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Nordic Association of Agricultural Scientists

NJF Seminar 481

Ergonomics, Risk Factors and Safety in Agriculture and Forestry

April 16-17, 2015, Tartu, Estonia

NJF

Nordic Association of Agricultural Scientists

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Seminar no 481

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Estonian University of Life Sciences

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TUNNUSTATUIM MAATEEMALINE MESS BALTIMAADES
MAAMESS 2015
PREMIER RURAL FAIR IN BALTIC STATES

Estonian University of Life Sciences

Institute of Technology is one of five institutes of Estonian University of Life Sciences. Main study fields, managed by relevant departments at Institute of Technology include:

- Agricultural and Production Engineering
- **Husbandry Engineering and Ergonomics**
- Energy Engineering
- Applied Physics
- Mathematics

DEPARTMENT OF HUSBANDRY ENGINEERING AND ERGONOMICS

Laboratory

Work technology laboratory
Laboratory of physical and psychical workload
Laboratory of working environment safety
Laboratory of heat pumps and indoor climate
Milking and milk cooling equipment
Laboratory of ergonomics Laboratory of milking equipment
Materials testing laboratory
Laboratory of water supply
Husbandry Engineering and Ergonomics laboratory
Laboratory of vacuum units
Biosystems Engineering Laboratory

Research activity

BTS WORK TECHNOLOGY AND ERGONOMICS

occupational health: risk assessment, musculoskeletal disorders, energetic workload, psychological and psycho-social risk factors (job stress, burnout, and impairment of work capacity);
ergonomic quality of tools (efficiency, comfort, health);
indoor climate;
noise in the work and living environments;
chemical and biological hazards;
farm equipment , technology and reliability;
effective use of milking equipment: energy consumption, structural performance;
cooling of liquid manure for the reduction of NH_3 emission;
Biotechnical systems theory

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Nordic Association of Agricultural Scientists

Ergonomics, Risk Factors and Safety in Agriculture and Forestry

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Proceedings of abstracts

Contents

1. Programme

16nd April

8:15 – 8:30	**Registration and morning coffee**	
	Opening	
8:30 – 8:40	Opening remarks and welcome	***Ass.prof. Oliver Sada***
	Plenary Sessions	
		Chairman: Ass.prof. Oliver Sada
8:40 – 9:20	The working environment in uninsulated loose housing cowsheds in Estonia	***Allan Kaasik***
9:20 – 10:00	The Road to Zero Accident Goal	***Markku Aaltonen, DSc(Eng)***
10:00 – 10:30	Drivers´ physical workload in agricultural vehicles	***Veli-Matti Tuure***
10:30 – 10:50	**Coffee break,** *room B137* Oral/ Poster presentations	
		Chairman: Ass.prof. Allan Kaasik
10:50 – 11:20	Effectiveness of IPMS tool for handling chronic low back pain with sitting workplace employees	***Hille Maas, MSc***
11:20 – 11:40	Qualitative and quantitative determination of wood dust in the air of the work environment	***Ada Traumann, PhD***
11:40 – 14:00	***Visiting exhibition MAAMESS www.maamess.ee and Lunch***	
		Chairman: PhD Marko Kass
14:00 – 14:30	Working environment, time expenses and degree of difficulty of animal keeping houses	***Ass. Prof. Oliver Sada, Einar Mikson, PhD***
14:30 – 15:00	Biological risk factors in agriculture and forestry	***Ass.Prof. Eda Merisalu***
		Chairman: PhD Brian Lassen
15:00 – 15:20	Brigade leader in the field of agriculture–management of small-size pig farm with or without health risks?	***Tiina Juhansoo, Ass.Prof. Eda Merisalu***

15:20 – 15:40	Chimney sweepers and health risks of cleaning of farm ventilation systems	***Aija Järvine***

Chairman: Ass.prof. Ragnar Lemming

15:40 – 16:00	Seroprevalence of Toxoplasma gondii in cattle in Estonia	***Maarja Tagel, Pikka Jokelainen, Prof. Arvo Viltrop, Brian Lassen, PhD***
16:00 – 17:00	Discussion	
19:00 – 22:00	***Dinner at Tartu University Restaurant, 20 Ülikooli Str. www.kohvik.ut.ee***	

