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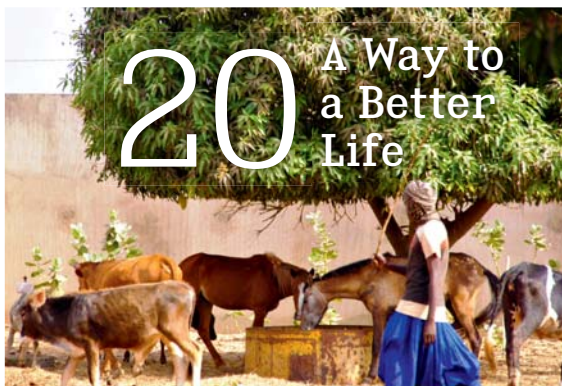
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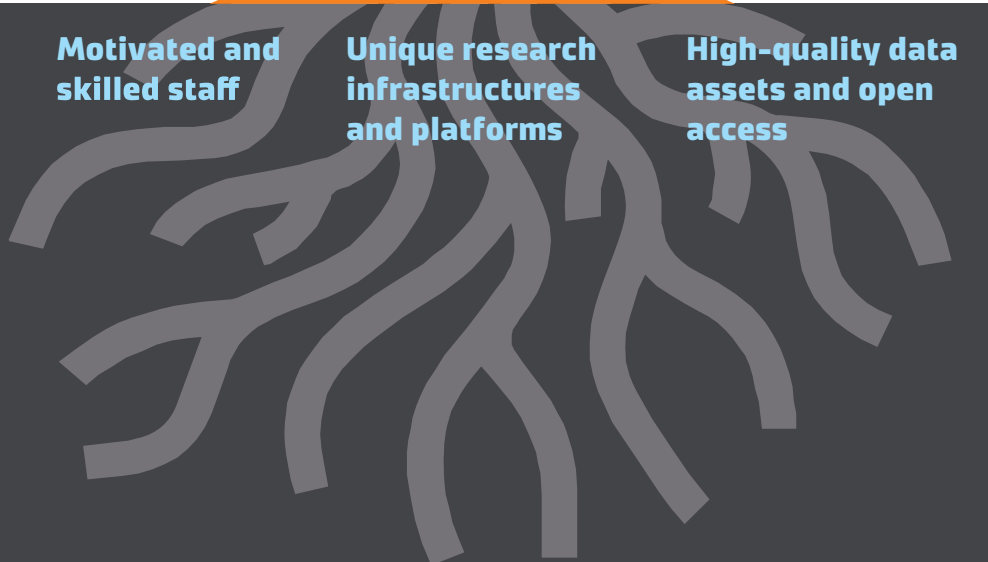
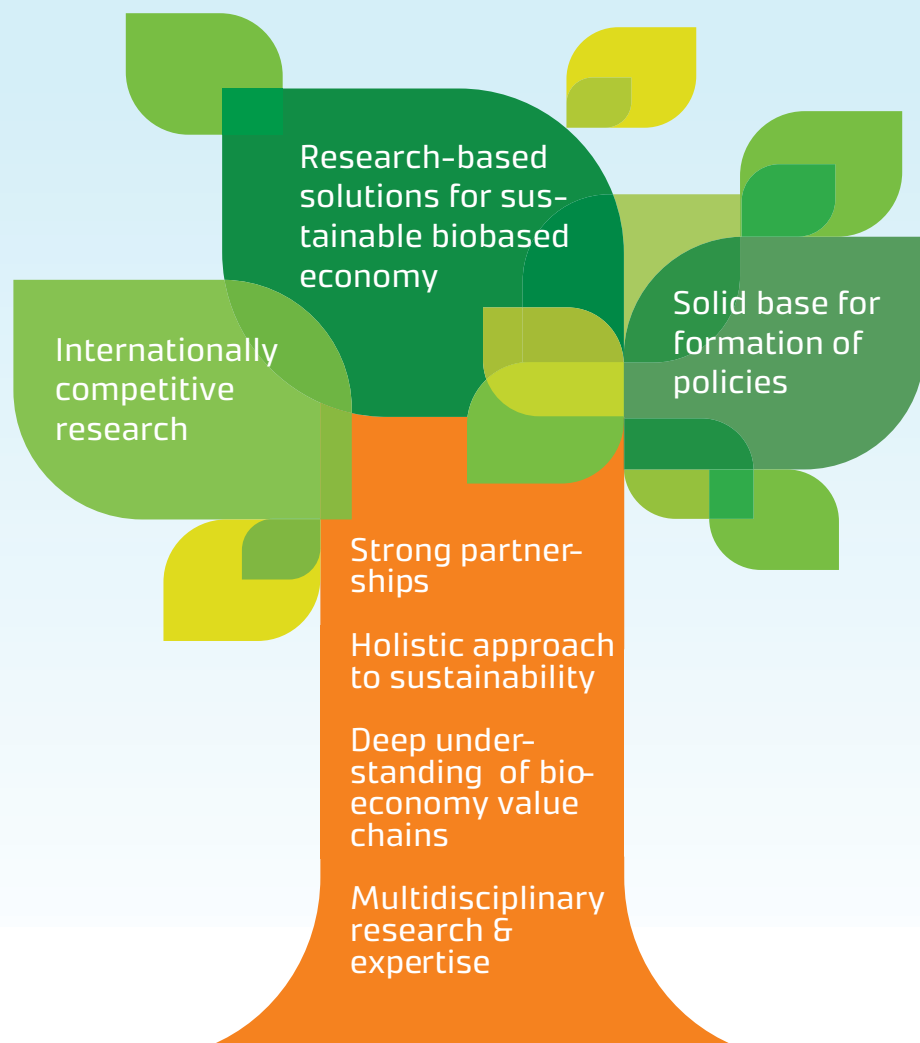
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Political and budgetary realities force to reform EU's Common Agricultural Policy

text: ULLA RAMSTADIUS

The EU's Common Agricultural Policy (CAP) is not like it used to be, as decision-making also deals with environmental, agricultural, climate and energy policies. The biggest challenge is how to make them work together, heading in the same direction.





In the ‘Communication on the Future of Food and Farming’ which was unveiled by Agriculture Commissioner Phil Hogan on November 29th, the European Commission lays out the future orientations for the CAP after 2020 and foresees significant changes in terms of the responsibilities shared between the EU and its member states.

According to **Jyrki Niemi**, research professor at Luke, the most striking aspect in the communication paper is the proposal for a new delivery model, which provides greater subsidiarity to member states and requires them to set up strategic plans, which will cover their actions under

the CAP. The Union would still set basic policy objectives, but Member States are required to produce plans showing how they intend to contribute to these objectives and to monitor the implementation by their farmers.

“In the absence of actual legislative proposals it is difficult to make predictions how this policy would work in practice. It seems likely that the agricultural policy will become more result-driven. Producers receive subsidies, for example, if they increase biodiversity, invest in the wellbeing of animals, preserve the cultural landscape and combat climate change. In the future, producers may also receive compensation according to how much their land collects carbon.”

Less money for the CAP

In its Communication, the Commission has avoided to mention two of the future CAP’s biggest challenges – the budget and Brexit. The CAP is currently the largest single spending item in the EU budget, accounting for around 40% of the total. The general pressure to reduce budget funding for the CAP has increased. The EU needs to address significant new challenges, especially with respect to climate change mitigation, immigration, security and growth, but there is reluctance among Member States to increase the overall size of the budget.

“The departure of the United Kingdom will add to these pressures. The loss of the



When it comes to climate policy, forestry and agriculture walk hand in hand.

▲ CAP accounts for roughly 40% of the EU budget.

UK's net payments means that the 27 remaining EU member states should to pay as much as three billion euros more per year in order to maintain CAP funding at the current level. At this stage the Commission is unable to say anything about CAP budget after 2020. The budget proposals will not be forthcoming until May 2018," Niemi says.

Finland's agricultural production volume to remain unchanged

In Finland, agricultural subsidies have helped, throughout Finland's EU membership, to safeguard the preconditions of agriculture in different parts of the country and in different production sectors. Subsidies have a much higher significance on agricultural income in Finland than in other EU member states, as production costs are much higher than market prices due to natural conditions.

In 2016, subsidies totalled nearly two billion euros, comprising approximately one third of total agricultural gross returns. In recent years, EU subsidies have accounted for roughly 70 per cent of total agricultural subsidies.

"On the basis of our economic models, it appears that a moderate decrease in EU

subsidies would only have a minor impact on agricultural production in

Finland, provided that production-based subsidies do not decrease. However, this requires that the national subsidy system remains unchanged and the price development of agricultural products at least matches that of production inputs," says **Heikki Lehtonen**, research professor at Luke.

Climate decisions have an impact on agriculture

According to **Pasi Rikkonen**, principal researcher at Luke, the guidelines of the EU climate and energy policy have a significant impact on the level of agricultural production and the growth potential of the Finnish food industry.

