

# Ecosystem Health and Sustainable Agriculture

# 1



# Sustainable Agriculture

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# Occupational Health and Safety in Agriculture

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## Introduction

The total number of work-related farm fatalities on United States farms in 2008 as reported by the US Bureau of Labour Statistics (2009) was 661. In several European countries and the United States the fatal accident rate in agriculture is double, or more than double, the average for all other industries (Forastieri, 2001). For example the fatal accident rate for the agriculture, forestry, fishing and hunting industry in the United States was 29.4 per 100,000 workers in 2008 (US Bureau of Labour Statistics, 2009), which was 7.5 times the national average of 3.7 for all US industries and was ranked as being the highest fatality rate of any industry. Together with mining and construction, agriculture is one of the most dangerous sectors of the economy in both industrial nations and in developing countries. Depending on the countries studied, the ranking of the most dangerous sectors of the economy varies, but agriculture is usually mentioned among the four or five most dangerous. The Safework Programme of the International Labour Organisation (ILO) gives the following examples of dangerous sectors of the economy:

- Agriculture
- Mining
- Construction
- Fishing
- Shipbreaking
- Transport.

The variability in working conditions, including even drastic changes in external circumstances, is a feature shared by all these activities.

The great variety of tasks performed in agriculture makes it impossible to provide a complete list of risks. Some risks are specific to one particular area of agriculture, or even to a particular workplace. Machinery, falling objects and falls are consistently the leading causes of work-related fatalities (Saari, 2001; Myers, 2001). Furthermore, animals and chemicals constitute a significant source of hazards in agriculture (Suutarinen, 2003).

## Agriculture

In the context of occupational safety and health, the term ‘agriculture’ is generally used in a broad sense including all activities directly related to cultivating, growing, harvesting and primary processing of agricultural products, animal and livestock breeding including aquaculture, and agroforestry. The term also refers to all agricultural undertakings, irrespective of size. A somewhat open question is whether subsistence farming should be included in agriculture. ILO does not include subsistence farming in agriculture but ISSA (International Social Security Associations) more or less includes it. The borderline between agriculture and forestry is not always clear and well defined.

The variable working conditions in agriculture can be compressed into some specific features, which increase the risk of occupational accidents (adapted from Forastieri, 2001):

- The work is carried out in the open air, exposing the workers to climatic conditions.
- The work is of a seasonal nature and certain tasks are urgent in specific periods.
- A variety of tasks must be performed by the same person.
- There is great variation in working postures and the length of the tasks performed.
- Contact with animals and plants brings exposure to bites, infections, allergies and other health problems.
- There is contact with chemical and biological products.
- A variety of machines are used.
- The work is often performed in isolation out of sight of others.
- Emergency services are often delayed in time of accidents due to the remoteness of a high percentage of the work sites.
- The worker's home is often embedded in the farm for a high percentage of farm populations, increasing the risk of farm-related accidents to children.
- There are high proportions of young and old workers.

The average farm size is increasing in the EU and North America but the number of farms, workplaces, is still rather high. In Finland, almost 70,000 farms are spread out over the country (TIKE, 2006). The units are small and on many farms the work is done by the farmer and his family. Some farms employ seasonal workers, especially for harvesting fruit and vegetables. There are of course also industrialised farms with permanent staff and occasional seasonal workers. In the United States there are 2.1 million farms (Hoppe and Korb, 2005). There is a wide range of farm sizes today in the United States, from the large capital-intensive units that rely on scale of size to utilise input resources more efficiently compared to small farms that focus on niche production of high-value commodities (Midwest Center for Agricultural Research, Education, and Disease & Injury Prevention, 2002). The largest 7% of farms account for 75% of total US sales of agricultural products (USDA, 2002).

## Risk Management

Risk management principles are not widely used in agriculture. Scientific contributions on the application of formal safety management theories or practices in family farming are not commonly available (Suutarinen, 2003; Murphy, 1992). Abstract and theoretical methods tend to reduce acceptance among farmers and a practical approach is needed when risk management systems are implemented. The methods used should be practical and economically feasible to achieve a high degree of acceptance among farmers.

