Global Outlook

Future competition for land and water

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Global Outlook

Future competition for land and water

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Foreword

Global Outlook – an International Symposium as part of the celebration of the 200th anniversary of The Royal Swedish Academy of Agriculture and Forestry

The world of today is characterized by an ever increasing globalization. The terms of the global trade affect our Swedish basic industries. The turmoil in the financial markets is greater than it has been for many years, creating uncertainty and disturbances. One of the challenges is to support a growing world population with food, water and energy in a sustainable way.

The times were turbulent also when our academy was founded 200 years ago. Sweden was a poor country that had just lost Finland to Russia. One of Napoleon's marshals was put on the royal throne and became King Karl XIV Johan. The new king of Sweden chose to develop the country within its boundaries, and to improve agriculture, through research, development and dissemination of knowledge. Therefore, he took the initiative in establishing an Academy for Agriculture.

Much has happened since then. Sweden has indeed developed within its borders to become a successful industry and welfare nation. The role of the Academy is different today. We do not exercise any public authority or have any official administrative tasks any longer. Instead, we have become an important meeting place and a forum for discussion and exchange of information and experience. In the circle of fellows there are experienced and knowledgeable practitioners from agriculture, forestry and industrial operations as well as well-reputed researchers and also officers in high positions in the Swedish public administration. Our valued foreign fellows hold corresponding positions in their home countries.

Global development requires a sustainable use of natural resources and protection of people and the environment. Environmental degradation and depletion of natural resources is a result of a number of factors in a complex context. There is now a broad consensus that greenhouse gases contribute to climate change. The conditions of the agricultural sectors are affected, by a clear political focus on greenhouse gas emissions, as well as by the consequences of climate change that alter the international competitiveness of farming. Primary products from forests and fields will play an increasing role both as energy carriers (as replacements for coal, gas and oil), as replacements for petrochemical products and processes, and as substitutes for energy-intensive, non-renewable building materials.

The Academy's 200th anniversary was celebrated by both historical retrospection and looks at future scenarios in the international perspective. Part of this celebration was the symposium "Global Outlook".

Kerstin Niblaeus
President

Carl-Anders Helander
Secretary General

Speech by Academy Fellow Louise Fresco at KSLA's 200th Commemorative Meeting, 28 January 2013

Your Majesties
Ladies and Gentlemen

Professor Louise Fresco.

It is a great honour to stand before you today at this celebration. Two hundred years ago, the birth of this Academy coincided with the start of the systematic application of chemical and biological science to many fields, including medicine, agriculture, forestry and food. The next two centuries constitute a remarkable period of enlightenment. Whether it was the use of fossil fuels to replace human and animal traction, the discovery and rediscovery of the Mendelian laws of genetics essential to plant and animal breeding, the unravelling of the centres of origin of crop diversity by Vavilov, von Liebig's invention of nitrogen and phosphate fertilizers making reliance on fallows, rotations or guano unnecessary, and later the production of nitrogen fertilizer from the air, the invention of drip irrigation or the chemical and the subsequent biological control of pests and diseases – each of these innovations has changed the world irreversibly, even if initial progress was slow: cereal yields in 1930 were not yet much higher than in 1850.

The results of all these changes cannot be illustrated in a better way than by the realization that if we would have gathered in this room 200 years ago, two out of three members of our generation would not have survived past the age of 40. And 9 out of 10 of us would still have been a farmer or a labourer. With very few exceptions and exclusively for members of the upper classes, human history has always been marked by poverty and food scarcity. Only very recently, starting with the generation of our great-grandparents, the majority of mankind has gradually liberated itself from the worry about its daily bread. Health, nutrition, income, leisure and education have all improved spectacularly.

Of these two centuries, the last fifty years, the time span of our own lives, have been the most exceptional. We are the first generations ever to witness both an unprecedented worldwide demographic growth as well as an unseen

growth in wealth. Not just in the west, but everywhere. Starting around 1970, the scientific progress in breeding, disease and pest control, fertilization and food processing that brought prosperity to Europe and North America, finally found its way to poor nations, the ones we used to call developing countries. Thanks to the Green Revolution, led by Norman Borlaug, the only agricultural scientist ever to receive the Nobel Peace Prize, crop yields increased in every single country. The scientific basis for this revolution is simple: added nitrogen and other nutrients, shorter plants with a better harvest index, pest control, shorter growing cycles, double cropping, mechanization and irrigation. Comparable techniques were applied to increase the productivity of animals, fish and trees.

At the start of the Green Revolution, world population stood at 3.5 billion. Population has doubled since, while the number of calories per person has risen by more than one quarter. The terrible famines of Biafra or Bengal have not repeated themselves, and the last wide-spread famine we witnessed as a result of crop failure was the Ethiopian and Sahelian disaster in the early 1980s. Experimental yields of crops have quadrupled. Chronic food importers, like India, have become food exporters.

It is the final proof that Reverend Malthus was fundamentally wrong. We now know that famine is not the inevitable outcome of population growth, and even that in the near future population decline, rather than growth, must be our concern. Thanks to the application of science, public policy and trade, scarcity and hunger are not a necessity. Land does not need to be the limiting factor, because yields per hectare are not fixed but can and do rise dramatically. Although there is a biological limit to yields, no agricultural scientist today doubts that overall land and water productivity will be more than sufficient to feed future population. It is a great message of hope.

But all is not well. The Green Revolution brought exciting progress, but it was also marked by a simplistic belief in yields and calories. This focus obscured the negative ecological side-effects of chemical inputs on water pollution and biodiversity, the need for micronutrients rather than calories, the social dislocation of labourers and the effects on farm income. In fact, the real beneficiaries of the increased production were the urban populations and not the rural poor. However, many lessons have been drawn in the aftermath of the Green Revolution. Food and agricultural science have adjusted accordingly, becoming more cognizant of environmental and social dimensions.

Within these two centuries, and within these last fifty years, the very last two decades saw even more of acceleration in food production. After the demise of the Soviet Union, global trade exploded, allowing vast quantities of food and in particular animal feed to be shipped around the world and integrating former subsistence farmers in worldwide networks. The growth in demand for animal foods and therefore feed is the single most important factor driving world cereal prices. Economic growth and urbanization led to a staggering growth in demand for animal products, sugar and fats. Never before have the diets of so many people been so diverse, so rich and so affordable. Most middle class households now spend about 15 % of their income on food, as opposed to over 50 % half a century ago.

This tremendous progress has come at a cost, however, of plenty and abundance. The presence of cheap and plentiful food implies that for the first time the number of overweight people doubles that of those undernourished, a problem that is growing in developing countries. Also, about 40 % of the food grown does not reach the mouth of the consumer – in rich countries because food is thrown away through a combination of carelessness and strict adherence to freshness dates, in poor countries because of inadequate transport and storage. The expansion of large scale food production and especially of animal production, the clearing of forests and marshlands, and the use of fossil fuels have increased greenhouse gas emissions and increased concerns about global warming. The drive for efficiency has led to intensive bio-industries and the inhuman treatment of animals kept in massive numbers. The drive for biofuels from agricultural and forest lands as an alternative energy sources now may compete with food production. Even taste itself has become a victim to progress, as bland unhealthy fast food has taken over our cuisine.

In fact, one could tell two opposing stories about the last two centuries. A story about the amazing successes of science leading to an unprecedented food availability and wealth. But there is also a pessimistic story about the disasters that man has brought onto the earth as a result of economic growth. Ironically, those who have most benefited from scientific progress and the growth of wealth are the ones most doubtful of its future utility. For some in Europe, we are close to a biological meltdown, a world where we poison ourselves and the planet. But honesty commands us to say that we have also learnt from our mistakes. We pollute less than before, we have passed legislation to protect forests and lakes. I see human history as a continuing process of learning. Yet, it is the lack of belief in human learning that today separates the Europeans from the emerging economies in Asia, Africa or Latin America.

The negative perception of the unprecedented success story of agricultural science is less innocent than it may seem. It risks threatening the very heart of future scientific progress. What has been achieved so far has been the result of a careful formulation of hypotheses, experimentation and peer reviewed reporting (with, obviously, a pinch of serendipity). This methodology is now questioned in western society. Science and technology combined with free trade are said to lead to uniformity and anonymity, undermining of local traditions. Science is equated with a blind belief in technocratic, top down and large scale solutions without regard for human diversity, animal welfare, and environmental damage. For some science is just one opinion among many others on the internet. The doubts about agricultural and food science take many forms: a return to local foods and identities, the rejection of intensive animal production or even modern technology as whole, the embracing of organic production methods, the rejection of fertilizer, antibiotics and chemicals, the boycotting of industrial food production and preservation, the negation of trade and the need for economic growth. Many of these points contain valid elements of critique, but as a combined general statement they represent a dangerous, conservative mix.

The profound unease that western consumers experience in the face of food abundance and that leads to these opinions reflects a highly urbanized society where the links between consumers and producers need to be restored

and where science has become invisible. This must be a primary responsibility for all of us in scientific institutions. I would think it is one of the greatest tasks for an Academy to communicate better about the potential and limitations of science and its role in human progress.

So in the light of the mounting criticism of science and the resistance to technological innovation in parts of the world, how do we tackle the challenge to feed over 9 billion people in 2050? Can we achieve the doubling of food and agricultural production this requires once again? The successes of the past, even with the lessons learnt so far, are no reason for complacency.

The challenges are manifold. We need sustainable, flexible and resource-efficient food systems. With more than two thirds of the population in cities labour must be made more efficient and mechanized. Food safety in the entire food chain, and in particular in animal production, needs to be rigorously ensured. Sustainability demands closing of cycles as much as possible, substituting non-renewable resources, reducing all emissions. It sounds daunting, but this task is actually quite feasible with current technology, on the condition that the right economic, policy and legal incentives are in place, including the principle of the polluter pays.

The task is feasible, but it is not business as usual. We cannot repeat the Green Revolution, even if the scientific basis of that revolution still stands. I would like to single out two areas in particular that will require all our ingenuity.

Firstly, there is the challenge of producing sufficient proteins. Animal production presents increasing problems in terms of public health risks (especially poultry and pigs), animal welfare, emissions from digestion (ruminants), and concerns about feed sourcing. Fish capture and production from aquaculture raise comparable concerns. Animal products represent some of the most valuable foods for vulnerable segments of the population and should in my view not be banned nor taxed. For the poor we need more meat, more dairy, more fish, even if overconsumption of animal proteins is already occurring in richer households. There is an urgent need in my view to obtain an international agreement on the modalities of future animal production, in order to create a level playing field. Standards on workers conditions, public veterinary health, animal welfare and emissions should be adhered to by all countries. Moreover, we need to explore innovations that reduce the burden of animal protein production. The way forward is to look towards partial substitution: in processed meats, without the consumer noticing it, up to a third of animal proteins can be replaced by vegetable proteins. Moreover, new sources of proteins can be found in algae, bacteria and possibly in waste water and through waste retrieval.

Secondly, there is the challenge of harnessing genetic technology, in particular genetic modification of plants, trees and animals.

Europe cannot afford its current paralysis. Decisions and even the implementation of previous decisions by the EU are now avoided by politicians for fear of public opinion. The result is that among the twenty most important producers of genetically modified crops there is only one European country, Spain, at nr 19. I am certainly not arguing for a blanket approval of genetic technology, but for the acceptance

of the principle that for some specific applications in the field of food, feed and bio-energy and climate mitigation, it may be essential and even the only alternative. I am thinking of disease resistance in cassava, the crop of Africa's poor, of provitamine-A enhanced golden rice, of feeds containing enzymes that reduce the phosphate load to the environment from pigs. Europe's long standing tradition of public scrutiny, public-private partnerships, transparency and risk control must induce it to remain in dialogue with the rest of the world and not to marginalize itself in what may well prove to be one of the important scientific breakthroughs of the future.

So there is much work ahead. Most importantly, the poor are still with us, as around 850 million people are still undernourished and perhaps a billion are not eating adequate diets. Their number has been stagnating and will not decline as rapidly as we hope. Hunger and chronic poverty are mainly due to civil strife in failed states, temporary dislocation due to natural disasters and lack of purchasing power rather than failures in agriculture. This is mainly the stuff of politics. Science can only provide partial answers here, but surely their lot must be our priority.

For the first time in our history the vast majority of the world has enough and even more than enough to eat, even if the diversity and quality remains wanting for many. Today, however, we need social and political institutions not to deal with the distribution of scarce foods, but to manage our abundance and our greediness. After an evolution of hundreds of thousands of years of scarcity, we humans have no innate tendency to moderation. Nor do we have a good collective memory. Entire young generations grow up today for whom food is something in a plastic dish, bought in a hurry in a supermarket, heated in a microwave and consumed with one hand while typing or telephoning. This is not just happening in the west, fast food is in every city around the world. Something invaluable is lost this way, namely the awareness that food links us with others of the past and the future, with Neolithic farmers who first domesticated wild grasses, with farmers at the other side of the world who feed us, and with those who come after us and will ask one day what we have done with the earth and our science. Increasingly, mankind is now removed from the realities of food production, and with distance and unease we have developed a tendency to foster a nostalgic longing for a harmonious past that has never existed and to view science and progress with suspicion. We are already forgetting what it meant to be a farmer 200 years ago: the hard work in cold and heat, the boring food, the long winter nights, the injuries and early death.

We are the first truly privileged generations, thanks in large part to the application of science. It is now our task to respond to new generations, new challenges and new expectations to promote an understanding of what options exist for the future of our food production. And we must attract, as in the period of the Green Revolution, the brightest minds to the science of food, agriculture and forestry to accomplish the promise that science holds for the greater wealth of mankind.