"When it comes to the climate policy, forestry and agriculture walk hand in hand. Considering agriculture in Finland, it is particularly significant how emissions and carbon sinks in the LULUCF sector are taken into account in calculations regarding the member states," Rikkonen says.

"If the climate package proposed by the European Commission is accepted

▲ Biogas plants are one way to improve self-sufficiency in energy.

and the large carbon sink of Finnish forests changes into a calculated source of emissions as a result of increasing logging volumes, the agricultural land use sector will face even more pressures. So far, the significant carbon sink of Finnish forests in the LULUCF sector has compensated for the emissions caused by agricultural land use."

The EU policy also has a significant impact on everyday lives in agricultural enterprises. Entrepreneurs are closely monitoring the decisions made on subsidies paid for cereal-based biofuels, the handling of emissions resulting from changes in land use and emission limits set for agriculture.

In the near future, farms will invest in renewable energy forms, such as solar power, geothermal heat and biogas plants in order to become more self-sufficient in terms of energy. As a result, farms may also receive new business potential in the energy sector," Rikkonen says. ■



Jyrki Niemi
Research Professor
jyrki.niemi@luke.fi

Transforming Wood into Food

text: SILJA ANNILA

At the moment, some sawmills treat sawdust as special waste, because it can't be put to good use. Growing sawdust piles can even limit production. Risto Korpinen from Luke thinks that sawdust could be a part of the answer to the world's need for food.





In 2050, there will be approximately two billion more people in need of food than today. Scarcity of nutrition will become increasingly common as the amount of arable land will decrease by 600 square metres per person. At the same time, Finnish sawmills are producing 3.3 million cubic metres of sawdust each year. Even though a large part of it is used for pulp and energy production, a substantial amount of it is piling up, unused and finally rotten.

World hunger and sawdust waste may seem like two separate issues, but Luke's Research Scientist **Risto Korpinen** thinks they can be combined. Korpinen is leading a project called *MonoCell – High-quality single cell protein for fish feed*. The project's title alone reveals quite a lot about its aim: to make high quality single-cell protein out of sawdust. The protein could later on be developed into fish feed.

“There has been a lot of discussion about the challenges that food production has to face in the future. That is also one of the reasons why I came up with this idea”, Korpinen says.

The idea of using wood as food is nothing new in Finland. In the years of the famine in the 19th century, Finnish people survived by making bread out of pine bark. The same emergency food was also eaten during the Finnish Civil War in 1918.

Against deforestation and extinction

According to Korpinen, it is clear that we cannot keep feeding soy and wild fish to the fish in our fish farms like we do today.

“The use of wild fish in feeding has led to the collapse of global fish stocks.”

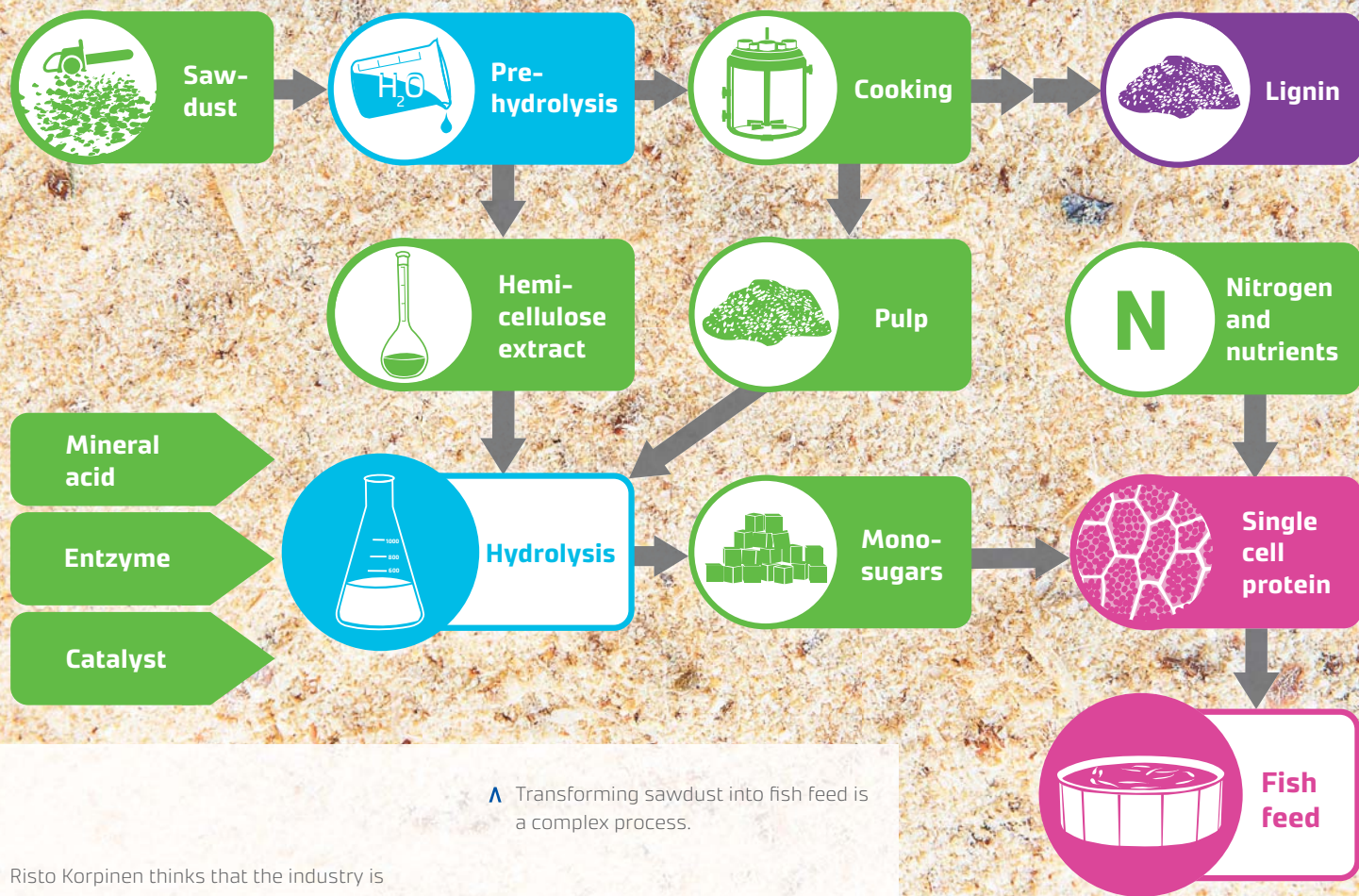
At the same time, the soy industry is facing a lot of criticism. Soy plantations contribute to deforestation and require

lots of arable land that could be used for planting food, not animal or fish feed.

“In Finland we use a lot of imported feed like soy. The industry is lacking a sustainable domestic option for fish feed”, Korpinen says.

Sawdust is a very familiar material to Korpinen. While he was a student at Åbo Akademi University in Turku, Finland, he wrote his master's thesis about making cellulose out of sawdust. Now he has a doctoral degree in science in technology and thinks that sawdust is an ideal raw material for fish feed because it is not suitable to be eaten as such.

“We could do these same things with potato or corn starch too, but starch can also feed humans. In the US they make bioethanol out of starch, even though there are plenty of people in the world suffering from hunger. It just goes against my morals to use food in fuel production.”



▲ Transforming sawdust into fish feed is a complex process.

◀ Risto Korpinen thinks that the industry is lacking a sustainable, domestic option for fish feed.

The team benefits from their vast experience

The MonoCell project really got off the ground in August when the first experiments were conducted. Utilising sawdust in protein production is a sophisticated process that includes several stages.

The aim is for the research to be done during the autumn of 2017. The team consists of ten researchers from all over Finland. Korpinen will mainly be working on the first stages, as he is the lead researcher and the one conducting the initial experiments. Some of the procedures are fairly familiar to the research team as they have previously been used in other projects.

“Everyone in our team has their own task that reflects their expertise. We have food scientists and nutrition experts, for example. At the end, researcher Frans Silvenius will do a life cycle analysis that will tell us how much energy and chemi-

cals have been used in the whole process”, Korpinen says.

New business for struggling sawmills

Korpinen believes that wood-based protein has a realistic chance of becoming a serious option for fish feed. Pulp mills have the right facilities to develop and use the MonoCell innovation and, thus, create new business for themselves.

“Mills could establish protein production units on their properties. They could benefit from the synergy by not just circulating the materials, water and chemicals but also energy, like electricity and steam”, Korpinen says.

The protein production would also provide an answer to a notable problem that sawmills in Finland have. At the moment sawdust can be used in making biofuels, for example, but the situation is still complicated. Due to Finland’s current

energy policies it is not profitable to use sawdust as an energy resource.