It is known from workplace inspection, accident investigation and social science research that the key issues to address in improving risk management are:

- A deep-seated culture of unwise risk-taking.
- Farmers' resistance to officialdom and their perceptions that regulations and bureaucracy unduly burden the industry and that utilising risk management principles to effectively manage risk will lessen the need for safety regulations.
- Health and safety is not yet universally regarded as integral to good farm business management (HSE, 2007).

There are four primary components of a risk management programme (US Department of Labor, 2007):

1. Management Commitment
2. Work Analysis or Risk Assessment
3. Hazard Prevention and Control
4. Training of Employees, Supervisors and/or Managers

**1. Management Commitment.** The first step in addressing injury risk is a commitment by the farm operator/manager. This is equally true for the small farm with just one operator as for the large farm with hundreds of employees. It is important to make reducing injury risk a top priority in order to preserve life and to enhance profitability.

**2. Risk Assessment of the Work Environment.** The key to improving safety and health in agriculture is to manage risks by assessing them systematically and to implement preventive actions based on the assessment. It is some-

times difficult to explain to farmers that a risk assessment is nothing more than a careful examination of what could cause harm to workers, and to make decisions on whether the precautions taken are adequate or whether more should be done to prevent harm. The aim is to make sure that no one gets hurt or becomes ill. A risk assessment involves identifying the hazards present in any undertaking and then evaluating the extent of the risks involved, taking into account existing precautions (EASHW, 2007; U.S. Department of Labor, 2002).

Key points in a risk assessment are:

- Identifying the different risks that could cause harm in the workplace.
- Considering who may be harmed and how, including temporary and part-time staff, as well as workers in specific risk groups such as children, adolescents and elderly persons.
- Evaluating measures that are already in place to control these risks, and deciding what further action needs to be taken.
- Recording all findings and sharing these with workers and their representatives (EASHW, 2007).

Detailed descriptions on how to perform a risk assessment are given in national standards e.g. BS 8800 and guidelines and in the United States Department of Labor's Job Hazard Analysis publication OSHA 3071 (STM, 2003; U.S. Department of Labor, 2002).

**3. Hazard Prevention and Control.** Farmers often have limited resources but once identified, some risks require minimal direct cost. Once risks are identified and prioritised, a plan can be developed to use available resources to address the greatest need first. Ideally the aim is to eliminate hazards, but often that is not practical. However the farmer can make sure e.g. that machinery has adequate guards and that personal protection equipment is readily available for essential risk reduction activities such as noise and dust exposure.

**4. Training of Employees, Supervisors and/or Managers.** It is also important to make sure that workers are familiar with the risk they are working with or ex-

posed to. Today there are a number of agricultural training resources readily available, particularly on the internet, and mostly at no cost to users.

In risk management, the health and safety attitude of the farmer is quite important, as some research results show an involvement of personal or environmental risk factors. McCurdy et al. (2004) found that multiple injury events in the same individual occurred more frequently than predicted by chance and Harrell (1995) showed that individuals incurring a farming-related injury scored higher on a measure of personal risk-taking and believed that accidents were inevitable, whereas specific safe farming practices e.g. wearing protective clothing and operating machinery safely, were associated with a lower likelihood of injury.

The general profitability of agriculture is low and on many farms there are no possibilities for investments in new and safe machinery or for improving the working conditions. The use of ageing machines with inadequate safety engineering constitutes a constant source of hazards, as operations involving high numbers of disturbances, e.g. machinery breakdowns, have a higher accident probability (Suutarinen, 2003). According to Loring and Myers (2008), between 1992 and 2005 a total of 1412 workers died from tractor overturns on farms in the United States. Those authors conducted a national study in 2004 to identify the prevalence of rollover protective structures (ROPS) in the US and found that 49% of tractors were not equipped with a ROPS. A study in Iowa found that only 4% of tractor operators wore the seatbelt installed on tractors with ROPS (Sanderson et al., 2006). Old tractors without ROPS and seatbelts are also a serious problem in the European Union.

## Workforce

The workforce meeting the variable working conditions of agriculture has unique characteristics compared with most other sectors of the economy. Production is often based on family-owned and operated enterprises or family farms. Family members younger and older than the conventional workforce take part in farming operations.

