	14.64	0	64.31	0	57.45	29.09
Hungary	7.00	15.25	6.47	4.64	4.49	3.42	12.83	7.48	7.52	5.49
Netherlands	8.53	0.42	0.38	1.81	1.44	0.27	0.24	0.29	1.22	0.83
Austria	40.07	25.1	24.43	29.36	34.69	33.52	65.15	34.19	36.35	25.38
Poland	2.94	1.27	1.13	0.68	0.64	1.19	0.62	2.75	2.63	0.71
Portugal	5.16	6.06	5.49	5.96	6.43	9.34	6.60	6.90	5.10	5.55
Romania	1.69	35.34	36.00	22.73	27.69	30.56	35.46	32.82	24.21	2.25
Slovenia	0	24.43	4.00	1.78	24.04	6.06	18.78	12.68	6.26	0
Slovakia	4.20	6.97	5.66	11.68	6.05	10.11	3.47	7.45	11.46	13.02
Finland	1.80	3.73	0.97	4.99	5.79	5.71	6.89	4.31	3.75	
Sweden	8.25	14.19	5.77	2.99	10.00	6.07	6.37	11.70	10.85	1.03
Norway	8.11	7.38	10.69	18.34	85.50	28.43	24.31	17.51	34.74	10.09
Switzer-land	2.81	5.48	13.73	1.97	9.17	5.56	11.39	2.04	9.22	
UK	10.86	13.73	12.94	12.97	11.04	10.14	8.19	13.01	12.57	

Appendix 3. Non-fatal accidents at work by economic activity and gender.

Table 11. Table on non-fatal accidents at work by economic activity and gender, EU-27, 2018 (Eurostat 2021).

NACE (Section)	(thousands)			(incidence rate)		
	Total	Men	Women	Total	Men	Women
Total (all activities)	**3 124,8**	**2 137,9**	**986,1**	**1 659**	**2 131**	**1 121**
Agriculture, forestry and fishing (A)	144,0	113,0	30,9	1 964	2 321	1 257
Mining and quarrying (B)	8,4	8,1	0,3	1 508	1 669	426
Manufacturing (C)	596,5	497,8	98,7	1 890	2 256	1 039
Construction (F)	362,6	355,2	7,4	3 319	3 653	618
Wholesale and retail trade (G)	377,2	242,2	134,9	1 431	1 840	1 022
Transportation and storage (H)	280,2	226,0	54,1	2 759	2 924	2 230
Accommodation and food service activities (I)	163,2	81,9	81,3	1 763	1 933	1 618
Administrative and support service (N)	289,7	207,1	82,5	2 570	3 378	1 605
Public administration and defense (O)	194,6	115,5	79,1	1 448	1 795	1 129
Human health and social work activities (Q)	338,7	74,0	264,6	1 664	1 636	1 671

Appendix 4. Press Release – January 2019

COST Action SACURIMA CA16123 calls for joined up thinking to protect the safety, health and well-being of all working in the Agriculture sector.

SACURIMA CA16123 is the first Cost Action of its kind to look deeply into Occupational Safety and Health in the Agriculture sector. This Cost Action, a Network for those involved in nationally funded research projects in the area of OSH in agriculture was born out of deep concern by researchers at the level of death, injury and ill health in those working in Agriculture.

COST Association (Cooperation in Science and Technology) has funded the safety culture project based on its overall objective to, produce benchmarked and evidence-based recommendations on improving OSH in agriculture that will inform and guide EU and National initiatives and efforts. Initially expected to attract a handful of countries to be involved, the action has grown exponentially, now having 30 countries and 90 members involved in the action.

At its **Workshop** to be held at the COST Headquarters, at Avenue Louise 149, Brussels, the chair of this Cost Action Prof Risto Rautiainen will give an outline of the Actions work and findings to date. Prof Rautiainen will also set out current published figures for fatalities across the EU and beyond stressing the fact that the SACURIMA Group believe these to be a gross under reporting of the fatality rate within the EU.

Prof Rautiainen welcomed the recent initiative spearheaded by the First vice president of the EU Parliament MEP Mairead McGuinness to include questions in relation to OSH in agriculture in the EU Integrated Farm Statistics Regulation. The MEP, pushed for the inclusion of these statistics and led the debate in parliament to address the issue, stressing that everyone must redouble their efforts to reduce deaths and injuries on farms. The European Parliament's adoption of the Integrated Farm Statistics Regulation will result in a new requirement at national level to record details of farm accidents and fatalities – which is an important step in efforts to address these issues. This is the view of Mairead McGuinness, MEP and First Vice-President of the European Parliament, who welcomed the decision (Wednesday, July 4, 2018).