The state subsidises the use of forest chips, which are partly imported, as a resource for energy but the subsidies do not regard domestic sawdust. This has led to a collapse of sawdust prices as an energy resource – and it is the reason why Korpinen is so optimistic about sawmills. Like pulp mills, sawmills could increase their profitability by gaining profit from one of their by-products.

The near future for Monocell already includes cooperation with an actor who is interested in producing the protein.

“We also hope to find partners from the producers of animal feed. But first we have to do the research and clarify the costs and material use.” ■

i Risto Korpinen
Research Scientist
risto.korpinen@luke.fi



Big Data

is transforming forestry

text: IINA ALA-KURIKKA

Forestry is developing rapidly with the help of new technologies and procedures. Jori Uusitalo, Luke's Principal Research Scientist and Project Coordinator of the EFFORTE project, explains how big data will streamline forest work in the future.

1. Terrain predictions are becoming more precise

Forest machines are expensive and having them stand idle is even more costly. It is difficult to predict the conditions of forest work, because they are affected by the weather, season, soil properties, elevation differences and the developmental phases of tree species. If forest work is done at the wrong time, it causes unfortunate environmental damage. Heavy machines can easily sink into clay soil.

The first step in preventing environmental damage is to understand the forest's conditions and the changes that affect it. Here, big data and new ways of creating prediction models based on big data are

helpful. Big data means the collection and analysis of extremely large amounts of data. The prediction models being developed in the EFFORTE project indicate when and with what kind of equipment it is worth going to the forest with.

“Prediction models are primarily a tool for planning forest work”, says Project Coordinator **Jori Uusitalo**.

Going into forests with fine-grained loam and silt soils, as well as peat soils, is done during the dry time in high summer or winter. During the rest of the year, the work is done on ground with high bearing capacity.

“When the forest's soil type and the properties of it can be assessed, work can

< EFFORTE project aims to increase efficiency in forestry by new technologies and procedures.

be offered for forest machines all year round.”

Big data has already been collected previously on the ground's elevation changes, for example. The EFFORTE project aims to combine different big data archives.

“For example, weather data combined with changes in elevation tells us where rainwater accumulates after a shower. Forest work can be planned more precisely with this information.”

2. Forest machines collect data while working

Big data tells us how the forest is feeling right now. Soon, research groups and companies doing development will not have to separately collect their data. As measurement systems and sensors develop, the data will accrue while the machines work in the forest.

As measuring systems and sensors develop, systems will learn to predict conditions more precisely. The data that accumulates alongside forest work will improve and flexibly alter prediction models as conditions change.

Prediction models can be created on, for example, how sinky the soil is or the quality of the forest's trees.

The tracks left on the ground by a forest machine tire are an indicator of how much the heavy machine sinks into the soil. The depth of the track can be measured with the help of the engine power.

“The more the tire sinks, the more power the machine needs to move forward”, says Uusitalo.

The tracks, combined with weather measurements, let you know when it is a good time to head to the forest.

The quality of wood can be predicted by examining other trees that have been cut down in the area. The logger takes a photo of the felled tree's stem. Counting the annual rings provides information on the growth rate of the tree. The harvester

calculates the diameter and length of the trunk as the pruning and cutting proceeds. The result is called a trunk profile.

“The growth rate and trunk profile tell us about, for example, the wood's density, firmness, moisture content and rottenness. The information helps us optimize what kind of products to make out of the wood.”

3. The forest can be managed with precision

Smart ways of measuring and analysing big data will ultimately lead to the forester getting to know the forest better. Different conditions require different procedures.

“A forest hollow is humid, but the hillside is dry. A large forest is different in different corners”, Uusitalo explains.

Precise information on a forest and its soil helps in targeting the work. This is called precision forestry. The work can already be optimized when saplings are planted.

“Different tree species thrive under different conditions, so the forest's soil, dryness, humidity and elevation differences have to be taken into account. If a species of tree thrives in dry surroundings, dry tussocks are built for its saplings in waterlogged parts of the forest”, says Uusitalo.

Forestry is a chain containing many links, where each stage of work affects the costs of the next one. People may fail to notice certain details, which the prediction models are able to indicate in good time.

“When you understand the soil's properties and growth potential, you are able to take into account the total costs and total return.” ■

Forest work can be planned more precisely with accurate weather data.

Research results available for immediate use

The EFFORTE project, coordinated by the Natural Resources Institute Finland, examines how European forestry will become more efficient with the help of new technologies and practices. Research units from Sweden, Scotland, Switzerland and France are involved in the project. The business world is represented by the largest forest industry companies in Finland, Sweden, Scotland and France.


One of the companies is Metsä Group, which develops and produces renewable wood raw materials from Northern forests. The company is part of the project's expert group, is involved in the research done in the project and arranges test areas for the project's field experiments.

“Industrial actors and research institutes have different information on the same subject. Industrial actors know what challenges and needs the forestry industry has today, while research institutes provide scientific know-how and international understanding for these challenges”, says Metsä Group's Development Director **Olli Laitinen**.

“Cooperation helps ensure that all the information is made available for use. We are all motivated by the fact that the results of the work are immediately put into practice through cooperation with companies.”



Jori Uusitalo
Principal Research Scientist
jori.uusitalo@luke.fi



Rewilding hatchery fish stocks

text: MIKKO SALMI

Fish reared in fish farms are no longer surviving well enough when released into the nature because in a simple rearing tank environment the genome of the fish has degenerated during several generations of captivity. In a project coordinated by Luke, domesticated fish stocks reared in farms are rewilded by crossbreeding genes from wild fish populations.



Photo: Panu Orelli



Successfully, the salmon populations in the Tornionjoki and Simojoki rivers have recovered during the last few decades through effective fishing regulations and intensive fish releases and are now providing good catches for fishermen based on natural reproduction.

Instead, natural reproduction of the other stocks of Baltic salmon and trout is weak or non-existent in our rivers. It is apparent that the viability and survival of stocked salmon and trout in the nature has significantly deteriorated.

"A farm environment favours different kinds of individuals than a natural environment. If it has not been possible to renew a hatchery brood stock of fish from the nature, the selection processes in fish farm conditions and breeding dur-

ing several generations of captivity have weakened the viability of the fish produced to be released into natural waters, most probably due to inbreeding among the brood stocks", says senior scientist **Pekka Hyvärinen** from the Natural Resources Institute Finland (Luke).

New methods needed

In addition to genetic problems, an issue with intensive production of released fish is the fact that the simple rearing environment does not prepare the released fish for the challenges they face in the nature, such as surviving the attacks by predatory fish or using live natural food.

"New methods are needed for domesticated fish stocks to genetically rewild them and to enrich the standard rearing methods."

Hyvärinen is responsible for the coordination of the project called Luonnossa menestyvät istukkaat (Successful fish releases) running under Environmental program of fishery research that was started in the last spring. The project funded by the European Maritime and Fisheries Fund aims, as its name suggests, at developing methods for successful performance of reared fish.

Research for practical business operations

The bare necessities of hatchery reared fish for life in the nature are strengthened through genetics and improved rearing and stocking methods.

"The aim is to bring the most recent research results and new, cost-effective methods into practical business opera-



Fish reared in enriched environment succeeds better

Enriched rearing tanks include natural rocks and gravel providing shelter for the fish, and the water conditions in the tank - direction and speed of flow and water level - are changed during the entire rearing period.

Enriched rearing is started as early as the eyed egg stage by incubating the eggs among gravel.

It has been discovered that an enriched environment decreases the harmful effects of diseases during rearing and improves the stocking results.

Rearing in an enriched environment is more laborious in comparison with present standard rearing, and the price of the released fish may be higher, but the benefits surpass the added costs.

< Enriched rearing tanks include e.g. natural gravel.

< Attempts are made to genetically transform the domesticated fish into wild-like fish to increase their survival and improve their performance in the wild.

tions, and to improve the overall sustainability of stocking and farming operations”, says Hyvärinen.

Methods are being tested in practical farming experiments at the Kainuu fisheries research station of Luke located in Paltamo and at private fish farms, as well as with stocking experiments in the nature.

”We have already received very encouraging results with stocking fish reared using the so-called enriched rearing method. Survival of the fish reared in an enriched environment has been greater compared

with fish reared under present standard methods”, Hyvärinen says.

”It was also found out that rearing in an enriched environment reduces the harmful effects of fish diseases during rearing.”

Does the viability improve?

Luke has started research efforts in cooperation with university scientists to study methods to genetically transform the domesticated fish into more wild-like fish. The aim of the studies is to find out whether it is e.g. possible to use fish stocks from nearby rivers which have preserved the characteristics of wild populations to rewild domesticated fish stocks towards the wild ones by crossbreeding these fish between themselves.

”A crucial factor for implementing the crossbreeding methods is whether the

viability of the farmed fish can really be improved or whether they produce some negative effects on the performance of offspring”, Pekka Hyvärinen says.

In the future, the project also will develop new less stressful transport and release methods for the fish.