Elderly people, children and adolescents are quite often involved in farm accidents (Suutarinen, 2003). In the US, 22.9% of the workforce in the production agriculture industry consists of workers aged 55 or older. No other industry employs more workers in this age group. In addition, 25% of farm operators are aged 65 or older (Peters, 2007). Myers et al. (2007) reported that farm workers over the age of 54 in the US had a fatality rate of 45.8 deaths per 100,000 workers compared with the average farm work fatality rate of 25.5 deaths. Tractors were by far the leading cause of these deaths, accounting for 46%, with trucks being second with 7%. Elderly people are often not sufficiently aware of the onset of the physical and mental ageing process. They often fail to recognise or underestimate potential new hazards because of their habits and routines. The most frequent causes of accidents among older agricultural workers are slips, trips and falls.

Family farms predominate in American and European agriculture and as a result young people are significantly exposed to significant work-related hazards on the farms where they live. According to the National Children's Center for Rural and Agricultural Health and Safety (2010), over 1.12 million young people under the age of 20 live on farms in the US. During the period 1995-2002, an estimated 907 young people died as a result of an accident on US farms. The three leading sources of fatal injuries to young people involved machinery (23%), motor vehicles including All Terrain Vehicles (19%) and drowning (16%). In 2006, approximately 3,600 children were injured while performing farm work. Young people who live on livestock farms had significantly higher injury rates (19.2 injuries/1,000 young people) than those who live on arable farms (12.1 injuries/1,000 young people). For European farm children, agricultural vehicles are the most common cause of injury, with 65% of those involving the child being run over. Other causes include unprotected machine components, falls, drowning and suffocation and contact with animals. Adolescents are a particular risk group because they readily do all kinds of machine work and are eager to try new machines even if they lack the proper training for the work (Rautiainen, 2004). Injuries to young people on farms occur while they are doing any one of three general activities of working, observing and playing in the agricultural work environment (Donham and Thelin, 2006). Young workers are much more likely

to suffer non-fatal serious accidents than their older colleagues. The average incidence rate of non-fatal accidents on farms in the EU is at least 50% higher among workers aged 18-24 than in any other age category (ILO, 2005).

Agriculture is a significant employer of women and many women also contribute in farming as wives or partners. Temporary, casual seasonal work, for example during the harvesting season, is an important feature of women's work in this sector. There is likely to be considerable task segregation by gender. Women are concentrated in elementary jobs in agriculture and in animal production. They more often take care of animals rather than performing field work. Reed et al. (1999) found that about 50% of over 1600 rural women from farm households surveyed in Kentucky and Texas described themselves as homemakers, yet they were regularly involved in work with farm animals for about 40% of their time and spent about 30% of their time driving a farm tractor. It could be anticipated that the occupational injury and illness experiences of men and women on farms would differ due to the significant differences in tasks they perform on farms. Generally, women working in agriculture are exposed to the same hazards and risks as male workers, but their frequency of exposure differs. Dimich-Ward et al. (2004) reported that the most common fatal machinery injuries for males involved tractor rollovers (32%) and being run over by farm equipment (20%), whereas for females the most common machinery-related causes of fatalities were being run over (45%) and tractor rollovers (24%). The most common cause of farm accidents in general for males was being struck by an object (33%) or animal (14%). For females the most common farm accidents involved animals (37%) or being struck by an object (32%). Women face further risks, particularly to reproductive health from pesticides and biological agents (EASHW, 2007). Lower extremities are the most frequently injured body parts for women (Carruth et al., 2001).

A six-year study in the US found approximately 11 times as many agriculture-related fatalities in males compared with females (Dimich-Ward et al., 2004). A greater number of males were injured regardless of how the occurrence of injury was categorised. This also holds true in Finland, where 75% of those injured in farm accidents are men (Karttunen, 2006). Servicing and maintenance of machines is the most risky task, followed by construction

of farm buildings. The relative incidence rate of injuries in maintenance of machines is 3.1 and in construction of farm buildings 2.1 when the relative incidence rate for livestock work is set to 1.0. The relative incidence rate for field work is 0.6 (Karttunen et al., 2006).