The action currently strives to define what safety culture is within agriculture, to understand the safety norms, how culture can be measured and how best to approach improving OSH in agriculture from a policy and practical point of view.

The chair of the action **Prof Rautiainen**, along with the chair of the sub-committee the Behavioral Working Group, **Prof Stefan Van Den Broucke** stressed that there needs to be better data capture with better data analysis to address the fundamental issues within OSH in Agriculture. They also stressed that more consideration of the impact of all EU policy on the safety, health and indeed well-being of all EU farm workers and farmers including their mental well-being. When the true extent of injury data is set out and analyzed for agriculture the Action expects that it will shock policy makers and representative organizations when they understand the true horror of what is happening on the ground to produce food for EU citizens.

Appendix 5. Press Release – November 2019 following meetings with EU Officials/Organisations

Call for major Policy Change in the Revised CAP for Agriculture

Issued by the SACURIMA COST Action on Safety Culture and Risk Management in Agriculture CA16123

***SACURIMA** is the first EU Cost Action of its kind to look into occupational safety and health (0SH) in the agriculture sector. The COST Action born out of a deep concern by agricultural 0SH experts, researchers and farm organisations now calls for critical changes to the next CAP to ensure its success.*

The Nine Key Objectives of the proposed new CAP, while all critically important fail to identify and support the key deliverable on the ground "the farmer". It is essential that the proposed new CAP succeeds for Europe. However, if we are to meet the challenges of the New CAP, to have food security, sustainability, rural development, protection of biodiversity and ecosystems, climate change amelioration, protection of soils and landscapes and indeed generational renewal, emphasis on lifelong learning and continual professional development (CPD) for farmers and from workers is urgently needed.

The SACURIMA Cost Action, having studied the current situation in relation to OSH in agriculture, the fatal and non-fatal injury levels, the level of ill-health and indeed stress and suicidality in agriculture, the variations in training levels and national OSH programs, and now calls for the following:

1. **Integrate OSH into current and future agricultural policies**
2. **Establish a European Network for agriculture safety and health**
3. **Allocate specific funding for Agriculture OSH research in Horizon 2020 / Horizon Europe**
4. **Develop and implement OSH education and skills programs for farmers and workers in the agriculture sector**
5. **Improve statistics to reflect the true level of agricultural workplace fatal & non-fatal injury and ill health.**

Focused and practical instruments must be put in place to update and support farmers and farm workers to meet the complex challenges within the proposed revised CAP.

In mid-October 2019 a delegation from the SACURIMA COST Action were delighted to meet, set out there policy recommendations and get general support from;

***Commissioner Mariya Gabriel**, currently Commissioner for 'Digital Economy and Society' and nominated to be the next Commissioner for 'Innovation and Youth'.*

***Ms Gabriel** was accompanied by **Mr Kevin Keary**; Cabinet Member of current Commissioner Phil Hogan, Agriculture and Rural Affairs Commissioner.*

Separate meetings also held with the following:

***Dr Miriam Dalli MEP**, Member of the Committee on the Environment, Public Health and Food Safety.*

***Daniel Buda MEP**, Vice-Chair of the Committee on Agriculture and Rural Development.*

***Dr Alfred Sant**, Member of the Committee on the Economic and Monetary Affairs and Committee on Budgets.*

***Ann Marie O'Brian** on behalf of Mrs MAIREAD McGuinness, First Vice President of the European Parliament and member of the Committee on Agriculture and Rural Development.*

*At **COPA*COGECA with: Ms Oana Neagu** - Director with responsibility for Commodities, Environment, Climate Change, Food and Feed. **Ms Marta Rosa**, Senior Policy Advisor; **Mr Tobia Capuzzo** - Project Officer for Research, Innovation, Horizon 2020, Pesticides, Antimicrobial Resistance and Digitization.*

***COST Action SACURIMA delegation included: Risto Rautiainen** – (Action Chair): **John McNamara** – (Action Vice Chair) **Pat Griffin** – (Action Communication Manager) **Anne Marie Heiberg** - (WG5 Chair) **José Rato Nunes** - (WG2) **Petya Stavreva** - (WG5 Member & former MEP) **Helle Birk Domino** – (WG5 Vice Chair).*

This SACURIMA cost action, initially expecting to attract only a handful of countries now has 32 member countries from across Europe and further afield, such as 2 Near Neighbor Countries (Jordan and Egypt) and institutions and observers from 2 International Countries (USA and Australia).

To discuss or get further information please contact any of the following:

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