The project coordinated by Luke is conducted in cooperation with the University of Eastern Finland, the University of Jyväskylä, the University of Helsinki and the University of Oulu, Evira and Metsähallitus, as well as private fish farming companies. ■



Pekka Hyvärinen
Senior Scientist
pekka.hyvarinen@luke.fi

It's a fishy business!

There's more to fish than just food, and thorough use of fish parts benefits both regular and circular economy. The full potential of fish-based added value products hasn't yet been harnessed. Luke's researchers give their view on how unused fish parts could be exploited.

text: KIRA KEINI
graphics: VILLE KUJANSUU



Pirjo Mattila
Principal Scientist
pirjo.mattila@luke.fi

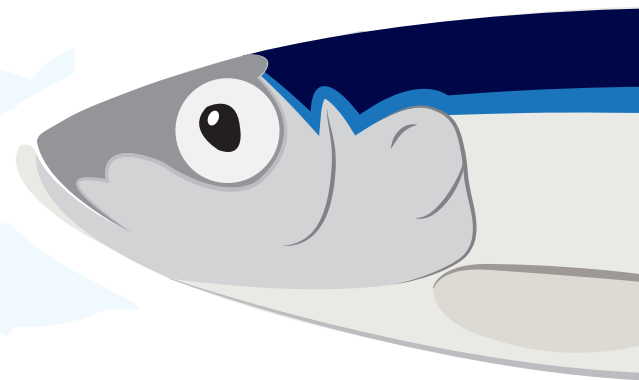


SKIN

Fish skin contains collagen, a protein that is used in, for example, **cosmetics** to increase skin elasticity and strength. Collagen can also be turned into gelatine which is utilised in foodstuffs, like **gummy bears**, as a gelling component.

Fish skin can also be cured and tanned for **leather products** like handbags or shoes. This can give new life to the skin that would otherwise be thrown away. As innovative as it sounds, the phenomenon is still in its infancy.

“The utilisation of fish leather is still somewhat amateurish”, says **Pirjo Mattila**, Principal Scientist at Luke.



OIL

Fish oil has a favorable fatty acid composition. It is rich with omega-3 fatty acids that contribute to, for example, the development of the brain, central nervous system and sight.

Fatty acids aren't the only component in fish oil beneficial to the health. The oil contains many vitamins, such as vitamin D, which is a crucial building material for bones and teeth.

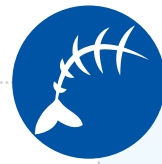
The health benefits of fish oil can be enjoyed as **dietary supplements** in the form of tablets or liquids.



SCALES

Fish scales contain chitin, an organic material that can be transformed into chitosan. Chitosan has multiple applications in for example biomedicine, dietary supplements and agriculture. It has properties that **help clot blood** and **protect plant seeds**, to name a few examples. The most extreme applications include using chitosan as a repairing material for **car paint coatings**.

Chitin is generally extracted from the shells of sea crustaceans. So far the only chitin available in Finland has been imported. Thus there still lies significant potential in the production of chitosan from Finnish fish.

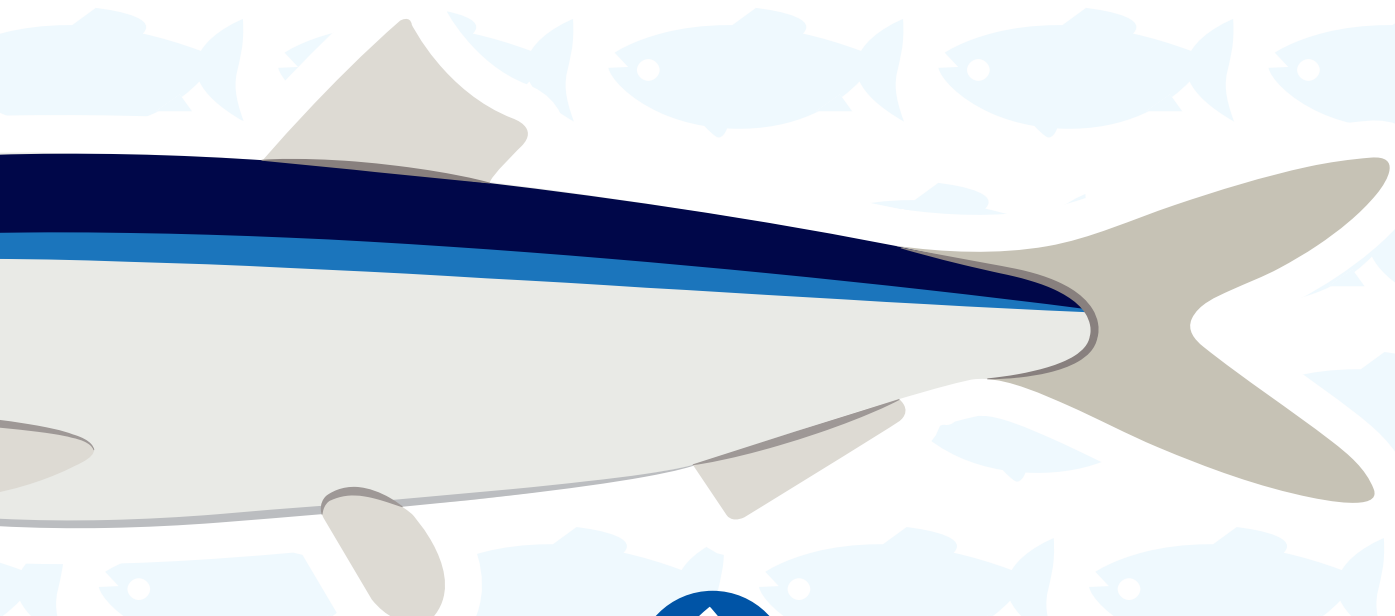


BONES

Fish bones are an excellent source of different minerals, such as calcium and phosphorus, and contain also collagen. The minerals can be used as raw materials in the chemical and fertilizer industries.

Phosphorus is a commonly used **fertiliser**: it has a positive effect on the development and growth of plants. Unfortunately the flow of phosphorus from fields to waters causes eutrophication. By obtaining phosphorus from fish bones the circle can be closed.

“This can be a way to recycle phosphorus: it moves back from waters to fields”, Pirjo Mattila points out.



FISH WASTE

Fish waste refers to the parts that are left over when fish are processed for food: skin, viscera, head and bones. In Finland a vast part of fish waste ends up as an ingredient in the **feed that is fed to fur animals**.

“The importance of the fur industry for the fishing industry is surprisingly big. The amount of fish waste from baltic herring and sprat put together is 140 million kilos per year. 40 percent of it was used by the fur industry”, explains **Jari Setälä**, Senior Scientist at Luke.

Fish waste can also be used for producing **biodiesel or landfill gas**.



PROTEINS AND PEPTIDES

Fish are an excellent source of proteins with high nutritional value. Moreover, structural parts of the proteins called peptides, can have various positive bioactivities, that is effects on living tissues. These include e.g. antiviral and antimicrobial effects. Fish peptides can even lower blood pressure and relieve pain. Fish peptides have already been commercialised. However, there are no Finnish manufacturers of these products so far.

Other fish protein products could also be of good use. “There’s a huge protein boom going on at the moment. Fish protein could be more widely used to **produce protein supplements**”, says Pirjo Mattila.



A Way to a Better Life

text: SILJA ANNILA

In Senegal, dairy production still faces many challenges. Conquering them would enable the local communities to count on having enough food and money for each day.



Photo: Milla Sell



In Africa, up to 80% of people get their income from farming.

It is hard for Senegalese dairy farmers to achieve high yields. The soil is dry and poor in nutrients. Drought usually means that there is not enough nutritious feed for the cattle, which has a negative impact on milk production.

As a consequence, the farmers' income decreases, making them barely able to cover the costs of farming and their children's education. Half of the population is food insecure.

Luke-coordinated FoodAfrica programme aims to improve sustainable food production and food security by bringing together a group of researchers from different backgrounds and disciplines. Together with the local farmers, authorities, students and entrepreneurs they have come up with solutions that can make food safer and accessible to all.

Improving productivity

The researchers studied different cattle breeds and animal husbandry methods. The goal was to find the best practices and promote them in local communities to improve the productivity of cattle.

The results were encouraging.

"Adopting good cattle management practices is one of the main solutions", states Luke's Research Professor **Jarkko Niemi**.

"When the cattle was managed well and provided with good quality feed, enough shelter and pure water, the yield of dairy cows more than doubled, compared to when it was managed poorly."

Naturally, some of the farmers can't afford the resources needed for good animal husbandry. To help them, the farmers were taught how to preserve fodder underground. The new, cost-effective method drastically improved the feed situation.

"The aim was to pass on the good practices through training and farm visits, for instance. I think FoodAfrica succeeded well", Niemi says.