The main farmer may have a secondary occupation, which can lead to excessive burdens on the farmer or the farmer's spouse. Part-time farming can result in long working hours and inadequate rest, for example during the harvesting season. Haste, fatigue or stress is often mentioned as the primary contributing factor in most injuries (Rautiainen et al., 2004). Farmers tend to have good occupational training in production methods and technologies, but not in safety and health questions or in personnel management. In Ireland, only 13% of farmers are trained in occupational safety and health (McNamara et al., 2006). Farmers in the US mainly receive this training in adult learning programmes through University Land Grant Extension programmes, their farmers' organisation, high school vocational agricultural programmes and through regional rural medical centres. There are a few courses in agricultural safety and health offered at a few select universities. The University of Illinois offers the only minor in agricultural safety and health for undergraduate students in the country. The University of Iowa offers the only MSc and PhD programmes specifically in agricultural safety and health.

The productivity of agriculture is significantly enhanced in many Western countries by the labour and assistance provided by migrant workers. The number of migrant workers has steadily increased due to the expansion of labour-intensive crops, particularly in the area of fruit and vegetables. There are no exact figures available on the number of migrant workers in European agriculture. The number of seasonal and migrant farm workers has been estimated to be about 4.5 million, of whom nearly 500,000 come from outside the EU-15 member states (Renault, 2002). Farms in the United States hire approximately 2.5 million seasonal and migrant farm workers (ILO, 2004). These workers work for a short period of time, e.g. for the harvesting season, and start their work after a very short introduction to the job. Information on health and safety is sometimes given in a language not understood or only poorly understood by the workers. Common injuries experienced by European migrant

workers are cuts, falls and slips. Sometimes these injuries are associated with fatigue, most usually brought about by long working hours (McKay et al., 2006). Snake and insect bites are common among young migrant workers during summer, and they affect the upper limbs during manual work close to the ground (Alex et al., 2003). According to Donhan and Thelin (2006), one of the most common work-related injuries experienced by up to 40% of some migrant worker populations in the United States is eye injuries. The causes of these eye injuries include scratches to the cornea, chemical eye irritation and ultraviolet sunlight exposure resulting in damage to the retina and cornea. Other common injuries include back injuries, lung irritation and related illnesses from exposure to organic and inorganic dusts.

### Incidence Rates

Comparing health and safety levels in agricultural work over time and between countries is problematic. Absolute accident figures are misleading. Instead, accident figures should be used in relation to some measure of exposure, such as work hours or size of working population (Suutarinen, 2003). The official data on the incidence of occupational accidents and diseases are imprecise and underestimated in agriculture, irrespective of the level of development of the country (Forastieri, 2001). This situation is more evident for occupational diseases. There are different arrangements for reporting occupational accidents and occupational diseases. Accidents can be identified at the moment they occur, but there are differences in how well the accidents of self-employed farmers are reported. Occupational diseases require medical diagnosis and not all work-related diseases are registered as occupational diseases. Occupational diseases often have contributing exposures outside the work environment that make the exact causes difficult to identify and quantify.

The following are examples of the incidence of accidents among European farm workers with more than three days' absence (per 10,000 persons employed) (EUROSTAT, 2005; Spirgys et al., 2005; Mikheev, 2004):

|                |     |
|----------------|-----|
| EU-15          | 516 |
| Denmark        | 154 |
| Finland        | 535 |
| Sweden         | 119 |
| United Kingdom | 194 |
| Norway         | 262 |
| Lithuania      | 24  |
| Russia         | 72  |

There has never been a comprehensive national surveillance system for non-fatal farm injuries in the United States. This is a long-term goal identified by agricultural occupational health and safety professionals, but has yet to come to fruition. Most significant studies focused on determining injury incidence rates have been conducted by stratified national, regional or state level self-reported random sample surveys conducted by such agencies as the National Institute for Occupational Safety and Health (NIOSH), the National Safety Council (NSC) or state Land Grant Universities. A disabling injury in the US includes injuries that range from permanent impairment to those that prevent normal work for at least a full work day. The NSC has estimated that the total number of agricultural work-related disabling injuries each year in the period 1993-2004 ranged from 130,000 to 150,000 (NSC 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004). This is an injury rate ranging from 330 to 400 per 10,000 persons.