17nd April

8.30 – 16:30 Excursions to enterprises and farms

- **Estonian Dairy Museum;**
- **AS Estonian farm**
- **Stora Enso Eesti AS**
- **AS Põltsamaa Felix**
- **Laeva VALIO**

2. Key note lectures

2.1. The working environment in uninsulated loose housing cowsheds in Estonia

ALLAN KAASIK

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The first large scale (more than 300 dairy cows) uninsulated dairy farm was founded in Estonia in year 2003. Since then, all new or renovated dairy farms have used similar technology. Today there are more than 150 farms of the same type. According to the current regulations the air of the working environment can contain an average of no more than 9000 mg/m^3 (5000 ppm) of carbon dioxide, 14 mg/m^3 (20 ppm) of ammonia, 7 mg/m^3 (5 ppm) of hydrogen sulphide and 5 mg/m^3 of particulate matter (PM total).

The first measurements were carried out on nine large scale loose housing dairy farms. The measurements were carried out, once a month from September 2008 till August 2009. As contaminants, the concentrations of particulate matter, carbon dioxide, and ammonia were determined, and temperature and relative humidity were also measured. The concentrations of particulate matter, carbon dioxide and ammonia were measured at one meter height from the floor, at eight to 13 locations, depending on the size of the building, for 10 minutes per measuring site. Measurements were performed in the daytime while the cows were most active, and while different work routines were being carried out. In all the buildings the temperature and relative humidity were constantly determined at intervals of 15 min. The second measurements were carried out in three uninsulated or semi insulated large scale loose housing dairy farms. The measurements were carried out once a month from October 2012 till December 2013. As contaminants, the concentrations of ammonia, hydrogen sulphide and carbon dioxide were determined, and temperature and relative humidity were also measured. The duration of each measurement was 24 hours, and the concentrations of carbon dioxide, ammonia and hydrogen sulphide were measured once per minute at one location. The interval between measurements of temperature and relative humidity was once per hour.

The first study: The average PM total concentration was 205 µg/m^3, varying on a monthly basis with a range of 130 to 313 µg/m^3; carbon dioxide 553 ppm (313-822 ppm) and ammonia 1.2 ppm (0.24-2.38 ppm). The annual average indoor temperature in barns was 9.6°C (on a monthly basis 2.0-20.4°C) and relative humidity was 83 % (on a monthly basis 60-96 %).

The second study: The average ammonia concentration was 2.43 ppm, varying on a monthly basis with a range of 0.0 to 9.7 ppm, and the average hydrogen sulphide concentration was 51.4 µg/m^3. The annual average indoor temperature was 11.0 °C (on a monthly basis -5.8 to 22.6°C) and relative humidity was 70.3% (on a monthly basis 52.2-96.8%).

Due to the excellent ventilation, the gases and particulate matter concentrations in the inside air of the uninsulated loose housing cowsheds were low. Concentrations were a little higher in the cold season due to the closure of the ventilation openings and the use of curtains. For employees a low temperature and high relative humidity could occasionally be a problem in the cold season.

2.2. The Road to Zero Accident Goal

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The zero accident vision (ZAV) is increasingly adopted by companies. Enterprises simply want to get rid of workplace accidents, because they are tired of their negative consequences. The ZAV is based on the belief that all accidents are preventable. If accidents are not preventable immediately, they very likely will be in the long run. The ZAV thus provides an ethically sustainable basis for accident prevention. On other hand, zero accident thinking is both an intellectual and a practical challenge for safety work.

The ZAV opens new ways to promote safety culture in a company. Safety is a value as such, and an accident-free workplace should be a human right for every worker. Safety is also a part of the quality of production. Accidents and near-accidents indicate problems in work processes. Safety culture is part of the company image. It is easy to lose but very difficult to get back. The safety and health of employees can also be an integral part of a company’s competitiveness.