Senior Specialist **Mila Sell** believes training local communities to farm more efficiently is an excellent way to improve their quality of life.

"In Africa, 60 to 80 per cent of people get their income from farming, and it will be extremely important in the future as well. Investing in expensive technologies will not be of any help if the basic solutions are not established."

New approach

Local cattle breeds in Senegal are popular but far from productive. With good herd management, crossbred cattle could provide a sevenfold increase in milk yield.



- ^ Local Senegalese cattle breeds are popular but far from productive.
- > Training local communities is an essential part of FoodAfrica.
- < A remarkable part of farmers in Africa are women.

“We noted that the cow types that partially or fully originate from Europe produce more milk. On the other hand, local breeds survive much better in a hot climate”, Niemi explains.

Mapping the cattle breeds was an entirely new research approach for Senegal. Genetic testing allowed the research team to examine the cattle’s origin, which had remained unknown for many farmers as crossbreeds can vary greatly in appearance.

“There is still a lot of work to be done with the breeding. But it has already been proven that breeding has significant potential for enhancing the livelihood of farms”, says Principal Researcher **Miika Tapio**.

If milk production increases, Senegal’s dependency on imported milk could be reduced. In the research period, the local Zebu cattle produced the smallest measurement of milk production, 307 kilos per year, whereas the High Bos Taurus breed produced 2,251 kilos per year.

“Production could easily be increased to 1,000 kilos per year. The potential is huge, even though we are talking about completely different numbers compared to Finland, for example, where cows produce almost 9,000 kilos of milk per year”, Tapio says.

Now, good practices are being passed on in Senegalese communities and academia.

The project’s findings have been integrated into the curricula of the Interstate School of Veterinary Science and Medicine of Dakar where one of the project’s partners, Professor **Ayao Missohou**, teaches.

Business women in the making

It is obvious that improving the productivity of dairy farmers will enhance food security in Senegal, but the project also had other ambitions.

“We wanted to improve the position of women in the Senegalese society”, Mila Sell explains.

A large part of farmers in Africa are women. According to Sell, women usually farm for the needs of their families whereas men farm products for sale. If the productivity of cattle increases, women are much more likely to become entrepreneurs.

“The next step is to get the attention of local politicians and policymakers. That way, education on better and more effective farming methods can also be spread to farmers who were not involved in our project.” ■

i Jarkko Niemi
Research Professor
jarkko.niemi@luke.fi



FoodAfrica

- A research and development programme that aims to improve the availability, security and quality of food in Western and Eastern Africa
- Provides knowledge and tools for local scientists, policymakers and farmers to improve food security
- Takes place in Benin, Ghana, Cameroon, Kenya, Senegal and Uganda
- Coordinated by Luke. Partners include CGIAR (Consultative Group for International Agricultural Research) institutes.
- Main funder is the Ministry for Foreign Affairs of Finland
- Relates to UN Sustainable Development Goals of ending hunger and poverty and achieving gender equality



Digital food system beats into information

text: MARJATTA SIHVONEN, JOHANNA LEPPÄNEN

Each and every one of us becomes a data producer, as eating becomes digitalised. With the aid of digital information, the food system becomes more and more international, and consumer segments for healthy food can be found as easily in Korea as in Finland.

My Data, i.e. personal data of an individual, are transferred in the web and make it easier to acquire a healthy diet. According to the researchers of the Natural Resources Institute Finland (Luke), the digital food system will offer new business opportunities for all operators of the system.

Luke's senior scientist **Terhi Latvala** knows that the digitalisation of the food system is subject to a lot of expectations, but also a lot of doubts. Information is continuously gathered on our health risks, our consumption patterns and our dietary guidelines. This data reserve could be used for developing an effective and healthy food system. However, familiar questions on data security and protection of consumers' privacy come up.

"I am thinking that the consumers would not be just providers of information at the end of the food system. At the moment, we give a lot of information to the trade without getting any of it back. My Data means that the consumers would manage their own information and would get to decide themselves who to share their information with", Latvala says.

More agility

By sharing their information, the consumers could get meals corresponding to their energy needs when eating in a canteen and notifications of product selections in shops that suite their diet. Latvala underlines that digitalisation is about refining information for individual needs.

“Consumers do not want individual products from grocery stores, but are looking for solutions for different situations, for parties, for dinners. By combining the consumers’ and stores’ information, the consumers’ situation can be solved as a service. Even the amount of waste would be reduced, when the shopping would be used for a specific situation”, Latvala describes.

Also, the consumers’ My Data would bring sought after agility to the food system. As the consumers would share their information, it would be possible to get more information on future trends in consumption for the food system.

Enabling marketing

Digitalisation is not something completely new. In agriculture, large farms have invested in automated production and robotics. However, in the future even small and mid-sized operators will be able to reach international markets in the web with quality batches and special products.

Although several unresolved issues within the food system that is becoming digitalised still remain, Latvala sees various opportunities in the future. One of the most important of them is the internationalisation of the food trade which makes it possible to transfer and track information on various products, services and materials as well as production equipment within global market chains. Digitalisation enables marketing of products to identified consumer groups that are scattered far and wide.

“With digital information, consumer segments for healthy food can be found as easily in Korea as in Finland. The food system is becoming increasingly international, and reliable operators will do well in digital trading”, Terhi Latvala says. ■

Digitalisation of the food system is all about personal needs.



Terhi Latvala
Senior Scientist
terhi.latvala@luke.fi



Photo: Johanna Leppänen

Keys of health for eating in canteens

Sirpa Kurppa, a research professor at the Natural Resources Institute of Finland, glances at her pedometer. “We are walking data repositories, but only by combining our own information with dietary guidelines we can solve major public health issues.”

The Finnish dietary guidelines and the free or heavily subsidized children’s and students’ canteens are a well-functioning system from an international point of view. According to professor Kurppa, public kitchens are fast to react to changes in the guidelines, but there is room for improvement.

“It would be easy to incorporate a personal guide function to this system. My own pedometer is quite simple, but devices that give information on need for energy and liquids are becoming more and more popular. All that is needed, is a common platform that pick information from the wrist or the mobile phone and incorporates this information into canteen services.”

Professor Kurppa believes that an instructive, smart food services application would function better than a doctor’s or a nutritional therapist’s talk about healthy choices.

“This information can be managed by us personally, unlike an expert’s talk that we tend to react negatively to.”

Kurppa points out, that we often behave inconsistently. We might feel regret for the coffee and pastry with the mother-in-law yesterday and try to compensate it by fasting for a day, which again makes us return to sweets.

“It does not work. My pedometer notices, that today is a day full of meetings and that I have only walked for 3,000 steps. It gives a kind reminder that tomorrow it would be good to try to walk for 7,000 steps. In the same way, a smart device can encourage to rectify errors in the diet in the long run.”

There are many ways to apply smart solutions. Kurppa proposes photo functions for canteen services for the elderly in order to find out how much of the portions has been eaten and, in the future, using genetic information for creating a personal diet.

Using artificial intelligence is profitable for the society, says Kurppa.

“We already buy different kinds of applications. If we think about who would pay for the platform connecting all the information, I would like to point out that the costs related to lifestyle diseases connected to food are very high.”

For example, in 2016, the global costs for diabetes treatments were 690 billion euros. In Finland only, the annual direct costs related to type II diabetes are more than three billion euros.

“We cannot afford this indefinitely.” ■

A close-up photograph of a cow's head, showing its brown and white fur. A yellow identification tag is attached to its ear, featuring the number '070' and '803' in black. The cow's eye is partially visible on the right side of the frame.

Prison came to the Lapland cow's rescue

text: IINA ALA-KURIKKA

The endangered Lapland cow was saved by a surprising group of people – the inmates taking care of them at Pelso Prison.



Photo: Jari Lindeman



In last May, the supervisors of Pelso Prison's barn received a postcard from a released inmate.

"He wrote that out of his prison experiences, working on Pelso's farm has been the nicest. But not nice enough for him to come back!" says the farm manager, **Reijo Virkkunen**.

Like many of Pelso's inmates, during his term the card's writer took care of Northern Finncattle, that is, Lapland cows, Finnsheep and grey Finnsheep. Taking care of animals in prisons is part of the Finnish domestic animal breeds' genetic resources programme.

In the early 1980s, there were less than thirty Lapland cows in Finland. Now, there are over three hundred cows and three hundred heifers in milk and meat production.

Protecting cultural heritage and animal health

The national animal genetic resources programme coordinated by Luke helps

protect the hereditary variation of Finnish domestic animal breeds. Domestic breeds are protected because they have economic, cultural and scientific value.

"Native breeds are part of the Finnish cultural heritage. For example, the native cow breeds, the Finnhorse and the Finnish Spitz are national symbols," says **Juha Kantanen**, the research professor responsible for the project.