Based on figures collected by ILO, the incidence of a fatal accident in the EU-15 is 0.8 per 10,000 farm workers (ILO, 2005, EUROSTAT, 2006). The corresponding incidence rate for the mining and construction industry is 0.5 in the EU-15. In 2003, the incidence rate of fatal accidents was 1.1 in the Czech Republic, 0.9 in Poland and 2.5 in Lithuania (Spirgys et al., 2005).

Only 1.9% of the US labour force work in agriculture (Dimitri et al., 2005), which involves approximately 1.8 million full-time workers (CDC, 2010). NSC (2004) reported that the mean fatality rate for the US agricultural industry from 1992 to 2002 was 2.23 deaths per 10,000 farm workers compared with 0.39 per 10,000 workers for all US industries.

In Ireland only 6.5% of the workforce work in agriculture, but it gives rise to 30% of fatal work-related accidents (McNamara et al., 2006). Over the past 10 years,

there were on average 49 fatalities per year on farms in the United Kingdom (HSE, 2007). Of the 45 people killed in 2005/06, 23 were farmers or self-employed workers, 13 were employees and 9 were members of the public, of whom 6 were children. This gives a fatal incidence rate of 0.88 per 10 00 workers. The main causes of accidents were (HSE, 2007):

- Transport (including vehicle overturns), 36%.
- Falling from a height, 13%.
- Livestock-related (contact with animal), 13%.
- Contact with moving machinery, 11%.
- Being struck by a moving or falling object (e.g. trees, bales), 9%.

Machines such as tractors and harvesters have the highest frequency and fatality rates of injury. Exposure to pesticides and other agrochemicals constitutes another major occupational risk causing poisoning and death.

Despite technological development and mechanisation, musculoskeletal disorders caused by awkward working postures and demanding physical work are still common. Other hazards are biological agents such as dusts, which give rise to allergies and respiratory disorders and lung diseases. Farmers also have a high incidence of melanoma from sun exposure.

Occupational diseases are generally more expensive than occupational accidents. Rautiainen (2002) studied compensation data for Finnish farmers and found that the mean cost of the 830 compensated occupational diseases was 6,636 euros, while for the 10,092 occupational injuries it was 1,340 euros. Occupational diseases had a higher risk than injuries of leading to a permanent disability pension. In the US, the average direct and indirect cost of a occupational disabling injury is approximately \$74,000 and the average cost of a work-related fatality is more than \$94,000 (Brown et al., 2001).

According to Walker (2001), about 80% of the workers in agriculture have a musculoskeletal disorder at some time and approximately 40% suffer from noise-induced hearing loss. Respiratory problems in agricultural workers are double the average for the general population. The incidence of dermatitis in the industry is not known, but there are about 450 cases per year in British horticulture.

Lower back pain is a common problem for farmers, with e.g. 41% of British farmers reporting pain each year. The figure in Sweden is slightly higher, with 47% of farmers experiencing pain each year. In the United States, 50% of adults of working age employed in agriculture experience lower back pain episodes each year and more than 10% seek medical care for their back problems (Donham and Thelin, 2006). In Finland, pain in the neck and shoulders is slightly more common than lower back pain, with 67% of farmers reporting pain in the neck and shoulders and 64% reporting back pain each year (Cowie et al., 2005; Perkiö-Mäkela et al., 2006). In Sweden, 82% of the men and 86% of the women working on dairy farms report some kind of musculoskeletal symptoms each year (Lundquist et al., 1997).

In Finnish agriculture the incidence (calculated per 10,000 workers) of different occupational diseases is: respiratory diseases 15, diseases caused by exertion 13, dermatitis 10, noise-induced hearing problems 4 and others 4.

A comparison of occupational diseases between countries is even more difficult than the comparison of injuries. First of all, there are different definitions of occupational diseases and different compensation systems and generally only compensated diseases are recorded as occupational diseases. The following Table 53.1 gives an idea of the problem, with the incidence calculated per 10,000 employees (Spirgys et al., 2005; Mikheev, 2004; Rautanen & Reynolds, 2001):

The differences in incidence are probably due to the definitions of occupational diseases and differences in the compensation system, and not to differences in the health risks in the actual work.