There are already a large number of examples how the zero accident concept has been applied in different countries and companies. The Finnish "Zero Accident Forum" is presented as an example of one successful application.

2.3. Drivers´ physical workload in agricultural vehicles

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The increasing number of working hours by using vehicles, unvaried work load and vibrations are important risk factors and challenges for occupational health services in agriculture during the next years. The aim of the study financed by the Farmers' Social Insurance Institution Mela was to find out physical work load caused by working postures and whole body vibration during driving various types of agricultural vehicles. Also the ways to reduce work load were gathered.

The data was mainly gathered on six farms, three of which were cattle farms and three crop farms. Small and easily movable equipment was used in gathering information about the driver's workload: a miniature camera was used to chart the driver's work postures and a wireless measuring device to measure the vibration of the whole body. The back and head postures were coded during the analysis utilising the OWAS method principles and the assessment method of body-part specific postural load. Total amount of working hours and the amount of machine work on each farm were calculated by using TTS-Manager programme based on standard times in agriculture.

The postural load was the highest in harrowing and in baling round bales with a tractor. The level of the whole body vibration was the highest in harrowing but also in driving a tractor with a trailer on a field. When taking into account also the working time, it is most important to decrease the work load when driving a tractor with the equipment attached behind the tractor and when driving a self-propelled forage harvester, to reduce the work load in driving agricultural machines.

There are several ways to reduce the postural load and the whole body vibration. Driving time can be decreased with efficient machinery or by decreasing the number of driving operations (combining operations). With job rotation driving time can be shared for several persons. The driver can reduce harmful consequences by stretching and exercising before and after driving operations. Unoccupied machines release the farmer from driving.

Key words: *physical workload, agriculture, driving, working postures, whole body vibration*

2.4. Effectiveness of IPMS tool for handling chronic low back pain with sitting workplace employees

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Background: Interface pressure mapping technology (IPMS) has been available for many years but is still controversial in its use and interpretation from both clinical and research perspectives (Jan 2006). Pressure mapping systems measures interface pressure. Pressure is defined as force over area (Gutierrez 2007), also Peak Pressure Index is used often as a parameter for establishing effective seating position (Lung, Yang et al. 2014). Interface pressure is defined as the pressure that occurs at the interface between the body and the support surface (Barnett 1997). Bringing human factors engineering to a new level, system is capable of characterizing pressure magnitude of the seat surface, back and head rest simultaneously. System also can collect the data in real time, software is essentially a dashboard control panel that assimilates the pipeline of data into comprehensible and easily interpretable images - all on one screen at the same time In the design of seating surfaces, position, density and conformity of materials is critical. System does not only significantly reduces the number of test iterations required, but is a benefitial design tool towards the quest for ergonomic fit. Employees, using sitting position benefit from learning how to maintain their position and relieve interface pressure on their muscles and connective tissue (Makhsous 2007).

Method: 4 case studies with 4 persons with chronic low back pain at the spinal column between L4-S1, at the age 35-45 years. Including 2 females and 2 males. Assessed by causative factors of low back pain during 3 months period. For the assessment of physical skin and connective tissue fatique, was used Pressure Mapping Assessment Tool, by Jennifer Birt, 2011, Canada. The primary analysis to specify low back pain causes was made on 6 areas: history, physical status, postures, surfaces, changes of positions, mobility and shear. Using IPMS determined current pressure distribution and based on the results of analysis have made: adjustments of working chair parameters, suggestions about additional ergonomic details (seat cushion, backrest, footrest) and physical therapy program about performing of mobility exercises during the working day and stretching exercises.

Results: All 4 subjects showed after intervention significant reduction of high pressure areas munder the sitting surface (average 68.3 %) by IPMS scans. Also all 4 subjects demonstrated average 35.5 % decrease in low back pain intensity and frequency by Comparative Pain Scale (Rich, 2008) All subjects defined their well-being subjectively better in 3 major categories:

during 3 months they have experienced less physical fatique during daily activities, felt less muscular pain in the evenings and have better quality of breathing functions.