Science also benefits from having different types of animals to study. A diverse selection of breeds and animal species makes studies more interesting and more scientifically valid. Native breeds help in genetic research, for example. In the Arctic Ark project, Luke and the University of Lapland are studying how domestic

animal species and their Northern breeds adapted to Lapland, one of the northernmost agricultural areas in the world.

For the native breeds to survive in the future, the genome has to be diverse.

"Climate change will alter the environment of livestock production, and new animal diseases will likely come to the North. Therefore, the immune systems and health characteristics of indigenous animals have to be refined through selective breeding", Kantanen says.

Hereditary variation is protected by, for example, maintaining a frozen gene bank. Another way is to keep livestock reserves where native breeds of animals are bred. One such livestock reserve is located in Pelso Prison.

The immune systems of indigenous animals have to be refined.

< Lapland cow's are curious by nature and, thus, well suited for animal therapy.

Animals make the inmates' work rewarding

Pelso's animals belong to the world's only genetic reserve livestock inhabiting a prison. Animal husbandry in prisons is rare, as in addition to Pelso there are domestic animals in Finnish prisons only in Huittinen and Kerava.

Pelso has decades of tradition in agricultural work. After the wars, about 1,500 hectares of land in Pelso was cleared for fields using prison labour. Up until the 1970s, cows and sheep were kept in the prison and their milk and meat were used in the prison kitchen.

The genetic resources work got to a start in the 1980s, when the first Lapland cows moved to the prison. Today, the prison produces organic milk and meat for sale. The aim is that the inmates do the cowshed and sheep barn's routine work under a guidance of the supervisors.

"Routine work includes feeding, milking, cleaning, giving milk to the calves, and daily monitoring of the animals' condition and health", Reijo Virkkunen says.

The majority of inmates do not have any experience in animal husbandry; each of them is trained for the task. The lessons and experience gained from the work will benefit the inmates after release.

"The work provides inmates with an opportunity to change their direction in life and distance themselves from former friend groups, if they so wish", Virkkunen says.

"I always tell the inmates that professional skills are important, but they should also get their life management in shape."

Working with animals is soothing and lifts the inmates' moods. The cows always greet you when you're walking on the pastures, says Virkkunen.

"Native breeds are curious by nature and they are well suited for animal therapy", Kantanen adds.

If necessary, the inmates will take a weak lamb under their care under a heat lamp. A small lamb grows attached to the person holding a feeding bottle and imprints onto them.

"From morning until evening they follow the inmates as if following their mother. When the lamb grows into a healthy

sheep, the inmate feels like they have done something meaningful", Virkkunen says.

The future is uncertain

In the spring of 2017, the Ministry of Justice issued a commission to re-evaluate the organisation of the penal system in Northern Ostrobothnia and Northern Finland. The options are to either renovate the Pelso Prison or combine it with the Oulu Prison. It is possible that the Pelso Prison will be closed down, which could also mark the end of its animal husbandry.

Until now, Pelso Prison's genetic resources work has been successful because various government and civil society organisations have worked together. Cooperation

between the Ministry of Justice, the Criminal Sanctions Agency and the Ministry of Agriculture and Forestry has meant that it has not been necessary to build a separate farm for the preservation of native breeds.

According to Kantanen, the cooperation between researchers and prison staff has also been excellent.

"For the work on genetic resources, the prison has been like winning the lottery. Pelso Prison has saved the Lapland cow." ■



Juha Kantanen
Research Professor
juha.kantanen@luke.fi

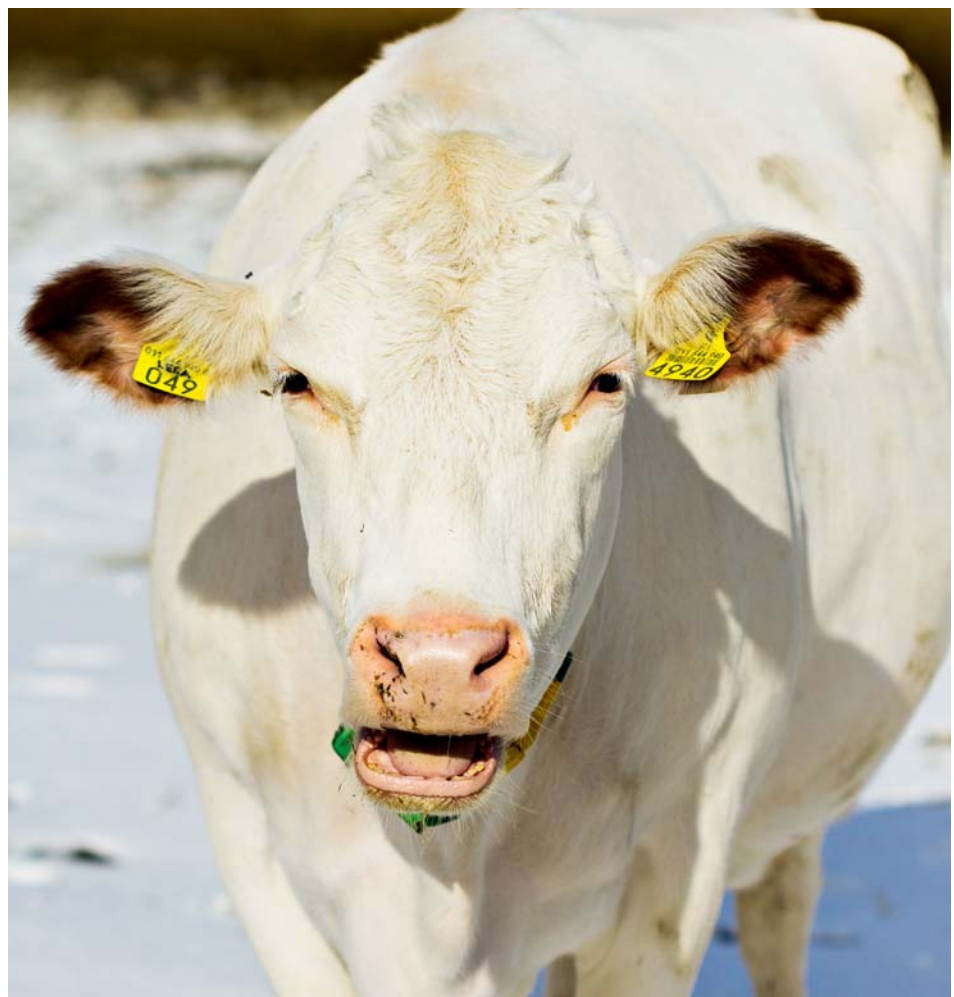


Photo: Jari Lindeman

▲ The Natural Resources Institute Finland and the University of Lapland's Arctic Centre are investigating how the Lapland cow's milk can be utilized as a special product in the hotel, restaurant and tourism industry. "The breed has a future if it remains as a milk producer", says Reijo Virkkunen.



Digital tools help get the best out of forests

text: KRISTIINA MARKKANEN

In order to maintain forests' diversity while their resources are put to maximum use, forest owners and planners need to make informed decisions and weigh all possible options. Luke's digital planning tools make this task a whole lot easier.

It's a tough job but someone has to do it. In the years and decades to come, Finnish forest planners and owners face new challenges as the National Forest Strategy 2050 and the Finnish Bioeconomy Strategy aim to, among others, increase logging by over ten million cubic meters in the next ten years.

How to maintain the integrity and diversity of Finnish forests while getting as much out of them as possible? One source of help is digitalisation. Digital tools bring additional value into handling large amounts of information and custom-

izing them according to the case at hand, says **Tuula Packalen**, professor and forest planning researcher at Luke.

"If you need to produce information that covers not just individual forest areas but whole municipalities and even countries, the sheer amount of data is impossible to manage without digital aid."

Luke has been working on digital tools for forest-related tasks and processes for a while now, Packalen says. Now Luke's researchers develop several digital tools that help plan forest use and provide valuable information on forest resources and ecosystems to base important decisions

on. Two prime examples are the forest indicator and the aptly named Yoda.

Yoda helps to make balanced decisions

Your Own Decision Aid or Yoda in short, is Luke's web-based tool for evaluating different planning projects one at a time. It's a versatile and participatory tool, says one of Yoda's developers, researcher **Mikko Kurttila**.

"Yoda has a visual user interface and is suitable for various different uses. That means people from different fields of work, not only forestry, can use it."

- ◀ A peat producer, for example, might use Yoda in assessing which peatlands would benefit them the most.
- ▶ It's a web-based tool that takes into account how the use of forests affects not just trees, but also other ecosystem services Finnish forests have to offer including berries and mushrooms

Luke's experts gather and put together data in Yoda for a certain use, for example evaluating which peatlands in a certain area should be restored, explains **Anne Tolvanen**, Luke's professor and researcher of ecology and multiple use of forests.

A peat producer, for example, might use Yoda in assessing which peatlands would benefit them the most. First they define the area they're interested in. Each peatland appears as a dot on a map. The user gets information on how much peat a certain peatland could generate, how much energy the peat contains or how diverse the peatland is.