Table 53.1. Reported incidence of occupational diseases in some countries (Spirgys et al., 2005; Mikheev, 2004; Rautanen & Reynolds, 2001).

|                |      |
|----------------|------|
| Finland        | 45.6 |
| Czech Republic | 7.3  |
| Poland         | 0.4  |
| Lithuania      | 1.2  |
| Russia         | 2.2  |
| United States* | 43   |

\* Data limited to farms with 11 or more employees, which represent less than 10% of US farms. Corresponding data not available for other segments of the farm population.

## Legislation

Agriculture is covered by different kinds of legal instruments such as international and national laws, regulations and rules, technical standards and similar documents. More than 20 ILO Conventions and Recommendations concern health and safety issues relevant to agriculture or deal with aspects of agricultural workers' working conditions. It seems that agriculture is not highly prioritised by the ILO member countries, as only five countries have so far ratified ILO Convention 184, published in 2001, on Safety and Health in Agriculture. Convention 129, published in 1969, on Labour Inspection in Agriculture has been ratified by 43 member countries.

Occupational protection laws often apply generally to all sectors of the economy, including agriculture. The general objectives are often very abstract and the rules have only limited effect, unless they are accompanied by more practical implementing regulations. Problems also arise from the fact that legislation often only covers employees, whereas there are no protective provisions for self-employed farmers and their family members.

In the EU there are two types of safety and health directives. Directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers in the workplace belongs to the first category. This directive is designed to secure a minimum level of safety and health at work and states that it is the duty of the employer to take care of the safety of his/her employees. Other examples of this category are the directives on noise (2003/10/EC) and vibration (2002/44/EC), giving exact limits on the maximum exposure.

The second category of directives aims to guarantee the safety of machines placed on the market. The machinery directive (98/37/EC) and the tractor directive (2003/37/EC) are examples of this category. The technical specifications of machines are given in harmonised standards and the specifications of tractors in separate directives listed in the annex to Directive 2003/37/EC. According to these directives, the manufacturer is responsible for the safety of a machine placed on the market. A certain minimum level of safety is ensured, and unsafe machines cannot exist on the market if the market surveillance is working properly. The main problem for the user is to keep the safety of machines on the farm unchanged during their

technical life span. Directive 89/655/EEC on the minimum safety and health requirements for the use of work equipment by workers in the workplace is the connection between machines and risk management as described in Directive 89/391/EEC.

The directives and standards regulating the safety of new machines represent quite a high level of safety, and improving the safety of the machines further by developing the directives will be difficult. For example when rollover protective structures were made compulsory on tractors in Finland, the number of fatalities in tractor roll-overs decreased from 1.6 per 10,000 farmers to 0.2 per 10,000 farmers, in absolute figures two cases per year. It is not quite clear whether these fatalities could be prevented by introducing safety belts in tractors. In most machine and tractor accidents the users and their decisions play a key role. Machines may not be correctly used or protective equipment may be defective or rendered inoperative. More weight should be given to the maintenance of machines and their safety components.

In the United States, farmers have traditionally opposed most mandatory regulations. The Occupational Safety and Health Act (OSHA), which came into law in 1971, initially included essentially all places of public employment, including all farm operations. However, after strong lobbying efforts by farm organisations, an amendment was passed in 1976 that did not allow the expenditure of federal dollars to inspect or enforce these regulations of farms with 10 or fewer employees (Donham and Thelin, 2006). This amendment essentially excluded approximately 90% of all US farms. Most agricultural safety professionals favour including all of agriculture under OSHA regulations. However, with the vast majority of US farms being small in nature and geographically dispersed, enforcement of these regulations would be extremely difficult. Nevertheless, with the strong liability risk that farm operators face in the US, a growing number of farmers are recognising that they must try to comply with established safe work procedures to minimise injury and liability risk. The OSHA regulations contain several standards specific to agriculture, including standards on tractors, safety guards on agricultural machines, anhydrous ammonia, field sanitation, use of the Slow Moving Vehicle emblem on farm equipment transported on public roadways, etc. (Langley

et al., 1997). The American Society of Agricultural and Biological Engineers (ASABE) has developed and published a variety of safety design standards. While these are consensus standards and are not mandatory for farm equipment manufacturers, most comply because of the liability risk. There are specific standards related to the safe application of agricultural restricted-use pesticides and the employment of young people on farms.