Conclusion: IPMS tool could be classified as evidence-based clinical tool for identifying the chronic low back pain causes. Concept and assessment tool can perform recommendations for the prevention and treatment of pain and can be used by health care professionals. However, chronic low back pain is a complex condition and is often not clearly identified by one reason. Understanding and eliminating the causes of low back pain needs knowledge of today ergonomic research and prevention needs clinical and assistive technology equipment area skills and experience. While the amount, duration and frequency of the applied pressure, the soft tissue's and spine structures response to loading, and the role of shear and/or friction are crucial, individual patient characteristics need to be assessed as well. Intrinsic factors such as diagnosis, history of previous surgical repair, body build, posture, muscles condition, nutritional status as well as magnitude and distribution of interface pressures must be considered.

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2.5. Qualitative and quantitative determination of wood dust in the air of the work environment

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Exposure to wood dust occurs in many industries, including logging and sawmill operations, furniture manufacturing, paper manufacturing and construction of residental and commercial buildings. Workers are exposed when wood is sawed, chipped, routed or sanded.

Wood dust causes irritation of the eyes, nose and throat. The particles generated by the machining and processing of timber are usually large particles which affect mucosal surfaces and the upper respiratory tract. Cedar wood dust has been associated with the development of occupational asthma. Pine has been known to cause irritant and allergic contact dermatitis. Chronic exposure to hardwood dusts in the furniture trade has been linked to the development of adenocarcinoma of the nasal sinuses.

Hardwoods are maple, oak, cherry; softwoods pine, spruce, fir. Health effects of wood dust may be classified primarily as irritation, sensitization and cancer. In the case of irritation, these effects can involve the skin, eyes, or respiratory tract. Allergic manifistations can involve skin or respiratory tract, and cancer associated with wood dust exposure involves the sinonasal tract.

Skin irritation caused by wood is often mechanical. Some woods contain chemicals that are irritant, like teak, mansonia and radiata pine can cause eye irritation, skin dermatitis, resulting in redness and blistering. Allergic contact dermatitis can result from teak and African mahagany, western red cedar, poplar, airborne pine dust, rosewood. Wood dust is a particulate that causes irritation of eyes and upper and lower respiratory tracts. The magnitude of the effect depends on the size of particulate and the amount of exposure.

Wood dust has been found to be almost four times as irritating as plastic dust in the same concentration.

2.6. Working environment, time expenses and degree of difficulty of animal keeping houses

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Milk and meat production farms present a biotechnical system „man-machine-animal", which together with the indoor climate of buildings or premises constitutes a work environment for animal production. Indoor climate parameters of working environment have impact on the human capacity for work and the productivity of animals. Humidity and ammonia have more harmful effect on premises, whereas the indoor climate depends on various factors such as applicable tending technology, number of animals, systems for providing animals with forage and water, removal of manure, use of litter, and season or outdoor climate. Working environment air gas composition, its variations on a daily basis and its dependence on applicable technologies and animal keeping methods have been studied to a lesser extent.

In present overview, the idea was to find out the impact of different methods for animal keeping and tending works on indoor working environment. The daily developments of air velocity and contents of oxygen, carbon dioxide and ammonia were measured on various height above the floor of cowshed and pigsty in the central part. Study results provide further information concerning the indoor climate in cattle, pigsties and also allow selecting the method for keeping of animals with the least harmful tending environment.

In order to maintain our position on European market, we have to find cheaper ways to produce milk and meat. One of the opportunities is to enlarge farms and introduce rational animal keeping technologies.

Usually the evaluation is performed on the basis of technical-economical indicators (such as reliability, ease of use, costs related to working time and exploitation, etc.). Today it is obvious that such evaluation of technologies cannot be perfect, as it does not take into account the impact of animal-keeping technologies on the indoor climate of the production premises and the level of physical effort for work. Therefore this overview focused on the technologies used in cowsheds and pigsties, not only in view of the determination of the amount of working time, but also in consideration of their impact on the indoor climate of the working environment and human work load.

Keywords: *Working environment**,** indoor climate, tender, keeping technology, tending activities, ventilations, chronometric research, working time expense, pulse tester, degree of difficulty of work*

2.7. Biological risks factors in agriculture and forestry

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The aim of this study is to analyse various sources of biological agents and materials that can be exposed to the workers in agriculture and forestry.