Louise Fresco
Professor,
University of Amsterdam

1. Agricultural policies over the last 40 years – three cases

The overarching goal of this session was to draw attention to the political aspects of farming, emphasizing that policies are as important for development and increasing production as are for example good soil conditions. Three cases were chosen to illustrate different courses of development during the last 40 years: the EU, the US and New Zealand.

Introduction

Professor Mats Morell.

Moderator Mats Morell, professor at the Department of Economic History, Stockholm University, began by giving a historical background to the ongoing debate on agricultural policy. He stressed that agricultural policy has been a central feature of the shaping of 20th century society. The Western industrialised countries strove to develop a modern farm sector, to form a basis for both social stability and continued economic development.

– At the end of World War II Europe was rebuilt and the modern industrial societies took form. This required the shaping of a much more efficient farming sector, but also that farmers were guaranteed their share of rising prosperity. Moreover, the rivalry between the United States and the Soviet Union made the threat of a new large-scale war ever present. This actualised the norm of self-sufficiency in many countries. There was no question that all this would come about without governmental intervention. A laissez faire agricultural policy was not on the agenda.

In his presentation Morell pointed out that the Depression of the 1930s hit the agricultural sector very hard, since it comprised many small producers. Their reaction to pressed prices was to compensate falling incomes by producing more, resulting in even lower prices. As a response, farmers' organisations attempted to establish control over the goods farmers supplied on the market. Similarly, industrial cartels strove for control of the supply of their products and trade unions fought for control over the supply of labour. At a certain point governments stepped in and helped guarantee supply control. Governments established tariffs, import quotas and in many cases they effectively established import prohibition. Exports were subsidised, in order to ensure that falling world

market prices should not affect domestic prices. Once established and strengthened by World War II, interventionist policy in agriculture, rather than free trade, became the new normal.

– One might say that the type of policy developed in the 1930s, laid the foundation for the CAP policy pursued from the 1960s. Similarly the supply management policy of the 1930s in the US cast shadows over post war policies there.

– From an orthodox economist's point of view there are two legitimate reasons for governmental intervention in a particular branch, Morell continued. One is to combat concentration, i.e. antitrust legislation. That was not the case in the farming sector. The second valid reason for intervention is market failures.

– Many small private producers tend to underinvest in research and development. Governments may have acted as a result of this dilemma. Another reason for intervention may be to counteract environmental side effects from increased productivity. Largely, however, the output stimulation agricultural policies pursued up until the early 1990s tended to aggravate such problems.

Morell further stated that agricultural policy has consistently been working on a national level, aiming at solving national or, at best, community problems. An unusually consequent neo-mercantilist approach has been persistent. Solutions have tended to be at someone else's cost. This threatens to produce tragic consequences – sometimes aggravated by those national policies – on a global scale. This is true of the environmental and social problems connected with farming, and it is equally true when it comes to solving the threatening food crisis from a growing population in a world where the claims on land are growing.

– Europeans need to ask what kind of "Common" Agricultural Policy will stimulate a global land use that is socially and ecologically sustainable, while still producing increasing amounts of food for a growing population, which is also growing richer and demanding more sophisticated food. It is clearly not enough to stop exporting subsidised foods to developing countries in Africa and to open our borders for their exports in the hope that this will make their domestic food production prosper.

Finally Morell concluded that reformulations of the problems are needed, as is an analysis of the interests and forces at play. Global strategies for food production and food security have to – like the closely related climate and water questions – be negotiated with major forces and interests which are part of the global interplay involved.

– It will be a formidable task to create understanding on the national stages where the traditional benefiters and interests of national policies act, of the interplay between these forces, and of the acceptance of the fact that policies and actions at one end have repercussions at the other end and that the entire interplay must be considered when policies are made.

The EU's common agricultural policy 1973–2013: a policy reformed or just more of the same?

Professor Alan Swinbank.

In January 1973 professor Alan Swinbank, University of Reading, was writing his PhD Thesis on the Common Agricultural Policy (CAP) and he thereafter went to Brussels to work for the European Commission in the Directorate General for Agriculture. He has spent the last 40 years considering CAP, especially focusing on the CAP reform process. Swinbank initially made a brief outline on the development of CAP and the societal context during this 40-year period.

In 1973 the old CAP was well-established, involving market price support, intervention buying, the build-up of public stocks and export subsidies. It was the result of intensive state intervention in the inter-war and after-war years, and the construction of the European Economic Community (EEC). The first reform attempts put forward by Sicco Mansholt in 1968 had failed.

By 2013 the world has changed in terms of technology, global politics, societal expectations, international finance and economic ideologies. The original EEC of 6 has grown to EU 27 (soon to be 28). During this 40-year period the world has gone from one food crisis (mid 70's) to another (2007–2008), as can be shown by the wheat (US hard red winter wheat) commodity price. Swinbank emphasised that the price peaks of the early 70's coincided with the accession of the United Kingdom to the EU, a huge net food importer. The combination of price shocks and the accession of the UK meant that any serious talk of CAP reform was off the agenda for about a decade. The EU was not seen as having disproportionately high prices at the time.

– But policy has changed. So what have been the pressures?, Swinbank rhetorically asked. The four usual suspects are: the budget, environmental concern and rural development, food safety and quality, and external pressure through GATT and the WTO.

In the 1970's and 1980's farmers responded to high support prices, which encouraged production. Intervention stocks and subsidised exports grew. In 1984 CAP budget expenditures reached 0.7 % of EU Gross National Income (GNI). But CAP as a percentage of the overall EU budget has now declined dramatically, largely because other policies and revenue sources have been added to the budget. CAP has fallen to 0.4 % of GNI. Swinbank judged that budget pressures, in themselves, were not enough to trigger CAP reform. Although, he admitted, there was a lot of talk about budget pressures triggering reform.

What about the environment as a trigger for reform? Environmental policies were first introduced into the CAP during the early 1990's, largely at the insistence of the British. The enlargement in 1995 brought in Sweden together with Austria and Finland, and the appointment of Franz Fischler as Commissioner for Agriculture in particular elevated rural development so that it became the second pillar of the CAP.

– But, despite the rhetoric, EU farm ministers resist any further transfer of funds from price and income support (pillar 1) to rural development and environmental issues (pillar 2) as can be seen in the current debate on the shape of the post-2013 CAP.

Various food safety and animal welfare concerns have certainly been in the news, Swinbank noted. Public support for farming has weakened and new issues and actors have entered the policy-making debate. But these issues have not triggered any substantial reform, according to Swinbank.

In the 1950's and 1960's agricultural exceptionalism prevailed both in nation states and in the General Agreement on Tariffs and Trade (GATT). Agricultural exceptionalism is the belief that agriculture is so different from other sectors of the economy that markets cannot deliver appropriate outcomes. Governments need to intervene to change the market outcome. From the outset the CAP was subject to sustained criticism in the GATT. Imports to the EEC were blocked, and the EEC's subsidised exports unfairly captured world markets. This concern was exacerbated by the trade losses countries suffered as a result of the 1973 enlargement. The UK's imports from Australia and New Zealand were displaced in favour of sources from the EU market.

In other sectors of the economy governments were embracing neo-liberalism and deregulation. Australia and New Zealand abandoned agricultural protectionism, as did Sweden in 1990. Influential studies by the OECD emphasised the cost of farm support. Depressed world agricultural prices in the 1980's brought the matter to a head. Agricultural protectionism was a key issue in the Uruguay Round of GATT negotiations (1986–1994) in which the EU was keen to liberalise trade in services and manufactured goods. In order to lock other countries into this deal the EU also wanted the Uruguay Round to be a single undertaking, in which nothing was agreed until everything was agreed. The World Trade Organization (WTO) was created, with increased disciplines on farm support (The Agreement on Agriculture), with the EU as one of its key supporters. In order to sign up to this package the EU was forced to modify CAP.

– Thus I believe the MacSharry reforms of 1992 were brought about by external pressure (the Uruguay Round negotiations) rather than budgetary, environmental or consumer concerns, although they had a role to play.

As a result of the MacSharry reforms of 1992 the support for cereals and beef was reduced, and farmers were compensated for the implied loss of revenue. These area payments (on arable land) and headage payments (on animals kept) were partially decoupled (i.e. they were linked to input, not output) and there was a reduced need for export subsidies. This principle was carried further in the 2003 Fischler Reform. MacSharry's area and headage payments were further decoupled by breaking the link with production, but not with land (the Single Payment Scheme). It did not matter what the farmer did with the land as long as he or she kept it in good agricultural condition. At the same time there was growing emphasis on the environment and rural development (CAP's pillar 2) in the Agenda 2000 reform of 1999.

In 2013 the architecture of support is substantially different from what it was in 1973. Most support is decoupled under the Single Payment Scheme, and those payments are declared as "green box" support in the WTO (no principle effect upon on trade). But the level of support has barely changed, and the support of farm incomes is still the main objective. The European Parliament declared in a June 2011 resolution that agricultural incomes were notably lower (estimated 40 % per working unit) than incomes in the rest of the economy.

– But there are many academics who would challenge these figures. If correct, this is a rather shocking result of 50 years of CAP price and income support. If farm incomes are the target, then it is a very ill-targeted policy.

At the time of this symposium the EU's institutions were engaged in a review of the CAP, and the funding of the EU, to apply for the period 2014–2020. The policy discussed is to roll forward the existing CAP with some redesign of the Single Payment Scheme (in particular making 30 % of the payment conditional on additional environmental provisions) whilst preserving the CAP budget in nominal terms and with very limited redistribution of budget costs and benefits between member states.

Tangermann's verdict: "The political aim appears to be to maintain as much of the existing payments as possible by suggesting a new, though phoney justification. The proposals do not create a new and future-oriented paradigm. They are a retrograde attempt at safeguarding an outdated policy approach. The reform process is brought to a halt with these proposals."

Institutions do matter and so do individuals. The original CAP was very much the creation of Sicco Mansholt. Ray MacSharry, Franz Fischler and Mariann Fischer Boel – all pressed for significant CAP reform. The current commissioner Dacian Ciolos is backtracking on reform. The CAP and its budgetary consequences are a persistent cause of conflict between member states. Those member states with relatively important farm sectors strive to protect their farmers' vested interests. Others see the CAP as a budgetary burden and basically pursue the politics of juste retour (wanting to see their contributions to the budget matched by offsetting receipts). Until the Treaty of Lisbon (2009) was adopted the European Parliament had few powers over the CAP. This has now changed (the Parliament has co-decision with the Council of Ministers) and its Committee on Agriculture and Rural Development (COMAGRI) shows no appetite for CAP reform.

– It is difficult to see how and when the current debate over the post-2013 CAP will be re-

solved. Environmental NGOs have succeeded in changing the rhetoric of the CAP, and have had some impact on policy, but farm ministers and COMAGRI seem determined that direct payments for farm income support should define the post-2013 CAP.

Swinbank's conclusion is that the CAP has changed significantly over the last 40 years. The change was driven by trade negotiations – a reform trajectory now stalled. The focus of policy has remained a fuzzy concept of the need to support farm incomes, even though it is not the incomes of the poorest farmers that CAP supports.

Swinbank ended with a plea for more targeted support for the environment, and his final comment was that world food security is not enhanced by supporting European agriculture.

Speakers of Session 1 meet with His Majesty the King of Sweden. From left: Bill Winders, Philipp Aerni, Alan Swinbank, Mats Morell, KSLA president Kerstin Niblaeus, H.M. King Carl XVI Gustaf and KSLA vice president Bo Andersson.

Cultivating conflict and change – the contours of US agricultural policy

Dr. Bill Winders.

– During the last 40 years the US' agricultural policy has moved increasingly towards the market, but it did not do it all at one time, and it did not do it in a unilateral direction. Instead it occurred in fits and starts, and the policy expanded and contracted.

Dr. Bill Winders, Georgia Institute of Technology, US, continued by explaining the main elements of agricultural policy that have marked this change.

US agricultural policy before 1970 was – as in Europe – focused on supply management. The three principle programmes that made up this policy were price supports (artificially high prices to support farm incomes), production controls (restriction on acreage) and export subsidies (in particular food aid to poor countries around the world). This policy was a commodity policy, and the two primary goals were to support farm incomes and to control overproduction.

– It was successful in fulfilling the first goal but failed badly at the second.

In 1973 there was a liberal and market-oriented shift in US agricultural policy. There was also a major change in the international food regime, which the US helped to shape after World War II.

At the same time, the world economy was struck by a food crisis. An important component of the liberalisation was the Agriculture and Consumer Protection Act of 1973. Price supports were reduced and production controls were suspended. Exports subsidies were cut and shifted from food aid to commercial exports.

In 1985 the Food Security Act instead marked a slight expansion. In particular export subsidies were augmented significantly, with the creation of the Export Enhancement Program. At the same time the Conservation Reserve Program was created, which was the first major conservational environment policy. It involved some production controls.

Ten years later the Federal Agriculture Improvement and Reform Act (FAIR Act 1996) was passed. It marked the end of supply management. The FAIR act ended price supports and replaced them with fixed income guarantees. These were intended to phase out and in the future end subsidies to farmers in the US. The FAIR Act also ended production controls. Farmers could grow whatever they wanted and how much they wanted, with a few exceptions. Export subsidies continued, but they were reduced.

But during a period after 1996 prices around the world fell, farmers sought price support and Congress reinstated payments during 1998–1999. The Farm Security and Rural Investment Act of 2002 restored price supports. But production controls did not return in 2002. Farmers received price support regardless of whether or not they adhered to restrictions on production. The management of supply – trying to control overproduction – was no longer a goal for US agricultural policy

And in 2008 a farm bill (US Food, Conservation and Energy Act) and US agricultural policy essentially continued with the same policy in terms of price supports, income subsidies and in terms of not bringing back production controls. It also expanded conservation programs.