## Prevention

All those working on a farm, employees and self-employed, permanent and seasonal workers, should enjoy the same level of safety and health protection. Enforcement is not always the best way of improving occupational health and safety in agriculture, as the number of safety inspectors is generally small compared with the number of farms. The effect of enforcement is limited by the fact that legislation often covers only employees, whereas there are no protective provisions for self-employed farmers and their family members.

In Finland the occupational health service provides individual advice and regular health checks for farmers and farm workers and 41% of Finnish farmers are members of the farmers' occupational health service (FOHS). The work of FOHS is mainly preventive but curative activities may also be included. The tasks of FOHS include:

- Analysis of working conditions by regular farm visits.
- Assessing and monitoring of work-related health hazards.
- Surveillance of health through medical check-ups.
- Drawing up proposals to improve working conditions.
- Adjusting work tasks according to the employee's capabilities.

Farmers in Norway who use FOHS are quite satisfied with the results, but the membership of FOHS is low, only 8,300 or less than 15% of farmers (Brunes, 2006). In Sweden, 37% of farmers use the occupational health service, mainly for regular monitoring of their health (Danielson, 2006). An attempt to trial such a service has been implemented in portions of the states of Iowa and

Nebraska in the United States. This programme is titled Certified Safe Farm (Donham and Thelin, 2006). The concept is that those farmers who volunteer to participate in the programme must adhere to most of the interventions listed for the FOHS. If they successfully comply, they receive about a 10% rebate on their total insurance costs. The rebates to date have mostly been funded by government grants, but the intention is that insurance companies will see the value of the programme and will eventually be willing to provide approximately a 10% insurance policy cost rebate. To date, insurance companies have been reluctant to become involved in this type of intervention.

The farmers' occupational health service is one way to promote occupational safety and health but it should not be the only method, as FOHS seems to have certain difficulties in reaching the majority of farmers. Other methods used are information campaigns and training activities, either for specialised groups or general training for all farmers. Sweden has started an information campaign to prevent injuries to children on farms. The model is adapted and developed from the North American Guidelines for Children's Agricultural Tasks ([www.nag-cat.com](http://www.nag-cat.com)). The idea is to assist parents and other adults in assigning appropriate and safe farm jobs for children and adolescents (Svennefelt and Lundqvist, 2006).

In addition, Sweden has two different training programmes available, one providing specialist training in the safe use of chain saws and one general training programme on safe farming. The safe farm programme includes one day of training every third year, followed by a farm walk-through by an expert that includes a check of children's safety if appropriate for the farm. Joining the programme gives the farmer 30% lower insurance fees (Danielsson, 2006).

Most of the intervention efforts in the United States have historically focused on various types of educational initiatives. The primary organisations involved include the Land Grant Universities located in each state through their extension programmes, farm organisations, and regional agricultural safety and health research and outreach centres. In 1990, a major new national focus on agricultural safety and health issues was initiated as a result of a series of national conferences that led to the publication of a report titled '*Agriculture at Risk: A Report to the Nation*'. In addition, a series of major articles were pub-

lished in the national media regarding the growing problem of farm accidents, and a new national grass roots organisation called Farm Safety Just-4 Kids was formed by a mother in Iowa who had lost a child in a farm accident (Murphy, 2003). Since the early 1990s, the US Congress has appropriated approximately 24 million dollars each year for agricultural safety and health research, establishment of nine agricultural safety and health centres, and establishment of a national agricultural child injury prevention centre. These efforts have significantly increased the scientific knowledge about health and safety issues facing the agricultural industry and the development of more effective interventions.

In many countries a code of practice, which usually means a risk assessment document or programme, has been developed. In Ireland and Finland, farmers are trained to use the risk assessment because according to surveys, farmers' abilities to identify the risks on their own farm are variable (McNamara et al., 2006; Murtonen, 2006). Some farmers are not able to define even the most critical risks or are not willing to discuss those issues, whereas others describe the risks very analytically but certain risks may be underestimated.