"Yoda can be used in many different situations from forest planning to peatland assessment. Luke's experts can insert whatever data they have into this tool and it will help the user move forward with their plans," Tolvanen says.

In addition to providing exact and relevant forest resource data Yoda is also a tool for visualisation. Using different colours and symbols, it helps the user perceive the big picture quickly. Without visual aids the amount of information might not be as easy to grasp.

In 2017, Yoda is in development under the EU funded LIFEPeatLandUse project led by Anne Tolvanen. In the future, however, for example Luke's clients can use it according to their needs.

"Yoda will be a helpful tool for decision-makers from the grassroots level to executive seats in the European Union", Tolvanen says.

Forest indicator visualizes the big picture

Another significant digital tool for visualising the use of forests is called the Forest Indicator. Developed by Luke and several collaborators, such as universities, it's a web-based tool that takes into account



how the use of forests affects not just trees, but also other ecosystem services Finnish forests have to offer including berries and mushrooms.

"The Forest Indicator opens its user's eyes to see the impact forest use can have on the diversity of our forests", Anne Tolvanen says.

The final version of the Forest Indicator will be the end result of a three-year research project that focuses on finding out how to get new products out of forests. Tolvanen acts as the lead researcher in it.

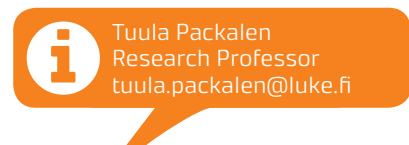
The Forest Indicator is meant for those interested in forest planning, individual forest owners, forest planners, officials and decision-makers. In 2017, the indicator is still in the making, but here's how it will work once it's finished.

The user enters the forest indicator web portal and selects a region they want to examine. The programme provides a list of indicators for the user to choose from

based on Luke's forestry scenario models (MELA). It helps to answer questions like how to maximize the amount of berries the forest can yield or to maintain the area's diversity as well as possible.

"The indicator has several options and colors for visualizing data. The user can choose for example whether they want to see the indicators as a bar graph or a clock face, where the hand shows how far a forest's diversity is from the maximum," Tolvanen says.

Although small pieces in the large puzzle of forest planning, Yoda and the Forest Indicator can bring a big amount of support to forest planners', owners' and decision-makers' work. When it seems you can't see the forest for the trees, all you need to do is open your laptop and the help is there. ■





An economist wants to find out the reasons behind our diets

text: SILJA ANNILA photo: VEIKKO SOMERPURO

Food is a complex topic. Research Professor Xavier Irz has studied food from many perspectives and still continues to find new, important research topics.

In the past... I am an economist but I ended up in that discipline somewhat by chance. When I was an undergraduate student in agricultural engineering, I was inspired by a couple of talks on international issues, such as the economics of developing countries. In my PhD I researched the role of agriculture in economic development.

I moved to Finland eight years ago and since then my research has focused on different themes. My main fields are sustainable food consumption and the functioning of Finnish food markets.

In the present... We are aware of the negative environmental effects of food. We also know about the health problems that poor diets can cause. I am trying to analyse why people choose the particular foods they eat. What are the drivers of those choices and of the resulting quality of diets? How could we steer people towards relatively more sustainable food consumption patterns?

A biologist is not going to start arguing with an astrophysicist, but the same thing does not apply when we are talking about food. Everybody thinks they are experts on food questions because everybody eats. The discussion rapidly becomes heated because the theme is so personal. This forces

the researcher to be very clear about the evidence and its strength.

I think that, at the moment, many policies are lacking coherence. There is agricultural policy targeting farmers, health policy for consumers and environmental policy. We should take into account that all these things have influence on how people make dietary decisions.

At the moment, many policies are lacking coherence.

In the future... There is a growing need for transparency and evidence in many discussions, and the subject of food is no exception. Luckily, in Finland policy makers and researchers have ongoing dialogue and new evidence is often taken into consideration in policy debates.

I think that the situation is better than in France and the UK, where I have worked previously.

That being said, we still need more evaluation of policies to understand what works and what does not. For example, in Finland, the government has intermittently introduced taxes on sweets and other sugar-rich products, but we are still unsure about the consequences.

I would like to study new food product innovations by manufacturers and retailers, in particular, to assess the potential of such innovations for raising the sustainability of diets. I am interested in meat and dairy substitutes. There is a lot of talk about them, but it is not clear whether those products are a temporary fad or a clear sign that diets are shifting towards plant-based products. Digitalisation and big data are also opening up new exciting possibilities to study how markets function and how consumers behave. ■



Xavier Irz
Research Professor
xavier.irz@luke.fi

From a pilot plant to a vantage point to European organic production

text: JOHANNA LEPPÄNEN photo: EETU AHANEN

Tuomo Tupasela, senior scientist specialized in food products, knows the field, the process, the product and the consumer. From the beginning of 2018, he will have a box seat for observing European organic production as the only Nordic member of the Expert Group for Technical Advice on Organic Production (EGTOP) of the European Commission.



You are a researcher specialized in food products, especially dairy technology, and an expert in sensory evaluation and quality of food products. What does your work consist of?

"I am responsible for the product development plant and the laboratory for sensory evaluation in Jokioinen, Finland. I also do organoleptic research with different raw materials. The raw materials include milk, cereals, berries and vegetables.

My work is close to the business interface. We visit our industry partners to discuss how we could possibly help them. We offer and search for solutions in cooperation with the customer, and, as a result, we get different products and recipes, for example. Luke has participated in the development of, for example, the Omega-3 eggs.

Luke also offers solutions for utilizing raw material side streams. The starting point is to use everything as fully as possible and to minimize the amount of waste ending up in landfills. When needed, we even help our partners with obtaining financing and reporting."

From the beginning of 2018, you will be the only Nordic member of the EGTOP of the European Commission. What is your own role in the group?


"The group will function as a technical and advisory expert body supporting decision-making pertaining to organic production. In addition to expertise in sensory evaluation and quality, I have competence in food technology. I have a lot to give especially on the subject of what organic processing is and what it could be in the future. Consumption of organic food is increasing in Europe, and the Commission has to be able to respond to growing production. EGTOP is about expertise, not about politics.

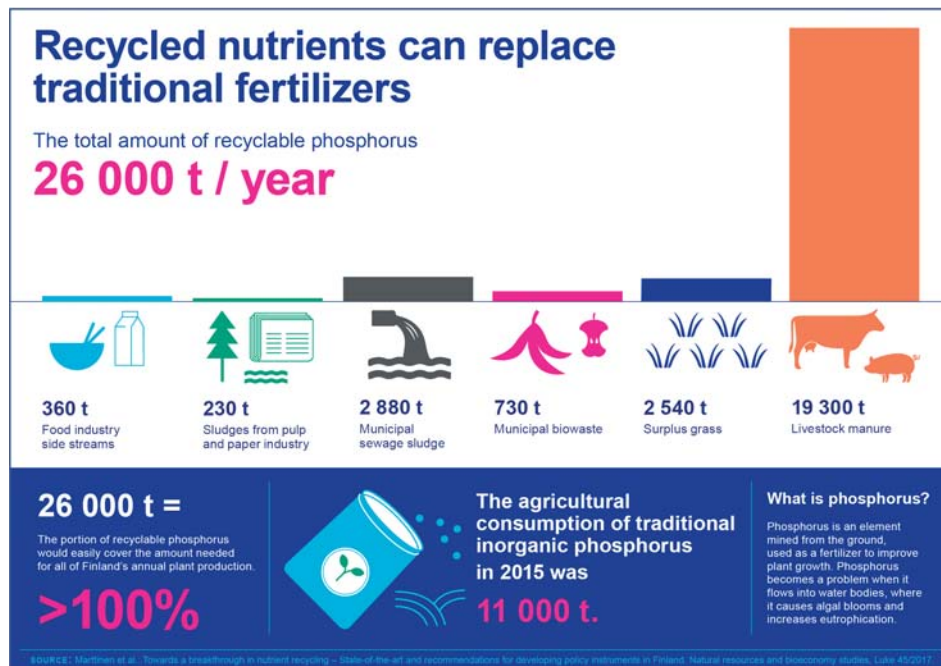
I base my work on the expertise of the Finnish Organic Research Institute and its wide network of experts. I am also a member of the scientific advisory committee of the Finnish Organic Research Institute. My appointment is also based on Luke's wide research organisation, the organic expertise of which is internationally recognized."

According to the new strategy of IFOAM EU, an interest group for the organic sector in Europe, half of Europe's farmland will have been converted to organic farming by 2030. In your opinion, in what direction should organic production be taken in Europe?

"At the moment, production within the EU is most likely not enough to cover the increasing demand. Originally, organic production was small-scale production. The current trend is that the size of farms and production volumes are growing, and organic production cannot be left outside this trend. If the market changes, also organic production must change. The aim is to have sufficient own supply to cover the demand.