– As you have heard, during this 40-year period there have been periods of expansion and periods of contraction. But each period of growth never quite reached what it had been before, so there is almost something like a downward spiral-effect in terms of movement towards the market.

– But how do we explain this? How did the US get where it is?, Winders asked.

– My answer is threefold and has to do with changes in the world-economy, political coalitions based on commodities (wheat, corn, cotton) and the political context in the US.

As markets expand or contract economic interest and policy preferences change, but they do not always change at the same rate within different groups of farmers. When wheat farmers, for instance, experienced a world economy that was expanding and offered an opportunity to enhance export, farmers themselves were willing to reduce income support and supply management. But during the 80's the wheat market became more competitive. The EU, Canada and Australia used export subsidies to expand their markets, which also stimulated interest in export subsidies among US wheat farmers. But not all agricultural segments in the US shared the same interest in export subsidies. Corn growers did not experience the same competition as wheat growers. Hence they were more in favour of reducing support and doing away with production controls. In short, they were in favour of the FAIR act.

Overall, political coalitions within US agriculture, based on commodities, have been the driving forces for change. Two key battles have been those between wheat farmers and corn farmers on export subsidies and production controls. Since the 1950's corn farmers have not been major recipients of export subsidies. Corn tended to be a relatively unregulated market, and corn farmers in the US had access to the EU market. They were feeding livestock in the EU. Wheat farmers by contrast, since 1954 until the early years of the 21st century had been large receivers of subsidies.

– Farm organisations representing corn farmers were saying: "We have to get rid of subsidies because wheat subsidies sometimes price wheat below corn and then the US wheat grow-ers steal our markets." Wheat producers, on the contrary, said: "We really need these subsidies, otherwise we are going to lose markets to the EU, Australia and Canada."

– So there has really been a battle between organisations representing wheat farmers and corn farmers when it comes to subsidies. A similar battle was fought on production controls. Corn farmers wanted to expand their market, while wheat farmers wanted to maintain production controls. As we can see today, the corn farmers won that battle.

Many policies within the US and in Europe have gone through a process of liberalisation during the last forty years: labour policy, social welfare policy, financial and banking regulatory policy, educational policy, criminal justice policy. All these political sectors had less governmental intervention. The liberalisation of agricultural policy was part of an overall trend.

– But I would argue that US agricultural policy is unique in the sense that it was driven from within. Farmers and farm organisations were pushing for change, themselves. On the other hand, it was not labour unions that were pushing for liberalisation of the labour market.

– Looking backward tells us three things. The overall movement is one of liberalisation, but it is not a steady process. The policy trajectory has been driven by political coalitions and divisions within agriculture, which are shaped by the broader economic context.

Looking forward Winders envisaged that conflict and change in the world economy and within US agriculture would continue to be the forces driving the direction of US agricultural policy.

Agricultural policy in New Zealand – taking advantage of the global knowledge economy

Dr. Philipp Aerni.

Dr. Philipp Aerni from the Institute for Environmental Decisions, ETH, in Zurich, began his talk by referring to the most important factors shaping agricultural policies: perception (values, traditions, education systems, stakeholder interests, media framing of farming), interests (stakeholders in politics framing their private interest as a public interest) and knowledge (based on theoretical baseline assumptions derived from neoclassical welfare economics as well as empirical research and practice).

According to Dr. Philipp Aerni, the global debate on sustainable agriculture is characterized by increasing gaps between perception and reality, as well as theory and practice. The global food crisis revealed these gaps and showed that old belief systems no longer applied. Innovative ideas are necessary to make agriculture simultaneously more inclusive, sustainable and productive. Models of problem-oriented collaboration involving competent and committed actors in civil society, farmer organizations, government, academia and business are crucial in tackling the global challenges of agriculture. They create demand-driven agricultural innovation systems that respond to the needs of small-scale farmers to produce more with less through home-grown innovation.

To investigate the relationship between perception and politics, Aerni and colleagues have carried out stakeholder surveys in Switzerland and New Zealand. The results reveal quite opposite attitudes towards sustainable agriculture and different ways of justifying national agricultural policies.

While political stakeholders in Switzerland thought that Swiss agriculture is already quite

sustainable and that international trade and new technologies are likely to render it less sustainable, New Zealand respondents generally thought that economic and technological change is necessary to make agriculture more sustainable. New Zealand politicians and farmers perceived change as an opportunity. Their Swiss counterparts viewed change as a risk. The more progressive New Zealand attitude is linked to its need to reconcile agricultural sustainability with global competitiveness. New Zealand rejects the view that agricultural trade and technological change represent a threat to sustainability.

Defensive policies prevail in politics and academia in "the old world" because mindsets reflect the past (Cold War) rather than the present (global knowledge economy).

As an example of this state of mind Aerni mentioned European aid for agricultural development in Africa, which is based on the belief that the concept of multifunctional agriculture would work in poor developing countries where the process of structural change in agriculture has hardly started. It is partially due to this misguided approach that Africa became highly dependent on food aid. There is a risk today, that the same misguided policy strategies are repeated in response to the public pressure created by the Food Sovereignty movement, which is largely based on old left-wing ideology.

– The movement may be right when it comes to the mistakes of neoliberal economic ideology, but it is silent about the fact that most famines actually occurred under socialist and communist regimes that were pursuing the goal of food self-sufficiency.

Until the 1970's New Zealand had a "normal" agricultural policy, with a farming sector relying on subsidies. The national economy largely rested on exports of lamb to Great Britain. When the United Kingdom joined the EU New Zealand lost its privilege as the preferred supplier of meat to the UK. Policymakers started to promote innovation as a way out and farmers accepted the need for change, because the agricultural economy of New Zealand was seen as too important to be treated as a social patient.

– Government stopped acting as a nanny for farmers and instead became their coach.

The deregulation and liberalisation involved eliminating subsidies and trade barriers. There was a hard adjustment period in farming, during the withdrawal of the public sector and re-entry of the private sector. But the government did not abandon the agricultural sector altogether. It focused its support for strict biosecurity measures, assistance in marketing, support for applied agricultural research and development, and incentives to create added value.

The policy change in New Zealand had long-term effects on research, economy and society. For instance, the possibility to receive government funding for Crown Research Institutes and universities is nowadays based on the potential for innovation and entrepreneurial opportunities. There is also a high recognition that agriculture is not about market failures but about market opportunities. The revival of the land-grant college idea has injected new knowledge into an entrepreneurial agricultural economy. This has led to new products and services with increasing returns.

Given New Zealand's 30 years of experience no one would advocate a return to the subsidised systems. Multifunctional agriculture in New Zealand may be more effective than in Europe. There has also been a tremendous development and commercialization of new agricultural products and services with global demand. Another positive effect is that people

in rural areas have become more self-confident through economic empowerment and local ownership. Keeping the image "clean and green" through the creation of a market for environmental goods and services (precision agriculture) and government incentives for regional collaboration has been part of the recipe. The Resource Management Act that was passed in New Zealand in the 1990's is an example of such a successful regional bottom-up approach in environmental policy.

– New Zealand can be seen as a natural experiment that falsified neoclassical theory. Yet, economic text books stick to it, ignoring New Growth theory. The development in New Zealand proved that governments could be facilitators of change. Yet, UN reports and environmental science departments focus only on regulating innovation and entrepreneurship.

Aerni criticizes farmer associations in Europe for embracing popular perceptions of non-farming constituencies to portray self-interest as moral concern.

– A good example of moral talk concealing self-interest was a recent interview with the president of the Swiss farmer association, Hansjoerg Walter. He argued that food imports to Switzerland would take food from elsewhere. It suggests that he is morally concerned that we may benefit from international agricultural trade at the expense of the poor who would be deprived of food.

– We all know that this is a misleading assumption because trade is not a zero-sum game. Walter knows that, but he also knows that for Swiss consumers his argument sounds intuitively right and makes him look like someone who puts morality before self-interest. The reality is, however, that he conceals the self-interest of his association in agricultural trade protection by assuming a language of moral concern.

In his concluding remarks Aerni stated that the stakeholder survey (mentioned above) revealed nostalgia in Switzerland and pragmatism in New Zealand. Farmers in New Zealand prefer investment to redistribution. The deregulation and liberalisation of the farming sector in New Zealand have ended the grievance culture amongst farmers. The New Zealand "experiment" has also shown that the government can work as an agent facilitating sustainable change. The main obstacle in the old world is that stakeholder interests shape academia, education, policies and markets. This leads to defensive policies. Change in academia is only possible by moving holistic and interdisciplinary approaches beyond the realm of like-minded groups.

NEW GROWTH THEORY

New Growth Theory, the more dynamic successor of neo-classical Welfare Economics, puts knowledge creation at the centre of economic analysis. It suggests that improved access to new knowledge and technology, investment in human capital and effective support of rural entrepreneurship will result in a more responsible use of natural resources as well as more choice, diversity, social empowerment and economic growth in poor rural areas.

AERNI ABOUT KNOWLEDGE AND IDEOLOGY IN AGRICULTURAL POLICY

According to the World-Bank-financed report of the International Assessment of Agricultural Science and Technology for Development (IAASTD, 2008), agricultural modernization in the 20th century produced many negative externalities for society and the environment that must be addressed by recognizing the public good character of agriculture.

This view is largely in line with the underlying philosophy of the concept of multifunctional agriculture, which frames technological and economic change as a threat to sustainable agriculture rather than an opportunity. Framing change as a threat to sustainable agriculture is a common phenomenon in affluent European countries.

This largely defensive view of sustainable agriculture is reflected in agricultural policies that were designed after the Cold War to justify the continuing protection of domestic agriculture from international trade. Instead of invoking the need for food security in times of war, the argument was that international trade poses a threat to a socially and environmentally sustainable farming sector.

But do such policies really promote best practices in sustainable agriculture and do they ensure that the domestic farming sector remains attractive for young people? Many trends in Switzerland indicate that this is not the case.

Unlike Swiss agriculture, New Zealand agriculture literally went through a process of renewal during the process of unilateral liberalization in the 1980s, and the result was a more diversified and competitive agricultural sector, better food quality and vibrant rural communities that are actively involved in the political process of finding local solutions to emerging environmental problems.

New Zealand nevertheless faces great challenges to make its agriculture more sustainable without undermining its global competitiveness. Yet its bottom-up approach in environmental policy as well as its significant public investments in technological innovation in agriculture make the country a pioneer in the pursuit of a new concept of sustainable agriculture that might not be in accordance with the social-planning model but is all the more effective in environmental management and less harmful to poor developing countries that face increasing non-tariff trade barriers in those countries that maintain a defensive view of sustainable agriculture. The bottom-up approach might also empower farmers and enable them to do more than just implement government and retailer directives and instead become fully integrated participants in the global knowledge economy.

2. Opportunities and challenges for farmers, researchers and business in the agricultural sector

To feed an ever growing global population we will need to produce 70 percent more by 2050. This we have to achieve from less land, while at the same time reducing our use of resources such as fossil energy, fertilizers and plant protection systems. This session, however, focused on the farmer's challenge to produce a range of crops, livestock and biomass in the sustainable way that is needed with respect to the generations to come.

Global Agricultural Policy from a farm gate perspective

Professor Emeritus Robert Thompson.

The world population is projected to grow by 2.6 billion by 2050. This equals two more Chinas to be fed. Sub-Saharan Africa will more than double its population (1.2 billion more people) and South-Central Asia will have about 750 million more people.

During the same period, Professor Emeritus Robert Thompson, University of Illinois, estimates the projected world food demand to grow by 70 to 80 %. According to Thompson, a 40 % increase is the effect of population growth.

The second most important driver for increasing food demand is broad-based economic growth and urbanisation in low-income countries. At present about half of the world population is living in cities, but this historically high figure is expected to climb to 70 % by 2050.

– Today almost one billion people in the world cannot afford 1,800 calories a day. Poverty is the principal cause of chronic hunger in the world. How many of these low-income consumers that will escape from poverty is the most important uncertainty when forecasting future global demand for food.

Thompson's main point in his introduction was that we could use public policies to accelerate the rate of broad-based economic growth in the least developed countries (LDCs). This would increase purchasing power amongst poor people, which is key to addressing the problem of hunger. The poor spend the first increments of their raising incomes on food, so policies that stimulate broad-based economic growth in LDCs reduce hunger. But at the same time this unleashes rapid growth in demand for agricultural products. This is the global challenge waiting ahead.

Unfortunately there is at most 12 % more arable land available, which can be brought into production – land that is not forested, subject to erosion or desertification. Most of this additional land is in South America and Sub-Saharan Africa. Technically it is possible to double the amount of arable land, but only at the cost of the massive destruction of forests, with an accompanying loss of biodiversity, wildlife habitat and carbon sequestration capacity.

– The only environmentally sustainable alternative is to double average productivity on the fertile non-erodible soils that are already in crop production.

The world's farmers will also have to more than double the average productivity of the water they use. This will require public policies and investments in research that increase water-use efficiency in agriculture. Water is one of the most severe constraints to expanding agriculture, and farmers account for 70 % of the world's fresh water use.

– Most farmers pay nothing for the water they use. Anything priced at zero will be wasted. Farmers need incentives to use this limiting resource more efficiently.

There are also physical and biological constraints to higher yields. Quality of the soil (fertility, water holding capacity, resilience) is one of the more obvious. The inherent land quality in Sub-Saharan Africa and large parts of South America is characterized by low fertility and medium to high resilience.