The specific biological agents include bacteria, fungi, mites, viruses and parasites transmitted from the animals in agricultural work, and fungi and ticks in forestry works. Certain species of fungi produce very toxic toxins, which can be found in agricultural materials and in the air of animal houses. Endotoxins, produced by certain bacteria are a potent risk to respiratory organs. Natural or organic materials such as plants, animal proteins, storage mitmes, moulds and fungi in soil may pose allergy risks to workers. Flour, grain and wood dust can cause respiratory and skin diseases among agricultural and forestry workers. Materials harvested for animal feed may contain moulds, actinobacteria, and bacteria, especially when stored wet. Materials of animal origin such as hair, dander, skin debris from cows, pigs, poultry and dust particles from flour also give rise to a risk of occupational diseases. Workers may be exposed to infected animals and be infected by zoonotic diseases. Some biohazards have the potential to cause cancer or foetal harm. Microorganisms can enter the human body *via* damaged skin or mucous membranes. They can be inhaled or swallowed, leading to infections of the upper respiratory tract or the digestive system. Exposure also occurs accidentally by animal bites or needle stick injuries.

Workers at risk in agriculture include farmers, animal handlers, grain handlers, root crop workers, mushroom workers and veterinarians. The tasks where risks are obvious and numerous: animal tending, manure handling, grain grinding, grain harvesting etc.

Workers at risk in forestry include gamekeepers, lumber-jacks, saw gate and plant workers, where sawing, cutting and planting of trees are the main tasks and munder occupational risks.

In some cases it is possible to reduce the risk of contracting a zoonosis by controlling the disease in the animal, for example, vaccinating cattle against Leptospira hardjo or using salmonella-free feed for pigs and poultry. This has the added benefit of not only protecting workers, but also having economic benefits of improved animal health.

Good control methods over work practices are very needful for prevention biological risks in agriculture and forestry. The steps needed to remove or reduce the risks to workers will depend upon the particular biohazard. To avoid the formation of aerosols and dusts during maintenance operations. Good housekeeping, hygienic working procedures and use of relevant warning signs are key elements of safe and healthy working conditions. To include decontamination measures for waste, equipment and clothing and appropriate hygienic measures for workers. To include instructions for safe disposal of waste, emergency procedures, and first aid. To avoid or minimise the use of equipment or tools likely to cause cuts, abrasions or puncture wounds, and use safe working practices and personal protective equipment where appropriate. Monitoring of work environment, risk assessment and regular health control and vaccination of workers are the needed activities.

Key words: *biological risks, agriculture, forestry*

2.8. Brigade leader in the field of agriculture – management of small-size pig farm with or without health risks?

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Agriculture has always been one of the most important sectors of economy in Estonia, a small country with a population of 1,312 252 (01.01.2015) and with active work force about 630 000 employees. The most part of economy are small- and medium sized enterprises

The aim of this study is to study health risk factors and to suggest possible prevention activities for persons working in the field of agriculture on the example of the work of a brigade leader of a small-size pig farm.

Method: An overview of literature and interview were used based on the case study.

Results: Analysing respective literature shows that different health risks (psychological, physiological, physical, chemical and biological factors) and prevention methods in farming occupations are well described. The prevention of physical, chemical and biological risk factors is well regulated in Estonia. In contrast, different psycho-social and ergonomic problems are less covered as in professional literature as far as poorly used in practice.

However, the prevention of such health risks in farming work environment is much more complicated.

The results of this case study show that awareness of health risk factors among leaders in farming need to improvement for better and complex management of all risks.

Conclusion: Knowledge about health risks and respective prevention methods is very important for preserving health of people working in the pig farms that to maintain and develop this field of agriculture, as one of important economy sectors in Estonia.