The definition of organic goes far beyond legislation, and there are differences in national definitions. In addition, there are dimensions that are not necessarily always discussed: Should an organic product always be locally produced, what is the environmental impact of an organic product like in industrial production? Should even the social responsibility aspect of production be taken into consideration? There are no clear statutory limits for all aspects." ■

 Tuomo Tupasela
Senior Scientist
tuomo.tupasela@luke.fi



Efficient nutrient recycling calls for a policy reform

According to a recent Finnish study, efficient utilisation of nutrients requires a policy reform. Normative guidance should better support the processing of organic side streams, such as manure, into recycled fertiliser products. Nutrient recycling is part of the EU's circular economy goals.

“The goal of normative guidance should be to use nutrients according to the needs of plants, and regulation should support the replacement of conventional inorganic fertilisers with recycled nutrients”, said **Sanna Marttinen**, Secretary General of the Finnish Partnership for Research on Natural Resources and the Environment.

“Regulation must be simple and appropriate, both within the EU and at national level. In order to improve nutrient recycling, information systems must also be developed.”

Efficient nutrient recycling plays an important role in the EU goal of transforming the economy into a circular one. The world's mineral phosphorus sources are finite, and EU countries are heavily dependent on imported phosphorus.

“Recycling phosphorus and nitrogen is important to promote water protection, food security and circular economy. However, currently nutrients are not being recycled efficiently enough to reach the set goals”, Marttinen said.

www.luke.fi/nutrient_recycling_pb

Luke's forestry statistics package is expanding

Since July, Natural Resources Institute Finland offers even more comprehensive statistical information for the forest sector. Each new sector has its own homepage in Luke's online statistical services under the menu 'Other' in forest statistics.

Forest biodiversity data estimates the number of threatened species and the quality of nature management in privately owned forests.

Harvesting and long-distance transportation of roundwood contains data about timber harvesting by shareholders.

Forest sector labour force data is based on an employment survey conducted by Statistics Finland.

The Energy section includes information on peat production, consumption and foreign trade, greenhouse gas emissions and removals, as well as energy consumption.

The forest industries homepage provides information about forest industry production and investments.

stat.luke.fi/en/



Photo: Erkki Oksanen

Upcoming events

- 9.-10.1. Bio-Wise-Trans Workshop, Joensuu, Finland
- 9.-11.2. DEEP Baltic Sea Challenge, Helsinki, Finland
- 5.-9.3. Nairobi Innovation Week, Kenya
- 17.-21.6. Ecology of Soil Microorganisms 2018, Helsinki, Finland

More information: Luke.fi/en

Better bioeconomy investment decisions with #biomassmasters

The future of bioeconomy is bright. However, investors need reliable information in order to evaluate the new investment opportunities in the fast-growing field. Luke's key experts in sustainable bioeconomy investments – the #biomassmasters – attended the 2017 Bioeconomy Investment Summit in Helsinki, 14 December.

Organised by the European Forest Institute with partners including Luke, the event gathered 500 people to discuss how to bring the economy and the environment together.

The topics within the expertise of Luke's #biomassmasters range from market analyses and regional economy to greenhouse gas and carbon balance inventories for optimized land-use planning. More information is available online.

www.luke.fi/biomassmasters

New land use planning tool for farmers

Many farmers would like to keep even their poorer fields for a rainy day. How can you efficiently reconcile crops with cultivated grasslands and afforestation? The answer is PeltoOptimi, a planning tool for long-term utilisation of field parcels.

PeltoOptimi divides fields into three categories based on the land parcel data and suggests how to utilise each parcel.

“Currently, parcels with a high yield suffer from shortage because investments are made also in poor parcels. If a farm invests in the high-yield parcels, its overall production level will not decrease even if some lands are removed from the scope of improved production,” explains **Pirjo Peltonen-Sainio**, Research Professor at Natural Resources Institute Finland.

PeltoOptimi takes changing conditions into account. If the need for grass fodder decreases, the tool calculates which parcels should be switched to annual crops. The farmer can also edit the parcel data.

First parts of PeltoOptimi were published in September, but the development work continues.



Novel ideas for using hardwoods

Broad-leaved tree species, or hardwoods, are in great demand for furnishings in houses and homes. New uses, such as in wooden houses, and for textile fibres and liquid biofuels, are expected to rise.

The International Scientific Conference on Hardwood Processing (ISCHP2017) in Lahti, Finland, declared that resources and input are now needed in collaboration between research teams and customers, utilisation of raw materials and design, as well as marketing of products.

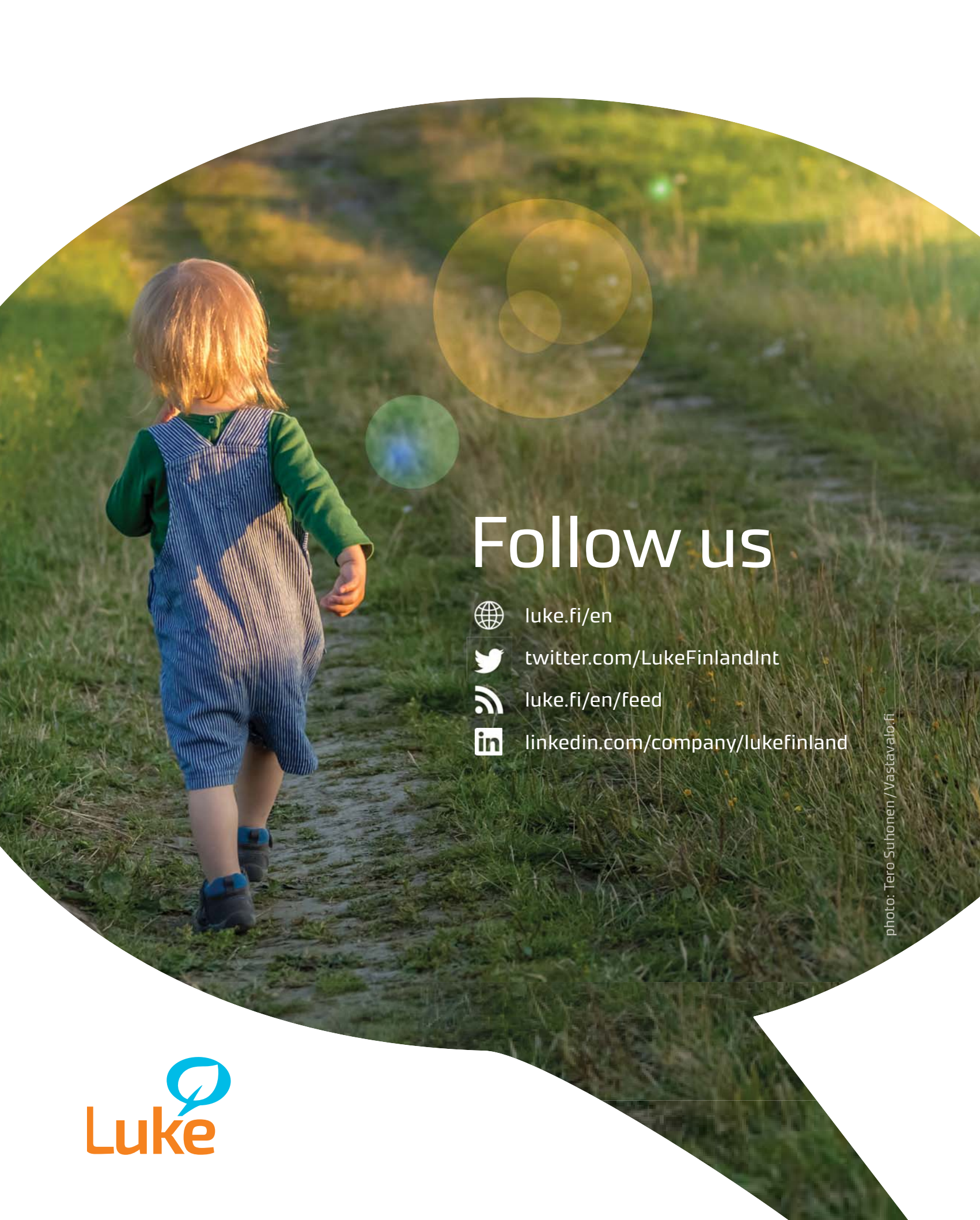
Hardwood product markets are composed of both limited market niches like ornamental items, home utilities and odorants, and large product segments like wood pulp, paperboard, furniture and biofuels.

“The value chains and enterprise networks for hardwood utilisation are transforming. They have to develop in order to contribute significantly to novel uses and markets”, said professor **Erkki Verkasalo** from Natural Resources Institute Finland.

Hosted by Natural Resources Institute Finland, the ISCHP2017 gathered 90 scientists, experts and company representatives from 23 countries.

www.ischp2017.org





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