– But despite the limitations of the soils Brazil has shown that with the necessary inputs it is possible to get high productivity in the soybean belt, comparable with the highest yields in the world. There is no reason technically why the savannah regions in Zambia, Zimbabwe, Mozambique and Angola in Sub-Saharan Africa, cannot become as productive.

So with good agricultural skills and the right supplementation of fertilizers and irrigation it is possible to compensate for inferior soils. A justified question is then what public policy measures are needed to make Sub-Saharan Africa as productive as large parts of South America. In his answer Thompson underlined the need of functioning markets to supply farmers with necessary inputs and improved technologies, as well as credits so they are able to buy those inputs and technologies. Farmers in the developing world also need markets to buy their outputs.

– We need remunerative input and output prices to farmers, to make developing countries' farmers contribute more to the world food supply. This will require public policies that stimulate investments in transport, rural electrification and communications infrastructure. Particularly in Sub-Saharan Africa the underinvestment in rural roads continues to be a significant constraint. There is also underinvestment in the education of farmers.

In many low-income countries the politicians have strived to keep urban voters quiescent by keeping urban food prices low, thereby reducing the incentives to invest in the agricultural sector. Ironically, the numerically larger group of farmers has little political influence. Corruption and macroeconomic instability, lack of definition or enforcement of property rights, underinvestment in rural public goods, urban bias in allocating development resources, lack of technology adapted to local agro-ecological conditions are other factors hampering agricultural development.

As a result of this lack of attention to agricultural development the agricultural sector in most low-income countries is underperforming relative to its potential, which would be consistent with both economic efficiency and

environmental sustainability. It produces less food and cash income for farm households and contributes less output to their national food supply.

Looking into the future, with population growth, urbanization and broad-based economic development, many low-income countries' food consumption will outstrip their production capacity, and they will become large net importers. South Asia, East Asia and the Pacific, as well as the Middle East and North Africa especially will become large importers of food. Sub-Saharan Africa is a big question mark. The region has the potential to become self-sufficient, even a net exporter, but it could also continue to underperform and remain a large recipient of food aid.

Thompson continued by questioning whether there really exists any "global" agricultural policy? The only global rules are in the WTO Uruguay Round Agreement on Agriculture. According to this agreement the domestic supports linked to production and/or prices of specific commodities should be capped. But there are no limits on direct, decoupled income transfer and no limit on investments in rural public goods (infrastructure, research, education, extension, etc.).

– If we want to address the poverty issue direct, decoupled needs-based income transfer is best, but most important of all is investment in rural public goods.

To put it succinctly, Thompson described the world's agricultural policies as being in disarray. Most high-income countries have subsidised their agricultural sectors and induced large production of goods, even when they do not have a comparative advantage. Low-income countries have turned the terms of trade against their farmers with public policy, actually increasing the poverty of the already lowest-income members of the societies.

According to Thompson one of the most important issues is to get agriculture back on the international assistance agenda. Agriculture has been off the global development agenda since the 1980s. Between 1980 and 2005 foreign aid to low-income countries for agriculture development dropped from 8 billion per year to 3.4 billion (from 17 to 3 % of the whole). In the 1980s a quarter of US foreign aid went to agriculture. It dropped to one percent by 2008. The share of the World Bank lending going to agriculture fell from 30 % in 1978 to 8 % in 2006. During the same period the share of foreign aid and development bank lending invested in agricultural research fell by an even larger percentage.

Another key point of his was that the developing countries must invest a larger proportion of their own development resources in their rural areas as opposed to the pronounced urban-bias they have had. The foreign aid programs also must reduce the urban bias in the allocation of their resources.

Agricultural policy decisions will be made under tight government budget constraint following the bailout from the financial crisis of 2008. The volatility of agricultural commodity prices has become a big concern. Urban consumers are gaining more influence on agricultural policy decisions. In high-income countries there is also a gradual decline in the fraction of farmers' revenues that come from government intervention. In the BRICs (newly industrialized countries) there has been an increase in the fraction of revenues coming from government support. These are common trends to be seen within the OECD countries.

– There is a world of opportunity for farmers throughout the world to meet the doubling of the food demand. The high-income countries cannot feed all the hungry people in the world. The developing countries' own farmers have to

play their part. But they will only do it in an environment of public policies that are more favourable to their production and their economic development, Thompson concluded.

Dr. Kerstin Niblaeus, president of the Royal Swedish Academy of Agriculture and Forestry, opened the symposium with a short introductory note.

New targets for plant breeding and the challenge of sustainable intensification

Professor John Pickett.

Professor John Pickett at Rothamsted Research, United Kingdom, opened by referring to a report published by the Royal Society (2009) on sustainable intensification of agriculture. He stressed that there is a pressing need for sustainable intensification of global agriculture in which yields are increased without adverse environmental impact and without the cultivation of more land.

– We need a second green revolution that is knowledge intensive rather than input intensive. We need new technologies to meet the challenges of the future.

According to Pickett anything that is a seasonal input is part of an unsustainable approach to agricultural production, and therefore researchers should try to use new technologies to minimize the carbon footprint associated with food production. Instead of using large amounts of energy-intensive inputs such as fertilizers, application herbicides, fungicides and insecticides, future farming must strive to achieve the same or even better results by using plant breeding materials that have the right characteristics (yields, nutrition and crop protection).

– Eventually we also have to move from annual to perennial systems. To some of you this is a very controversial idea, but perennialisation is already embedded in the agricultural scientific research programs around the world.

With perennial crops, erosion and nutrient leakage is reduced. Pickett admitted, though, that there is a lack of knowledge on how to control pests in the rhizosphere, so a lot of research

must be done before perennial crop systems can be introduced on a larger scale.

Pickett underlined that he was in no way against organic agriculture, but that he is extremely critical of inefficient agriculture.

– To be able to spare land and preserve species diversity, agriculture has to be very efficient in the areas that are already under the plough.

To support this view he referred to a publication in the American scientific journal *Science* that – using global data – stated that land sparing is the most promising strategy for minimizing negative impacts of food production, at both present and expected future levels of production.

Pickett continued by acknowledging the collaboration with the International Centre for Insect Physiology and Ecology (ICIPE) in Kenya (especially Zeyaur Khan and Charles Midega) and the whole group of researchers, extension workers and farmers in the region, who had contributed to a knowledge-intensive way of raising yields on what was originally subsistence farms, to production levels that could provide incomes for school fees. The work in Kenya demonstrates that knowledge-intensive interventions against pests, diseases and weeds can improve yields without external seasonal inputs. According to Pickett the new agricultural practices even stabilized the rural communities, who could escape starvation conditions.

– The green revolution had left them behind, or was not relevant to their needs.

With a push-pull system, that involves companion cropping, yields went up dramatically, soil erosion decreased and pests and weeds were effectively controlled. There was even more feed for the cattle, making it possible to hold larger groups of livestock. The key mechanisms in this system are intercrops attracting natural enemies, and pushing away moths – that would otherwise attack the main crop – towards a surrounding trap crop.

In the Northern hemisphere knowledge-intensive agriculture is represented by complicated business plans, and in the development of decision support and smart systems.

– GM crop protection against insects is by no means as robust or diverse as conventional insecticides. But GM breeding techniques, so far, have not been a bad story, Pickett said. We must now acknowledge the advantages of BT cotton[1] for which we have new and compelling evidence. BT cotton is currently the only real good intervention that exists against insects.

Pickett then presented examples of how to use modern biotechnology to combat pests and insects in more environmentally friendly ways. Researchers are trying to imitate and gain inspiration from already functioning chemical pathways in nature. Plants themselves produce poisonous chemicals. Contrary to popular belief nature is not benign. For example, wheat plant tissue produces small amounts of toxins called hydroxamic acids, which are active against aphids and other pests and diseases. In modern breeds the trait is only vestigial, and it is not possible to achieve crop protection by conventional breeding. But ancestral weed species, such as the diploid goat grass, have the ability to use this pathway in their defence against insects. So by using biotechnology the researchers are now trying to bring in these ancestral traits into modern breeds.

Pickett was even more enthusiastic about future possibilities to use non-toxic approaches, and thereby allay some of the fears that remain around the idea of killing pests with pesticides.

1. BT cotton is genetically modified to contain a natural toxin created by the bacteria *Bacillus thuringiensis*.

– We must get away from constitutive expression of toxins. It is like putting a lot of DDT on the field and thereby getting persistent environmental effects and resistance problems.

The new generation of GM crops should instead be designed for delivery of pest control, to target the natural products that acting by non-toxic modes of action, affect, in more sophisticated ways, behavioural and developmental processes in pest organism. Such natural products are exemplified as insect pheromones and other semiochemicals, i.e. those chemicals that affect behaviour or development of organisms. By using clever techniques the researchers can find out what chemicals insects respond to. This, combined with molecular techniques, gives the opportunity to start making plants not liked by the pests that would otherwise feed on them.

Pickett explained briefly two hypotheses they are working on. The first one is "ratio-specific odour recognition", in which plant odour specificity is achieved by a particular ratio between constituent volatiles. When the researchers raised the level of a specific compound in the mixture that the orange wheat blossom midge recognizes as floral volatiles, the mixture became unrecognizable as a host.

The other hypothesis is "species-specific odour recognition", in which host plant odour recognition relies upon taxonomically characteristic volatiles not found in unrelated plant species. Specific compounds are used where all the pests of oil seed rape use products of the glucosinolate pathway in its response. By using electrophysiology to see which compounds that the insect responds to and elucidating the biosynthetic pathway, it is possible to exploit this knowledge in plant breeding to make highly attractive and unattractive push-pull type oil seed rape plants.

In May 2012 a delegation from the Royal Swedish Academy of Agriculture and Forestry (KSLA) visited Rothamsted Research Institute, and the visitors were, according to Pickett, intrigued to hear about the two-year field trial, on a new kind of GM wheat crop expressing the aphid alarm pheromone, thereby to control those pests. When aphids are attacked they produce a sticky, defensive secretion to alert one another to danger, and from that secretion evaporates an extremely small amount of a volatile pheromone, which alerts other aphids to the attack. This odour, (E)-β-farnesene, can also be produced by some plants as a natural defence mechanism and not only repels aphids but also attracts the natural enemies of aphids, e.g. ladybirds. The scientists at Rothamsted have put the gene for this activity into the GM wheat plant, using biotechnological tools and genetic engineering. The result is a wheat breed, which produces high levels of aphid repelling odour, which could help promote sustainable agriculture reducing the need for chemical pesticides.

– But the field trial with this GM crop was under threat last year from an activist group called "Take the flour back", Pickett explained. The group was against genetic modification of food and planned to sabotage the field trials, even though the researchers had received legal permission for their trials. But the researchers at Rothamsted managed to turn this very troublesome situation to something positive. By using an amateur video they reached out with their message, and there was no longer a mass movement behind those who wanted to vandalize the experimental fields.

– Instead of accusing the protesters and saying: "how stupid of you to think… whatever", we said: "let us talk about what your worries are". This was very successful and the trials are still running.

Another raft of work Pickett presented involved using small lipophilic molecules, normally produced by plants when they are damaged.

– We use them to switch on the genes that we want to switch on. One of the compounds is cis-jasmone, a component of Chanel Nr 5, so nothing very frightening there. It regulates a number of defence genes.

The compound is patented for such use and already in industrial production, because it is able to switch on defence even in normal plants that are not genetically modified. It is quite generic and very innocuous. It has a good effect attracting parasitic wasps. It works against other pests in crops being protected against lepidopteran insects by BT endotoxins, like cotton. It also works in horticultural crops and in animal feed crops, such as soya beans that are heavily attacked by bugs.

Finally, Pickett told us about "smart maize" grown in Africa that has an indirect defence elicited by herbivore eggs. When eggs are laid on the leaf, a chemical goes into the plant from the eggs and switches on defence, which calls on help from parasitic wasps to attack eggs and larvae before plant damage has occurred.

– We develop this smart maize not just for the benefit of farmers in Africa; we also hope to sell to Monsanto and Dupont Pioneer, as this is a trait they do not have in their hybrid maize.

This chemistry relates to an over-the-horizon technology – the sentinel plant. Sensitive sentinel plants, intermittently sown in the crop, detect problems (not just pests, diseases and weeds, but also depleted or excess nutrients and water) and signal to the main crop of smart plants to deal with them, thereby avoiding the problems of constitutive expression. This innovation could be of great use in protecting soybean fields from attack from soybean rust.

Pickett ended his speech by mentioning even broader opportunities embedded in deliveries by genetically modified seed: suppression of methane production by ruminants, interference with N_2O-release from fertilized soils and perennialisation.

– We have made great progress in the United Kingdom. We now have government support. The environmental minister said GM is the future. We may not have taken full advantage of this technique yet, but we certainly need to do so in the future. We must not forget lessons we can learn from nature and specifically agro-ecological investigations, that show real returns in the short term for those very impoverished farmers who are among the billion or so people going to bed very night without enough food.

The consumer perspective – not just market solutions?

The Swedish EU parliamentarian Marit Paulsen initially made a brief link to the speech by Robert Thompson and his estimate of the need to raise food production by 70 % by 2050.

– Let us remember to use food efficiently. Half of the food that is produced today is wasted. To reduce wastage is an important part of the solution to reduce hunger in the world.

EU parliamentarian Marit Paulsen.

Marit Paulsen has worked for several decades with food safety, rural development and animal welfare. In her fields of political interest, there has for quite a long time been a strong focus on empowering the consumer. The EU Commission has, as an example, pushed for the valorisation of consumers. In theory – if only consumers got to know about and appreciate the costly investments in animal welfare, they would be more inclined to pay for it.

– But can the consumers be trusted?, Paulsen asked. Her short answer was no. Her more specific answer was "no, not always, but sometimes, if the conditions are right".