2.9. Chimney sweepers and health risks of cleaning of farm ventilation systems

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Regular cleaning of ventilation systems is essential to ensure good indoor climate areas. Chimney sweepers usually clean chimneys and flues but in some countries for example in Finland they clean also ventilation systems. In the agricultural sector ventilation systems are used in farms. Breathing of farm animals' rises carbon dioxide concentration in farm air .Also from manure evaporates carbon dioxide, hydrogen sulphide, ammonia and methane. Ventilation systems' cleaning is important because of reducing the amount of humidity and organic dust coming from animal food, hair and decrements. Exposure to different toxic substances can rise occupational risks among both chimney sweepers and farm workers. Increased risk of allergy, respiratory system problems and skin diseases is possible.

2.10. Seroprevalence of Toxoplasma gondii in cattle in Estonia

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Toxoplasma gondii is a zoonotic protozoan parasite that has been underestimated and overlooked in Estonia: the infections are common in humans, domestic cats, and wild boars. In this nationwide cross-sectional study, we estimated the seroprevalence of *T. gondii* in cattle. Sera from 4080 cattle, collected in 2012-2013, were screened for anti-*T. gondii* IgG antibodies with a commercial direct agglutination test. Samples that tested positive at dilution 1:100 were defined as seropositive. The overall seroprevalence was 18.7%. As herbivores, the seropositive animals likely encountered and ingested *T. gondii* from the environmental reservoir: via water, feed, or pastures contaminated with *T. gondii* oocysts. The apparent local environmental *T. gondii* contamination on the cattle farms can pose a risk also for other hosts, including humans. In addition, the result suggests that Estonian undercooked beef and raw milk might be sources of human *T. gondii* infections.

3. Enterprises and farms

Estonian Dairy Museum

Address	Hans Rebase tee 1, Imavere küla, Imavere vald, Järva maakond
Mobile phone:	(+372) 503 3886
Telephone:	(+372) 389 7533
Website:	http://www.piimandusmuuseum.ee
E-mail:	info@piimandusmuuseum.ee

AS Estonian farm

Address	Tehnika 1, 72301 Oisu, Järvamaa, Estonia
Telephone:	+372 3871416
E-mail:	oyest@estpak.ee

Stora Enso Eesti AS

Address	Imavere vald EE-72401 JÄRVA MAAKOND Estonia
Telephone:	+372 38 49 301
Website:	http://www.storaenso.com/imavere
E-mail:	sawmill.imavere@storaenso.com