The Health and Safety Executive (HSE) in the United Kingdom has chosen another approach by leaving out the training and developing interactive software to help farmers carry out a comprehensive health and safety assessment of their farms. The software is available on the HSE website and is aimed at all farmers and farm managers who are responsible for health and safety.

Features of the self-assessment software include (HSE, 2007):

- A downloadable application, which can be installed on the farm computer and completed off-line at the farmer's leisure.
- A configuration screen that tailors the questions to those relevant for the individual farm.
- A series of questions on key health and safety topics.
- A benchmark for each question of the minimum standards that should be attained to comply with legal requirements and the reasoning behind it.
- The ability to order relevant free HSE guidance.
- A facility for the farmer to add additional risks to his/her assessment on issues/hazards that are either

not covered by the questions or that are unique to the particular farm.

- A facility to allow separate assessments to be produced for more than one farm/holding.
- Outputs in the form of a prioritised list of identified actions.

A more demanding approach is to integrate occupational safety and health into the quality management system of the farm. Theoretically, this seems to be an ideal solution. The problem is that the quality of products is highly prioritised by farmers and the development of the quality management system is finished as soon as the product quality part is done. Some farmers continue by including environmental quality into the system, but few have the endurance to include occupational safety and health. Despite these difficulties, strong efforts have been made, at least in Norway, Sweden and Finland, to include occupational safety and health as an integral part of the quality management system of farms. Academic training efforts in the US have begun to focus more on training farm operators how to develop and implement safety and health risk management plans. Courses have been developed at major agricultural universities such as the University of Illinois and Penn State University that focus on training future agricultural professionals in the basic principles of risk management.

Intervention studies seem to be quite effective in changing the safety behaviour of farmers. In an intervention study in Denmark, Rasmussen et al. (2003) showed a substantial reduction in the number of farm injuries and measures of safety behaviour revealed significant improvements. The intervention effect was estimated to be a 30% reduction in the rate of all injuries and a 42% reduction in medically treated injuries. These results suggest that appropriate training followed by a farm walk-through by an expert could substantially improve the effectiveness of self-assessment systems.

If the farmer is motivated, simple checklists can provide a good start in improving farm safety. The US Occupational Safety and Health Administration (OSHA) has produced a list of simple rules to remind farmers of important safety issues. By following these rules, most accidents could be avoided but the problem is that the rules are very general and are only intended to be remind-

ers of major safety risks and provide basic intervention recommendations. Farm operators and workers would need to seek out other sources to more fully understand the issues and how to implement appropriate intervention measures. The steps recommended by OSHA to improve the safety of farms are:

- Read and follow instructions in equipment operator's manuals and on product labels.
- Inspect equipment routinely for problems that may cause accidents.
- Discuss safety hazards and emergency procedures with workers.
- Install approved rollover protection structures or protective frames on all tractors.
- Make sure guards on farm equipment are replaced after maintenance.
- Review and follow instructions in material safety data sheets and labels that accompany chemical products and communicate information on these hazards to workers.
- Take precautions to prevent entrapment and suffocation caused by unstable surfaces of grain storage bins, silos, or hoppers.
- Be aware that methane gas, carbon dioxide, ammonia and hydrogen sulphide can form in unventilated grain silos and manure pits and can suffocate or poison workers or explode.
- Take advantage of safety equipment, such as bypass starter covers, power take-off master shields, and slow-moving vehicle emblems (OSHA, 2007).

## Conclusions

Occupational safety and health work in agriculture has to respond to the needs of diverse farm types, e.g. small farms with part-time farming and large farms with permanent and/or seasonal workers.

Larger farms usually have larger and more modern machinery and therefore less machinery injuries. New animal confinement buildings are generally better in terms of air quality and working conditions. However, the increasing farm size may bring longer work exposure

times and increase the risk of chronic diseases. Stress is also often reported as a major problem among farmers.

The introduction of safety measures depends on the technical, economic and social development of the agricultural industry. Integrating safety into quality systems and the planning of new production processes and buildings is a great challenge for all concerned –farmers, safety organisations, professional associations, extension services and administrations. However, this is a challenge that must be met in order to protect the most valuable asset that the agricultural industry has, namely its people.

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