– I am not the same person or consumer on Monday when I am stressed after work as on Friday afternoon when I am shopping the food for the family dinner during the weekend. And in the shop, I usually make my husband very angry, because I read and consider very carefully all the information on the packages. Most people do not do that.

She also questioned the existence of the general public or the general consumer.

– We are all different. I would rather talk about citizens. And some citizens are especially vulnerable.

Paulsen mentioned a special Eurobarometer

from 2011 that identifies vulnerable groups of consumers: old people for their limited computer skills and young people for their limited awareness of consumer legislation. In particular people who have difficulties paying their bills cannot, of course, disregard the economic aspects of consuming.

– Farm gate selling is an excellent idea, but how can we make this a realistic option for a divorced mother with four children in the suburbs of London? Not all people can afford the luxury of buying organic or special labelled food.

Paulsen singled out the urbanized world as one of the biggest challenges to success in the work with animal welfare. Most people live far from where the animals are raised and their knowledge of current farming practice is terribly low. Processed and pre-fabricated food is further disconnecting people from the source of the food. Which consumer thinks of how the pig was raised when buying a pizza? Who reflects on how the bird was slaughtered when buying pre-fabricated chicken soup?

And reality is full of seeming contradictions, Paulsen continued.

– Several international studies show that around 80 % of the citizens are interested or very interested in animal welfare. Nonetheless, this interest is not translated into buying practices. But people are not lying in their answers to surveys. Many consumers seem to think that they are choosing animal welfare-friendly products by choosing quality assured products. For them a "KRAV" label indicates that the meat comes from a happy animal.

Swedes may also have the most up-to-date and costly kitchens in the world. There are numerous cooking programmes on TV. And even if Swedish is a small language more than one cookbook per day is published every year. Most of the recipes in magazines are based on locally produced food. Nevertheless, sales of locally produced food are small. Today about half of the food in Sweden is imported and the amount of food going to waste is very high.

– It seems to me that people in Sweden have a "pornographic" interest in food. We like to watch it, to read about it – but not to do it...

Obviously, there is a need for better information to citizens, Paulsen argued.

– If the price for chicken is four euro per kilo while paprika costs twice as much, how do people think the bird was raised? Have you seen a paprika in a slaughterhouse? Something is wrong.

– For 40 years I have believed that properly informed consumers will move the development forwards. But I am disappointed. I don't believe this anymore.

According to Paulsen the consumers' multitude of concerns calls for a multitude of information. For this, the simple label is not physically big enough. Modern information technology should be used, instead. The National Board of Agriculture also suggests that market-based solutions must be complemented by public interventions, including different tax incentives on the international level.

– The word "international" is key. We need common rules, like a common European Animal Welfare Law, to create a level playing field. Otherwise we just export the production – and the problems – elsewhere.

Paulsen finished by referring to international studies that have concluded that some consumers consider that producers, through the control by EU and national authorities, are responsible for the welfare of the animals. The producers, on the other hand, believe that it is the responsibility of the citizens, through their consumer behaviour, to promote the welfare of the animals.

– In that way, we can all sleep well at night – because we believe the other party is responsible. *We* can all sleep well, but perhaps not the animals.

Speakers during session 2: Marit Paulsen, Elisabeth Gauffin, Robert Thompson and John Pickett.

A farmer's perspective

Dairy farmer Elisabeth Gauffin started by declaring that she was going to be quite political in her statement, though, without taking a stand for any political party. She challenged the view that agriculture and food production should be left solely to liberalisation and free trade.

Dairy farmer Elisabeth Gauffin.

The sector is simply too important for a country, its population and sustainability, she argued. As earlier speakers had delved quite deeply into future dilemmas for agriculture, she only briefly mentioned the many difficult tasks that soon must be tackled: double the amount of food by 2050, produce more with less resources, mitigate and adapt to climate change, limit negative environmental impact from agriculture, reduce fossil energy and increase renewable. Gauffin noticed that those are topics that have been high on the global agenda for some years now.

– Some problems seem unsolvable. But some seem to have a solution in reach if we just made an effort. As our well-known Swedish author Henning Mankell said in connection with the World Economic Forum in Davos 2013: "Many of today's problems are totally unnecessary, we could have solved them yesterday, but we chose not to do so."

To succeed it is crucial to have a more holistic perspective on land use and food production, Gauffin believes.

– We have to get back to basics, understand the food chain, how nature and agriculture function. It worries me that we have lost the ability to see how things are linked together. Sometimes I wonder if it worries anyone else but me?

High food prices, bio-energy versus food, land grabbing, lack of research & development, CAP, smallholder farmers suppressed by giants,

livestock's long shadow were other urgent issues that Gauffin listed. According to Gauffin, Swedes have an extreme focus on low food prices. Swedes seldom ask how it is possible for food to be so cheap.

– But cheap food costs. It might not cost you and your family, here and now, more than the figure on the price tag. But it might have cost someone else, somewhere else in the world, dearly. Most likely it will cost us all in the future.

Low food prices are often a result of food being produced in an unsustainable way, Gauffin explained.

– Waste of natural resources, low wages, poor conditions for workers, low profit in the agricultural sector, negative environmental impact and lack of good animal welfare are all examples of unsustainable food production. If you add to that: cheating, i.e. the use of additives such as flavours and colours and minimizing the use of good raw materials from the agricultural sector, these are all ways that make a lower price possible.

Gauffin continued by taking up the cudgels for the common European agricultural policy, CAP. She claimed that Swedish and European farmers are wrongfully accused of being inefficient, not being competitive and spending most of the EU budget. The perspective that the EU has actually managed to secure food production, which was one of the original goals when the CAP was established, is overlooked and forgotten.

– In particular, we have made it possible to include other important factors in the agricultural policy: environment, rural development, animal welfare, food safety and biodiversity. This is possible because we have a common agriculture policy.

Gauffin criticised politicians for ignoring the fact that the CAP is actually doing some good. The sceptical attitude to CAP that is typical among Swedish politicians can possibly be explained by historical circumstances. Sweden has not been at war for 150 years, nor has its population suffered from starvation for a very long time.

– We simply expect food to be available everywhere, anytime, at low cost.

Gauffin also adopted a provocative note by saying, that in Sweden no politician has any idea about food security. There is simply a strong belief in Sweden that food supply is not an issue. Food can always be obtained from abroad. The fact that Swedish food production has been declining for many years has received very little attention from authorities. Today Sweden imports more than half of the food consumed within the country. Great faith is placed in free trade and market liberalisation, guaranteeing Swedish consumers ready access to food.

– I think this an irresponsible point of view. We should contribute, in a global food security perspective, by using the whole potential of the Swedish agricultural land and other natural resources. But anyone who dares to say anything about food security and how to provide Swedish citizens with food in case of emergency risks being accused of being a socialist with a planned economy as an ideal. Not even during the food crisis in 2008, when most countries revised their strategies for food security, was there any such discussion in Sweden.

On the subject of urbanisation Gauffin referred to a recent debate started by the Supreme Commander of the Swedish Armed Forces who declared that the military defence forces in Sweden only have the capacity to last a week. And then only in five mostly urban areas, including the big cities in Sweden.

– But honestly, what is there to defend if there is no food production and energy supply?

In most parts of the world urbanisation is

accepted as a law of nature, without much reflection. Cities are expanding on the best land we have. Concrete is still the most profitable crop.

This development – concentrating people, environmental problems and all kinds of risks – is hazardous in the long run. Rural development, agriculture, a prosperous countryside is a way of reducing risks for a society, and increasing possibilities to be sustainable. This is also sound when it comes to defence, Gauffin stressed.

The Swedish Board of Agriculture recently published a report on the need to cut down on meat consumption. The report pointed out that consumers should be much more selective and choose sustainably produced meat, i.e. eat less, but better meat. The Swedish Board of Agriculture advocated a meat tax as one possible way of reducing meat consumption. But Gauffin wondered how such a tax would comply with the market rules within the EU, WTO, etc. Gauffin also called for political leadership.

– No one at a high political level in Sweden states that sustainable agriculture in our country should include animal production and eating meat. If we produce milk, we should also eat some of the cows and calves being produced.

According to Vaclav Smil, professor at the University of Manitoba, Canada, approximately 22 kg of meat per year is sustainable meat consumption. Gauffin agreed with that estimate.

– If we ate that amount, there would be enough for everyone and we would have a healthy nutritional diet.

The book *Eating animals* by Jonathan Safran Foers explains how meat can be so cheap. Industrial animal production – animals housed in confinement – concentrating waste and environmental problems, causing health problems, antibiotic resistance, spreading diseases and infections, is a cynical way to achieve lower costs and therefore lower consumer prices.

– But animal production has its place and belongs in agriculture for a sustainable reason. One has to understand how everything is linked together and that production has to be in balance, not to harm nature. Going back in history this was an understanding that mankind had thousands of years ago, when we gradually abandoned hunting in favour of livestock farming.

When Gauffin mistrusts in her work as a dairy farmer, she reads a quote from Peter Drucker (American management consultant, 1909–2005): "In the long run only those who sell real goods and services to real consumers and get paid in real money survive".

– It is comforting to know that no matter what the food we produce will always be in demand.

Being an organic dairy farmer, she rounded off with a short remark on the debate on organic agriculture. Gauffin strongly opposed the opinion that organic production can never feed the world, because it is an inefficient and nutrient draining production system.

– Organic production is not the factor that is going to make us fail, on the contrary. There are a number of other factors that are more likely to lead us in the wrong direction: misuse of human resources, natural resources and land, disrespect for ecosystems and biodiversity, short-sighted political decisions, conflicts, poor governance and the fact that we still do not pay serious attention to climate change.

Discussion, session 2

Moderator Bo Andersson: I have the impression that there exist two arenas. One arena for high-income countries of the temperate zone with an abundant supply of staple food, and that are happy to import from low-income countries, where their corporate companies have established themselves to produce the qualities that we demand. The other arena is the low-income countries where there still are many poor farmers, and some of them are actually forced off the market by these corporate farms, or working for low wages, providing us with cheap imports. Is this true, you believe, or is it one common arena?

John Pickett: With the immense price rises we are expecting many of these things will be ironed out, I believe. Certainly the grip of the food industry on primary production will go. Farmers that at present cannot afford to buy enough food will be making it themselves by new technologies that they will pick up. They are ready to receive information-intensive production methods.

Robert Thompson: Your scenario may be accurate today. But do not forget the 2.5 billion additional consumers that will be born in the low-income countries. The markets of the future will be in the South. South to South trade is what we are going to see, not so much South to North. In fact, there will be a world of opportunities for efficient farmers, wherever they are in the world, to serve those regions that do not have any hope of being self-sufficient, East Asia, South Asia, Middle East, North Africa and maybe Sub-Saharan Africa.

Professor Christian Hera: We need to use all methods we know of to reduce hunger and expressed concerns over the use of gene technology.

Robert Thompson: Genetic engineering is no silver bullet, which is going to solve all our problems. But probably the greatest dangers to future agriculture are increased frequency of extreme events due to climate change; extreme drought, flooding, heat waves and hurricanes. That is where genetic engineering has it greatest potential pay-off, being able to use the full diversity of genetic resources from whatever species to introduce heat tolerance, drought tolerance, and in particular maximize the likelihood to continue to produce crops in agro-ecosystems where they are now produced. Of course there are numerous other techniques, too, that are beneficial, but no National Academy of Science has ever concluded that GM crops impose any danger to human health or the environment. It would be irresponsible not to use all the tools of modern biology at our disposal.

Elisabeth Gauffin: If my colleagues in the developing countries had access to the same resources, inputs and markets that I have, adjusted to their conditions, I think they could raise productivity quite a lot. And as Robert Thompson said this morning, it is also about production losses, lack of infrastructure, lack of good governance, etc. There are so many things that could be done if we choose to do so.

Science journalist Peter Sylwan: Biosciences including molecular biology and genetically

modified organisms will probably revolutionize society in the coming 50 to 100 years, maybe at the same level and impact as information technology has transformed society the past 50 to 100 years. But how come we always talk about the need of informing and educating the audience when it comes to genetic engineering? We never have to inform the audience about the technology behind the Internet or the mobile phone. Could it have something to do with trust and usefulness?

John Pickett: The problem is partly that there still are people, even in public agencies and certainly in authorities in the UK, who believe that there is no food problem and that there will be no shortage. We can just use our hard currency to go out and buy the food. All that changes the perspective of what technologies we want to use. But it is quite apparent to a young person how exciting it is to use some of the personal media, you are referring to. You are right that there are many technologies that we can use. I emphasize the point of GM, because it is spectacularly powerful, and we must not overlook it.

Marit Paulsen: Everyone loves gene technology when it is used to make insulin or growth hormones. But if you use the same technology for producing food everyone is upset. I cannot say why it is like that.

Robert Thompson: You really should have the same standard of labelling on medicine as on food.

Marit Paulsen: Yes, I agree. Unfortunately there is a majority of members of the parliament who believe instead of knowing. In a year and a half there will be a new election to the European parliament. You should ask the candidates and start a discussion throughout the EU today. Do you want to have members of the European parliament that are against every new technology when we are talking about food? It is up to you, as the voters.

Professor August Temu: *One:* In the continent of Africa 40 % of food is lost before it reaches the plate. But here we are only talking about more production. We do not talk enough about how to avoid losing what has already been produced. *Two:* One thing that has distorted everything is food aid. It comes when people are starving. It never comes in the form of assisting people to produce. It is used in a political sense, not really to save the lives of people. *Three:* Simple solutions may be very useful in certain situations. But let us not over-glorify technology. A lot can be done before we introduce new technologies. It is a big problem that these fragile GM plants require much more care and input than our ordinary plants. Last year we had 30 % losses in maize production in Kenya because the additional input was not available to our poor farmers. We must be realistic and careful when we are talking about simple solutions to complex problems. Food security is so important that we cannot leave it to farmers, engineers in genetics and so on.