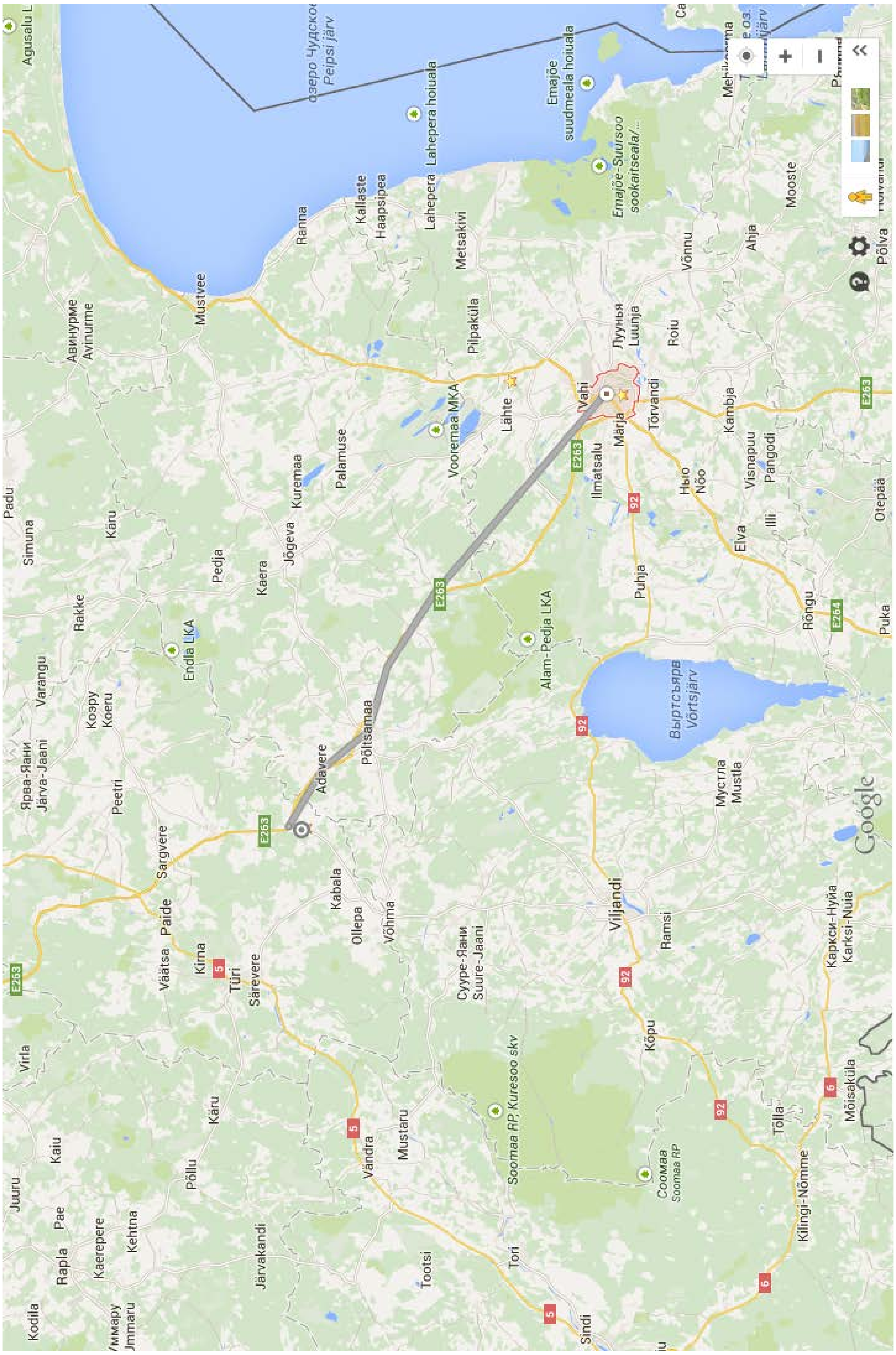
AS Põltsamaa Felix

Address	AS Põltsamaa Felix, Tallinna mnt 1, Põltsamaa 48103, Eesti,
Website:	www.felix.ee
E-mail:	info@felix.ee

Laeva VALIO

Address	Valmaotsa küla, Laeva vald, Tartumaa 60608
Telephone:	+372 730 1687
Website:	www.valio.ee

The Map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TARTU NÄITUSED

MAAMESS 2015, 16-18 April, Tartu Fairs Centre, ESTONIA

37 800 visitors, *402* companies from 9 countries and *50 000* square metres of exhibition space – that was last year's MAAMESS, organized by Tartu Fairs Ltd. Annual visitor numbers are growing steadily, and this is all the more gratifying because the fair is designed primarily for professionals.

MAAMESS is like a mirror of rural life: an excellent opportunity to make your company visible and familiar to farmers and agricultural organizations. Here foresters and agriculturalists, food industry representatives and gardening enthusiasts can establish new contacts, exchange the latest information and gain useful experience.

XXIII International Agricultural Exhibition
XXI International Timber Processing & Forestry Exhibition
XXI Food Fair
XVII Gardening Exhibition

The high quality of MAAMESS is confirmed its membership of EURASCO, the organization uniting the largest agricultural exhibition organizers in Europe.

MAAMESS also cooperates with fairs conducted in neighbouring countries that are dedicated to agriculture and rural life.

It is wonderful that with each passing year there are more and more companies and delegations from abroad among MAAMESS participants. The fair is not a purely Estonian event – it is important for many foreign companies. The participation of 42 companies from other countries in last year's Maamess is testament to this, as is the high number of delegations and their composition. The opening of the fair was attended by foreign guests of the Baltic Agroforum, including representatives of several countries and international organizations.

Welcome to Tartu!
See you at Maamess!

Margus Kikkul
Maamess, Project Manager

Year tractor
Case IH Magnum 380 CVX

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