John Pickett: August Temu makes some very good points, but I do believe that none of us want to starve the poor farmers of new technologies, whether they are GM or not. If seeds are improved in a way that matches the farmers' production systems, and they can save the seeds, this would benefit the poor farmers.

Robert Thompson: I agree with the criticism of food aid. It is an embarrassment that the US is still sending it. It is a response to the farmer lobby that thinks it makes bigger markets. I also agree that it is very important to reduce losses.

On the subject of traditional technologies; with traditional varieties the farmers are constrained to one tonne per hectare. If Sub-Saharan Africa persists in growing those low-yielding varieties this will be a massive drain on the world food economy. Yes, a lot can be done with already available technology, and for farmers that pay 500 % of the world price for fertilisers, it does not pay to adopt the more productive hybrids. There are available technologies that are not adopted, but there are often other reasons than their fragility, like the underinvestment in rural transports and corruption along the roads, which may well be the biggest barrier to the development of agriculture in Sub-Saharan Africa.

Marit Paulsen: I have bad news for poor African farmers. In the voting last week in the parliament there was a majority vote in favour for re-introducing export subsidies. This is devastating to poor people and the development of the countryside in Africa.

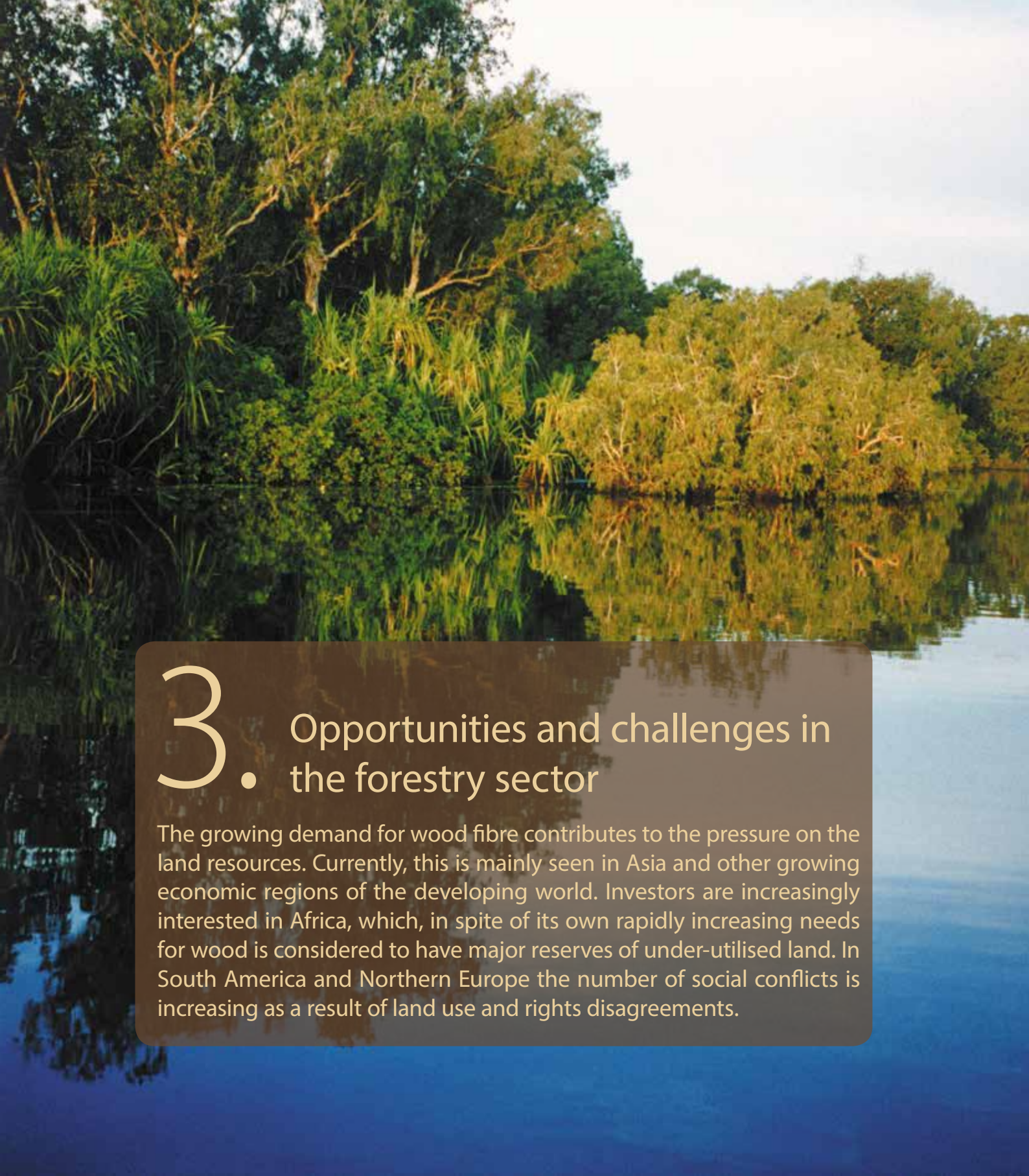
Audience: Why is the dialogue on GM crops so different in North America and Europe?

Marit Paulsen: In the US you have your God in the churches. We have ours on the plate. There is no good answer.

Elisabeth Gauffin: The big GM companies that have been in business for many years have not helped to promote positive attitudes towards GMO by their way of action. Transparency, and who will have the power, who will decide how to use this technique, that matters to me as a farmer.

Robert Thompson: GM crops were developed in the late 70's at the same time as public investment in agriculture was reduced. Critics of corporate business selling GM technologies and patented genes, should ask for larger investments in public agricultural research and development, instead of saying no to the technique.

Marit Paulsen: Most European GM researchers have gone to the US. But we need science in Europe. We should cut down on agricultural subsidies and instead use the funds for agricultural science.



3. Opportunities and challenges in the forestry sector

The growing demand for wood fibre contributes to the pressure on the land resources. Currently, this is mainly seen in Asia and other growing economic regions of the developing world. Investors are increasingly interested in Africa, which, in spite of its own rapidly increasing needs for wood is considered to have major reserves of under-utilised land. In South America and Northern Europe the number of social conflicts is increasing as a result of land use and rights disagreements.

A global overview: is there enough land for food, fibre and fuel?

Professor Sten Nilsson.

Professor Sten Nilsson, CEO at Forest Sector Insights AB, took the audience on a journey through land use and land competition issues, presenting the major drivers and challenges. He emphasized that from a land use point of view it is not the number of people *per se* that is important, but the economic living standard of the people.

– If politicians, bankers and economists don't mess up the economy too much, we will have tremendous economic growth over the coming thirty years. Global GDP will more than double.

The most rapid growth will take place in developing countries, which will make it possible to bring people out of poverty and increase their standard of living. But the increase in middle class consumption, especially in China and India, will put an enormous pressure on natural resources. The world population will need 70 % more cereals in 2050, global meat consumption will double and global livestock numbers are expected to increase from 60 to 100 billion animals. A somewhat peculiar aspect of this growing ecological footprint is the pet food market, which is currently worth about USD 67 billion. The pet food market is growing by 5–6 % per year. It has the most profitable product rate of return of any food segment (25 %). The slice of tuna in the pet food is nearly twice as expensive as the slice that humans eat, for example. Energy consumption is also expected to increase by 30 % by 2040. Without improved energy efficiency and intensity gains

OECD demand would grow by nearly 90 % and non-OECD by more than 250 %.

The development of new bio-based products that can use raw material both from agriculture and forestry in bio-refineries to produce bio-composites, fragrances, paints, pulp, bioethanol, fine chemicals, etc., is uncertain, Nilsson said. The conventional industry is only using a fraction of the opportunities waiting be discovered and developed in the components in fibres and biomass. How big the market will be, and how quickly it will evolve, is difficult to assess. Fresh water is another crucial factor in the green sector. According to different estimates, there will be a deficit of around 40 % in 2030. At the same time, human infrastructure is growing rapidly, and the additional land requirements by 2040 correspond to the area of South Africa.

– Maybe this does not sound alarming, but it is often the best land we are losing. The nature infrastructure is also under pressure. We could debate the merits of the concept of ecological footprint, but it is the only thing we have to estimate the integrated impact of what we are consuming and wasting. It tells us that we need 2.5 worlds in 2050 in order to keep the earth in a sustainable shape.

Finding new resources of supply is becoming increasingly challenging and expensive, Nilsson continued. Resources are more and more interlinked. Changes in one resource have impacts on others. Environmental factors are more and more constraining resources utilization and there is a growing societal concern regarding this fact. Meeting future demands will indeed require an expansion of supply.

Using global data-sets Nilsson has made a study for IIASA (International Institute for Applied System Analysis), estimating the availability of additional productive land. If subtracting built-up areas, currently cultivated land, leaving natural forests intact, excluding non-vegetated areas (e.g. deserts), protected areas, steep slopes, and areas with unsuitable climate, there are some 2.1 billion hectares left, most of which is grassland. Taking into consideration the need of current populations of ruminants for grassland there are only 700 million hectares left, and not all of that is accessible. Some areas are under high political risk and/or are not economically accessible. Taking all this into account leaves only 250–300 million hectares available for agricultural expansion. Based on these calculations, Nilsson projected the situation in 2030 with regard to bioenergy, agricultural, forestry and biochemical additional land needs, with the result that there will be a deficit of 220–250 million hectares. A number of similar studies have been made after the IIASA study, coming to a variety of different results.

– One possible conclusion we can draw is that we know nothing. Uncertainty in the data-set is larger than 50 %. The other conclusion that can be drawn is that we can fix it. We just have to make the right investments and apply the right policies in the right places. But will we do it? Probably not! There will be a huge land-use problem and a substantial land deficit. In reality, there is no unused land. Even with the right political decisions it will not be easy. Twenty percent consists of "low hanging fruits", i.e. are within easy reach, 40 % are medium difficult, but the last 40 % will be very difficult to reach.

Nilsson noted that large-scale land-use conflicts are already obvious. One example is international "land grabbing" since 2000. According to Oxfam, around 230 million hectares have been grabbed, of which 30 % is forest land. There is also national land grabbing. In India the state is taking away common and for-

est lands, and preventing rural villagers from having access. Another indicator of increased pressure on land is the average price of land. In Sao Paolo state in Brazil average land prices have doubled since 2006. The situation in Uruguay is similar, where land prices have increased fivefold during the past ten years. The demand and supply curves are pointing towards a tight situation.

There is major concern about many failed agricultural policies. Productivity gains have declined during the past 20 years, and they will continue to do so in the future, Nilsson believed. Between 1988 and 2000, 80 % of agricultural production expansion was a result of clearing forest land for agriculture. So there has been a failure to increase productivity on agricultural land. But there are positive examples of good policies reversing deforestation, for example in South Korea, Costa Rica and Brazil, Nilsson pointed out.

Good governance offers some potential. There are 240–290 million hectares of degraded agricultural land that could be converted into productive cropland. There are 300 million hectares that are suitable for agro-forestry. That kills two birds with one stone. You get wood production and higher agricultural production from the same land in comparison with not having the trees.

– Urban and vertical farming can contribute to increasing food supply, but will not solve the problem because they are small in scale, Nilsson said.

– On the other hand, if we could solve the problems caused by food wastage, we would not have any food problem.

Or is synthetically made meat from the lab the solution, he wondered? It does not demand any land, animals or farmers. But will it be accepted? Nilsson also mentioned the huge amounts of industrial wood that will be needed by 2030. Present consumption is about 1.6 billion m^3. An additional 700 million m^3 will be needed in 2030. FAO has estimated the demand for wood for energy (heat, power, biofuels, coal replacement) at 6.5 billion m^3. Today's use is only 1.7 billion, so it will be a tremendous challenge to satisfy this need.

Based on this picture of the world, Nilsson continued, we can see that we will have dramatically different future resource landscapes. The Nordic countries and the Boreal region have, on average, more available land, forests and water resources per capita than other regions of the world. Nordic biological production systems are more robust than in many other parts of the world. Land resources in the Nordic countries (and the Boreal region) will therefore become more and more valuable – if managed properly.

Nilsson then criticized the present fragmentation of knowledge, responsibilities and interests, and ended by offering a way forward. Business enterprises think in terms of market supply chains. Farmers and foresters are thinking in terms of their land. Governments think about environmental issues through regulations and setting aside protected areas. Financial actors think about investments in sectors and individual firms. Policies and planning are undertaken by individual sectors and are often in conflict with other sectors. Land-use issues most often fall between agriculture, forestry, environment, industry and economic ministries. Industry-based strategies and business mod-els are based on constant or falling real prices for resource inputs.

– What a mistake it will be. We need to shift the mindsets among stakeholders. New mindsets must reach across traditional sector boundaries, to deal with interconnected problems and opportunities. We must have an inte-

grated approach on how to deal with the land. The conventional forest value chain, which tells the story from the forest to the consumers, is obsolete. The relevant one is the landscape value chain.

– We need a productivity revolution. That is the global picture. This revolution must come out of increased synergy effects. We have to get as much as possible out of economic, natural and societal values from the landscape.

Anniversaries are opportunities for celebration and festivities, but they should also be the time for reflection, Nilsson rounded off. The Royal Swedish Academy of Agriculture and Forestry has been successful for 200 years, but has separated forestry and agriculture. Nilsson strongly advocated a new structure, which can stimulate dialogue on future integrated land use. Even the life science universities are hindering integrated land-use thinking, through the boundaries set by the faculties.

– Tear down the faculties! And reorganise the relevant ministries and their agencies into one natural resource ministry with affiliated agencies.

Speakers session 3: Jan-Erik Nylund, August Temu, Jintao Xu and Sten Nilsson. Seated: Moderator Björn Lundgren.

Future forestry sector development in Africa

Professor August Temu.

Professor August Temu, Deputy Director General, World Agro-forestry Centre, Kenya, opened by pointing out that many people have a strange way of looking at Africa, often with mindsets frozen in the sixties.

– Many of you associate Africa with a starving woman holding a starving baby. But this picture is unrealistic, and I beg you not to take it too seriously. Organisations use the worst images of Africa to ask for money that they themselves spend, most of the time.

Professor Temu continued by, on one hand, acknowledging the importance of the "save the rain forest crusades" from Western countries, but, on the other hand, he was also very critical of the fact that economic and societal aspects are almost totally ignored in the discussions about African forests.

– There are business opportunities in African forests and I will share them with you, he said.

Contrary to many urbanized industrialized countries and their citizens, the lives of the African peoples are very interwoven with the forests. 650 million hectares, or 17 %, of the world's forests are located in Africa. This is equivalent to more than 60 % of the area of Western Europe. But only 1.5 % of the forest is planted. Deciduous forests cover a quarter of the land. More than 90 % of the forests are publicly owned. Biodiversity is enormous, with 1,100 different timber species alone, and numerous global hotspots on the continent. This diversity contributes to resilience in a changing climate – far from all species will go extinct when the temperature rises by two degrees.

In spite of the existing huge natural resources, the contribution of the African forests to GDP is only 6 % (direct harvest excluded). Almost all (80 %) harvested wood is used for energy (charcoal and firewood). Since Africa is not very densely populated, the productive land

area per capita is 2.5 in Africa, compared to 0.7 in China and 0.23 in India.

– So, why then is Africa considered to be in difficulties? Yes, we are dominated by small-scale farming, predominantly subsistence systems with 70–80 % of the production going to direct consumption. Land fragmentation is a problem, and a lot of sensibilities hold back rapid policy moves in this area. But, interestingly, change is already taking place. It is evolving naturally because the size of smallholders' holdings is approaching an uneconomic level.

There are large areas of public lands in drier zones, extensively and easily accessible to local populations. The largest human, livestock and wildlife populations are found in these woodlands and dry forests, because that is where the livelihoods are. Temu pointed out that the people in the woodlands areas are the biggest threat to the rainforest, because they convert large areas of rainforest to agriculture, each year.

– So the most important intervention, to save the rainforest, is to create true resources on land where the people are, so they do not have to move into the rainforest and cut down the trees.

The intensive activity in the woodlands requires an introduction of measures to enable the ecological systems to function better, and to be sustainable. An example of such an initiative is the Great Green Wall for Sahara and Sahel Initiative (GGWSSI), in which 21 African countries are involved. Agroforestry is the key innovation, and reinforcement of the livelihoods a priority.

The initiative is not simply about growing trees. It is about very intensive agroforestry. They test out technologies that are known from traditional practices and local people, and try to make them more productive, economically profitable and at the same time fixing environmental conditions.

Temu underlined the need for a broader landscape approach. The agricultural and forestry sectors must work together. With trees in the agricultural system, for example, it is possible to have production all year round. Agroforestry transforms agriculture from a few seasonal months of production per year to continuous production. An obvious advantage is that the trees feed from different layers in the soil. According to Temu, many communities have generated valuable innovations in these areas.

– The huge diversity of trees and shrubs is a wonderful resource guaranteeing that there is always something that comes out of the land.

Although Temu noted the absence of agricultural experts from the discussions on landscape perspectives, the climate change challenges have mediated a better appreciation of cross sectoral linkage. The multi-functionality of the trees – and the landscape – is more widely appreciated. With agroforestry using the right trees, the landscape can be green all year round, instead of having seven months of dry earth. Some smallholder farmers, such as the coffee and tea farms in Eastern Africa, are growing perennial tree crops.

– This does not reduce the productivity of the farms in any way. In the areas around Mt. Kenya, 70 % of the timber for local sawmills comes from agroforestry systems. We are looking at agroforestry as an answer to many of the challenges in international conventions (climate change, biological diversity, combating desertification).

Temu continued by stating that under agroforestry conditions soil biological conditions are more beneficial than under normal single crop systems. The damaging termites that cause

large food losses are less common in agroforestry, while earthworms are more common.

Rising economic prosperity in Africa is driving up demand for wood and other tree products. The emerging middle class has a taste for a fancier and healthier life. ICT (Information and Communication Technologies) is more freely used and diverse than in many other parts of the globe. The world has never been smaller. Temu especially highlighted the business opportunities in Africa. The small forest owners' approach to the development of tree products is a growing reality. The urgent needs are: policies that promote investments in such small-scale business, working partnerships between investors and farmers, and strategies and plans to capture, process and market the products.

– Sweden has the experience, knowledge and innovations required to assist in addressing these needs. Instead of land grabbing we could cooperate around new types of business models.

China is harvesting an enormous amount of non-wood tree products from Africa.

– Instead of complaining about China taking so much of the biological resources out of the land, we should turn it around. How can we produce more of these resources ourselves so can benefit even more from the interest in them from China and elsewhere?

– The non-wood products (pharmaceuticals, cosmetics, novel foods, spices, etc.) need greater recognition, strategic production and harvesting, processing and marketing. Domesticating and value adding for such products is the way forward for Africa, Temu stated.

– To my mind this business opportunity is the least exploited.

Only 1.5 % of forests in Africa are industrial plantations. This fact holds big opportunities. The tree growth rate in many plantations is very high, only 10–15 years for pulp and paper, 20–35 years for sawnwood and panel products. The private sector is coming in, but not enough, Temu observed. There is still a great need for private sector driven initiatives with adequate diligence on environment conservation and social responsibility.

– Policies in Africa have become much better. We are trying to identify models to pay private farmers for the ecosystem services they produce. Out-grower schemes involving local investors are a real opportunity.

The prevailing image of Africa as an unproductive wilderness inhabited by poor communities is a myth and is disappearing very fast, as the economic engines have started to significantly transform Africa. Many valuable tropical timbers, such as mahogany, teak and some others, are not as slow-growing as often stated. Trees and forestry have a much greater role in the continent's economic development than has been acknowledged. Investment in African forestry is not only potentially lucrative but is also imperative.

– A paradigm shift is taking place. Let us be part of the change!

Temu's final message was that never before have needs and opportunities for investment in trees and forestry by farmers, communities and the private sector been so explicit and promising for Africa.

Future development in China

Professor Jintao Xu.

Professor Jintao Xu from the National School of Development, Peking University, began by showing a map over the forested areas in China. The forests are scattered mainly in the East and South East, covering about half of the country. Most of the Chinese population live in these forested areas, the other half of the land being basically arid and semi-arid, Xu explained.

It may seem like China has large areas of forest, but in reality the rapid economic growth and lack of sufficient growth within the forestry sector made China the world's largest importer of timber in 2011.

Timber imports have increased more than fourfold since 1997, and the gap between domestic consumption and domestic timber supply keeps growing. Total consumption of wood, converted into timber equivalents, is over 200 million m^3 in China.

– Meeting the growing demand for timber resources is a tremendous challenge to China's forest sector and the supplying tropical nations.

Xu and colleagues have made a projection of the future timber demand and supply. By 2020, the demand for round wood imports will probably be 100-150 million m^3. If other wood products are included the figure can well be double that. China will continue to be a major player on the world market and put huge pressure on natural resources.

Nationally the Chinese government has implemented numerous measures to address the growing gap between wood imports and exports. A massive afforestation program has been running over the last three decades, initially without much result. But, along the path of continuing economic reform, the plantation projects became more successful. Forest cover-

age rose from 12 % in the late seventies to 20 % in 2010. More than 66 million hectares of new forests were planted during this period. But the afforestation programs have not been enough, Xu concluded. The incentives to invest in the forest sector have been too weak, and the reforms have been too dominated by government programs. There have not been enough true institutional reforms, Xu said. The low productivity has partly been a result of the low survival rate of plants. After some years, many plantations became afflicted by problems associated with monoculture practices, such as pests and diseases.

During the reform process, government programs were converted to something Xu called "engineering afforestation project management". The most important change was the introduction of new ways of allocating projects to farmers, for example the implementation of "reimbursement schemes", by which the government reimburses forest keepers by measuring the success rate of the forest plantation. As an effect of these reforms, the success rate of plantation forests rose significantly. The government also implemented two nature conservation programs: the sloping land conversion program (SLCP) and the natural forest protection program (NFPP).

Xu presented some fundamentals of the Chinese forest system. In principle, there are two different types of forestland ownership: state owned or collectively owned. State ownership covers about 40 % of the area, and most of the state-owned forests are natural forest, so the volume is high (68 % of total forest volume). They are managed by "large-scale state forest enterprises" or "small-scale state forest farms". Collective ownership runs at the level of administrated villages. This type of forest management covers 60 % of the area but not more than 32 % of the volume. The collective forests are producing a growing share of total timber production, though, as a result of continuous efforts and a better incentive system.

Xu then explained that there have been two rounds of collective tenure reform. The reform of the collective tenure forest basically implied that the assets should be decentralised and diversified. Decision-making should be moved to the households. The first round took place between 1981 and 1986, but was not welcomed by forest authorities. At the end of 1986, most of the forest land was allocated to households, but the share of household management varied widely from province to province. Tenure reform remains a controversial issue.

The second round of reform started in 2003, when the largest collective forest province, Fujian, announced its reform plan. By that time the political climate had changed, and the trust between government and farmers had improved. After the Fujian announcement, the central government stepped in and played a supportive role. Between 2003 and 2007, 14 provinces joined the reform process, and by 2010, 20 provinces had announced provincial reform policies. In July 2008, the central government published the second forest tenure reform policy, the first since 1981.

Fujian province has always been a model province for the collective forestry sector. The region has competent forest authorities and a strong forest industry. There are huge vested interests surrounding the collective forest, and excellent foresters with deep knowledge.

In the eighties, the Fujian province entirely rejected the idea of household reform, and tried a different model, a shareholding model. It involved keeping collective management but start distributing benefits among farmers. The central government established Fujian as an ex-

perimental region for this shareholding model. But it failed very badly after 15 years. In the late nineties, one village after another started distributing land to households instead.

– This experience from Fujian is very important. The major effort to maintain collective management had failed. Politicians and experts realised that they had to try other models.

Before the central government had adopted a new policy there were already 14 provinces with their own provincial policies. So, the central government policy basically synthesised and legalized these regional initiatives. The process went from local initiatives to national consolidation. What was new in this second round of reform?, Xu asked. In essence, it was that Fujian announced the establishment of a household management system. The households were also given longer contracts. In the eighties it was normal to have contracts running only from 5 to 10 years, which is far too short when planning forest management. Now the contract periods are from 30 up to 70 years. The households also gained much stronger property rights. Children can inherit the land, and the land can be transferred between farmers. Farmers get a printed forest certificate for their forest plot, which they can use as collateral.

Politically, the reform represented a step towards completion of the rural land reforms. The reform affected 147 million hectares of the total of 167 million hectares of registered collectively owned forest land. It affected the livelihood of 70 million rural households.

The reform process during 2000–2010 significantly altered the forest tenure structure in China. Forestation increased significantly, and the share of forest income rose. But, the policy changes by no means achieved uniform results in all provinces and villages, Xu said. Some villages even decided to reduce the element of individual management, which came as a surprise to the central government.

– The rural community is not a Utopia. There is normally an elite group and a group of ordinary farmers. The tenure reform is a reflection of the bargaining power of these different groups. Thus, transparency and strong outside monitoring increase individual tenure, while strong traditional leadership limits progress.

The central government hopes that the reform will also improve the livelihood of farmers, alleviate poverty, and result in social stability and less tension between farmers and the local government. Other goals are to increase the incentives for private sector investment, and to get higher productivity.

Land could be a safety net, making farmers more ready to take risks and to dare to seek more rewarding jobs in the cities. A contrasting hypothesis is that labour gets tied to the land, and that risk-taking is reduced. According to Xu, some studies indicate that land is a safety net for better-educated farmers. They move away to the cities when they have more forest land, and they return home in times of economic crisis. But for less educated farmers the increased forest tenure has a labour-absorbing effect. A universal effect for all farmers was enhanced self-employment. The reform gives farmers greater ability to borrow and invest. Stronger property rights increase labour inputs on forest land.

A remaining challenge is to increase the planted forest area by another 40 million hectares by 2020. Currently, China's forests are only two-thirds as productive as the global average (in terms of m^3/ha/yr), so there is also a great need to increase forest productivity.

– Raising productivity is probably more important than increasing the forested area.

High on the political agenda is also to in-

crease the forest sector's contribution to green growth. China is known for being the biggest emitter of CO_2. Carbon sequestration must increase. So far the contribution of the forest sector to the production of bioenergy is negligible.

– We face a very steep learning curve. We do not know much about modern bioenergy. We are suffering from ill-advised national development strategies since the 1950's. China could learn a lot from Sweden.

There is a continuous need to modify constraining forest policies.

– Currently, we are discussing whether to remove logging quotas and replace them with management plans, but this has been controversial. Farmer property rights remain a bit shaky. 40 % of forest land is still under state control, but the state forest reforms have met major obstacles.

Xu ended his talk by mentioning that the reforms in China could possibly inspire policy making in other developing countries. China has gone through a social experiment in individualization that may have implications for these countries. He clearly pointed out, though, that the choice between community and individual management is dynamic and varies from case to case.

– Hopefully, the reforms in China can result in more efficient global resource management and less pressure on tropical forests.

His final message was that there is great need for and plenty of opportunities for South to South exchange, learning and sharing.

Tenure and land use issues in industrial forestry – South America and the Nordic countries

Professor Jan-Erik Nylund.

– When we say that South America has a large potential for forestry, we in fact mean a handful of countries. The possibilities to participate in industrial tree plantations (ITP) are limited to certain areas, where both technical and transport infrastructures are established, and where people are willing to accept forestry, said Professor Jan-Erik Nylund, Swedish University of Agricultural Sciences (SLU), by way of introduction.

In his talk Professor Jan-Erik Nylund focused on industrial forestry and the paper industry, i.e. ITP and large pulp mills. He emphasized that it is misleading to talk about reforestation in connection with industrial tree plantations, since ITPs are more like a kind of agricultural land use with a long rotation period (5–15 years). When growing ITPs it is never the intention to recreate anything like a natural forest.

– Unfortunately, FAO has confused these things, which gives fuel to people that oppose any kind of rational forestry.

Looking at production statistics, the biggest pulp producers are the US and China, but they use all pulp themselves. Big exporters of pulp are Canada, Brazil, Sweden and Finland. There is an enormous production potential from one hectare of favourable forest land. Brazil has an average of 41 m^3 per hectare and year, and the plantations supplying wood to the new pulp mills, like Veracel, have a production average of 50 m^3 per hectare and year.

The high productivity is a result of tremendous work on plant breeding to develop

suitable eucalyptus varieties. Uruguay and the Amazonian North are less productive regions. Indonesia also has a lower average production. Chile and Indonesia have about the same productivity level, even though Chile has a colder climate (comparable to many European countries).

The importance of climatic conditions and the use of different tree species are revealed in the following figures: in Brazil it takes only 100,000 hectares to produce one million tonnes of cellulose, whereas in Scandinavia 700,000 hectares are needed to produce the same amount.

Even though South America has large areas that seem suitable for ITP, there are fairly strong obstacles and resistance to the use of land for ITP. NGOs are criticizing the socio-economic impacts of ITPs and the transformation of the landscape. Nylund continued his presentation by describing the situation in certain South American countries.

In Chile, only 16 million hectares are climatically suitable for tree plantation. Two million hectares are already planted, and the productivity is extraordinary. On these planted hectares Chile produces as much timber as Sweden does on 20 million hectares. But the planted area accounts for 10 % of the total land area, and more land cannot be taken from agriculture or the native beech forests. So the way for the Chileans to increase timber and pulp production is to intensify management of the plantation forests. The production model in Chile is to integrate activities; pulp production, board production, saw milling, and so on.

The real problem in Chile, Nylund noted, is the armed conflict over former indigenous land in the Araucania core area. The region corresponds exactly to the peak production area for ITP. It was conquered in the 1880s from the Mapuche indians, after a military junta took over the country and nationalized all land. After the fall of Pinochet's military government, a conflict flared up when the Mapuche indians tried to reclaim their rights, both politically and through violence.

– So long as this conflict continues it will remain difficult to motivate large investors to invest much capital to intensify production or expand forestry.

In Uruguay cellulose production and ITP are currently expanding very fast. The country is no larger than a Brazilian province, but it has been very ambitious in making land classifications, identifying where forests can and should be grown. It is a matter of debate, though, whether land should be converted to other uses than those it was originally used for.

– In Amazonas, the question is: should we fell the rainforest and convert it into grazing land to produce ecological beef for Europeans? In Uruguay, they have land for producing ecological beef, but should this land be converted to industrial tree plantations?

In Uruguay, there is a political consensus that the forest production potential should be exploited as far as possible. At the moment, only two mills are operating and they have secured their raw material base. According to most politicians, there is room for at least two more mills, and pulp mill ventures are seen as an example of economic diversification.

The forest areas are very sparsely populated, and the political debate at present is not about remote tree plantations per se. Instead, city people are worried over foreign dominance, mainly Argentinean and Brazilian, of the agribusiness sector.

In 2012 the Brazilian Pulp and Paper Association (BRACELPA) published estimates of the profitability of various crops. Coffee

and trees are by far the most profitable crops. Interestingly, soy crops are only one third as profitable as ITP. Soy beans are planted on areas ten times larger than ITPs, and it can be questioned whether it is sensible – from a national economic perspective – to have such large areas under soybean production and such small areas cultivated as ITPs.

– The point is that nobody objects to soybean cultivation in Brazil, but there are violent protests against tree growing. So Brazil suffers first of all from political conflicts over land use. There is an old heritage of national land grabbing. A good person is a man (or woman) who cuts down the forest and grazes cows, or grows maize and beans, on the land.

There has never been a complete land reform in Brazil, and various interests are arguing whether to have a policy for agro-business or one for small subsistence farmers.

Currently, the political establishment is in favour of both agro-business and ITP, but other strong forces want to see a different policy. As a result, there are dozens of land occupations at every mill.

The water balance problem in Brazil is often understated, Nylund continued. The precipitation is enough for the plantations, but infiltration to groundwater is drastically reduced. The massive scale of plantations causes regionally lowered water tables.

Nylund then remarked on the enormous areas in North Eastern Brazil that were cleared during the fifties and sixties with direct government incentives. That land was taken over by landlords, who did not use the land. Instead, squatters, without proper registration, moved in and started making a living out of the land. Even the population is very sparse, between 10 000 and 15 000 persons have to be displaced for every 200 000 hectares of new plantation.

– Brazilian policy today offers no provision for the people that have to leave their homes. People without land rights are evicted, and they often end up in favelas in the towns.

According to Nylund, the conflict over Brazilian reforestation or ITP could be the strong common preference for a pastoral or arable farming landscape.

– Even with only 10–15 % ITP local people say "oh, we can't live here anymore". They accept soy, cows and coffee, but they simply can't put up with trees.

The same repugnance to forests is common also in Argentina. Nylund even describes Argentina as a country with a national disinterest in forestry.

– Great landowners have by tradition not invested in industry. They have put their money into the bank in London. Argentineans do not want to grow forests.

Furthermore, erratic economic policy has provided disincentives for large-scale investment and discouraged foreign investors.

– There is also a general resentment against what are called "papeleras" following the Frey Bentos conflict over possible pollution caused by its mill.

Argentina has only one large paper mill, but 1.2 million hectares of ITP which should be able to cater for six or seven mills. Foresters claim that 20 million hectares are suitable for ITP. That said, Nylund did not believe Argentina would enter the ranks of major forest producers within our generation, but he hoped he was wrong.

The NGOs in Argentina as well as in Brazil and Uruguay unconditionally reject all ITP, and Nylund described them as having high organisational and communication skills.

– They combine scientific competence with a biased use of hard evidence. Often they pre-

sent well-founded examples but they only give a partial picture. What irritates me most is that they do not relate their criticism to other forms of land use. People are not campaigning against sugar cane or soybean plantations.

In one way the South American NGOs are new in that they combine ecological and social concerns. They elucidate the societal impacts of large-scale land use changes on tenure. They also keep up the pressure on companies to improve their corporate social responsibility (CSR) and ecological profiles.

– We should be grateful for small mercies. Unless the companies change their attitudes and way of operating they will sooner or later face a backlash, which will be do them no good whatsoever.

Conclusions

There is a growing distrust against industrial forestry worldwide. In South America, people protest against changes in the preferred agro-pastoral landscape, and the transition from subsistence farming to global market agriculture. When powerful companies don't anchor their activities in the needs and ambitions of local communities discontent increases. In the Nordic countries, the gradual change from semi-natural forests to intensive forest management has also been widely discussed, especially after a series of investigative articles in the daily newspaper Dagens Nyheter. Without glorifying the Nordic situation, Nylund pointed out that there is a Nordic experience, which says that green-washing and arbitrary CSR activities are not enough to make companies accepted and legitimate. The success model for the Nordic countries has been based on collaboration with local communities, diversified activities, creation of multi-actor social clusters and a social responsibility for the whole zone where the companies are working.

– For those wishing to expand forestry in South America these experiences should somehow be applied. Now the big pulp mills operate as industrial enclaves in a colonial way. Yes, they are honest and pay taxes, and they do not pollute, but nor do they contribute to the areas where they are established.

Nylund concluded that the companies in Brazil can continue to expand, but unless they change their way of working, they will get problems. In Uruguay, the companies might get away with the present management model, since there is no alternative land use opportunity other than low producing cows on eternal pampas. Chile has a multifaceted industry, like the Nordic countries, and people accept forestry. Chile should just continue as up to now, and not allow large industry to take over too much, Nylund concluded.

Discussion, session 3

Moderator Dr. Björn Lundgren started by asking the Swedish speakers what the long-term implications for the Nordic countries would be, if trends of increasing productivity in China, Africa and South America were to continue? Would the Nordic countries retain some comparative advantages?

Sten Nilsson: There won't be any free lunches. The forest industry in the Northern hemisphere is under pressure. The market for a number of our flagship products is heading to the cellar. We have to replace those products. We also see many new players moving in on our traditional markets, with a lot of capacity (printing and writing, tissue and paperboard). They are sometimes operating under more favourable economic conditions. They might have faster growing raw materials, but there are also subsidies involved in building this capacity. The northern hemisphere has had an advantage in the long fibre of its conifer forests. But nowadays it is possible to produce most of the conventional products with short fibres and even of better quality and at lower prices. Technological developments will push this even further.

The long fibres are still outstanding and of high importance for producing liner and folding boxboard. That is a growth market. But the Nordic countries will not be competitive if they stick to conventional products. They must create higher value products. The paperboard industry must go in the direction of becoming a packaging industry, producing intelligent and environmentally friendly packaging material. The tissue industry has to go in the direction of becoming a health industry. There are tremendous opportunities in using fibre products in the health industry, which is the world's biggest industry. The market for newsprint and writing paper will bottom out somewhere, but we don't know where that bottom is. The media and forestry sectors should join forces to combine paper and electronics in clever ways. The big problem area is the sawmilling industry, which cannot continue to produce sticks of wood. It must become more of a construction industry, producing advanced building systems. In addition, there are numerous opportunities in producing biochemicals, bioplastics, advanced biofuels and biocomposites. It is only the imagination that sets the limit to what can be produced from wood fibre.

Jan-Erik Nylund: Forestry is all about mindsets about how to use the land. Green goal posts standing in the forest, so that Germans can shoot moose; that is one choice. If we want to develop Swedish forests through more intensive management, and still be competitive, we can always find a niche for that. The energy crisis will help us to sell things we cannot sell to anybody else. It is up to us to decide, just as it is up to the Brazilians and to commercial companies to decide to adopt policies that can be accepted.

Björn Lundgren: Currently, Africa and China are net importers of wood products, but you are making great efforts to develop your forestry sectors. Do you envisage a situation in which

you become net exporters and competitors to the Nordic countries on the wood industry market, within the coming 20-30 years?

Jintao Xu: A key thing in China is to establish a solid property rights system. We need better protection for private farmers' property rights, to provide incentives to invest in better management. The gap between imports and exports will narrow in the coming decades, but I don't believe China will become a net exporter within the next few decades.

August Temu: A lot of the basic primary production should and needs really to be used within the countries in Africa. We don't have to start business by planting trees. We can pick it up from a different and more advanced level. Foreign interests are pushing the limits too far when they begin their business by asking for land, that is where the conflicts begin. They should begin at a different level. Then we can become strategic and complementary, at the same time.

I see us taking over a lot of the basics in terms of establishing and managing forests. Africa currently exports very high quality timber, in the form of round wood. But countries are beginning to resist the exportation of round wood, which means they have to develop and invest in local processing companies, so they can at least sell lumber. I believe Africa should produce, harvest and do the initial processing. We will be net exporters of pre-processed products. The more industrialized world can handle the final level of production.

Management consultant Ulf Johannisson, Medverket AB: Should we give any subsidies to low value products, such as biofuels?

August Temu: Yes, if you are referring to subsidies that make economic sense to a particular country. But no, if you are thinking in terms of rationality in a global perspective. There are many more useful options.

Jintao Xu: Subsidies could be used by governments to correct market failures. The value of the forest is underestimated and that is why it is necessary with subsidies to the forest sector. We have huge subsidies for agriculture, but there are few subsidies to the forest sector in China. We need more subsidies instead of less.

Sten Nilsson: In principle, I would be pleased if we could get rid of all the subsidies. But hardly any of the fast-growing plantations we have today were created without subsidies. We do not have subsidies in the forest sector in Sweden today. So there is a risk, if we do not have the same subsidies globally, that we get different competitive conditions. But it is difficult to compare the value per hectare between all crops and products, taking totally different value scales into account. There is an increasing demand for environmental and social services, such as climate friendly fuel, and the value of those products are measured on a different value scale from ordinary forest products.

Vice chancellor Lisa Sennerby Forsse, Swedish University of Agricultural Sciences (SLU): How do we attract young people into our sector to develop the natural resources further in the future?

August Temu: One of the biggest challenges was that forestry was viewed as something you do in the bush. Today there is a much better understanding of forestry in the context of natural

resource management, on a higher level, relating to the society, environment and economics. In Africa, women are dominating courses in agriculture and forestry, which is a good thing.

Jintao Xu: We produce plenty of college graduates with forestry degrees, but very few return to the forest regions. There is a simple economic explanation to this. New graduates move to where they can get jobs that pay the highest return. With the underestimation of forest value, forest jobs will not generate good return. Instead, workers try to find work in the government. China must establish a system that rewards forest work. With stronger property rights, larger land holdings and more educated foresters this might happen. After the economic crises, more young people are returning to the forestry sector, although on a small scale.

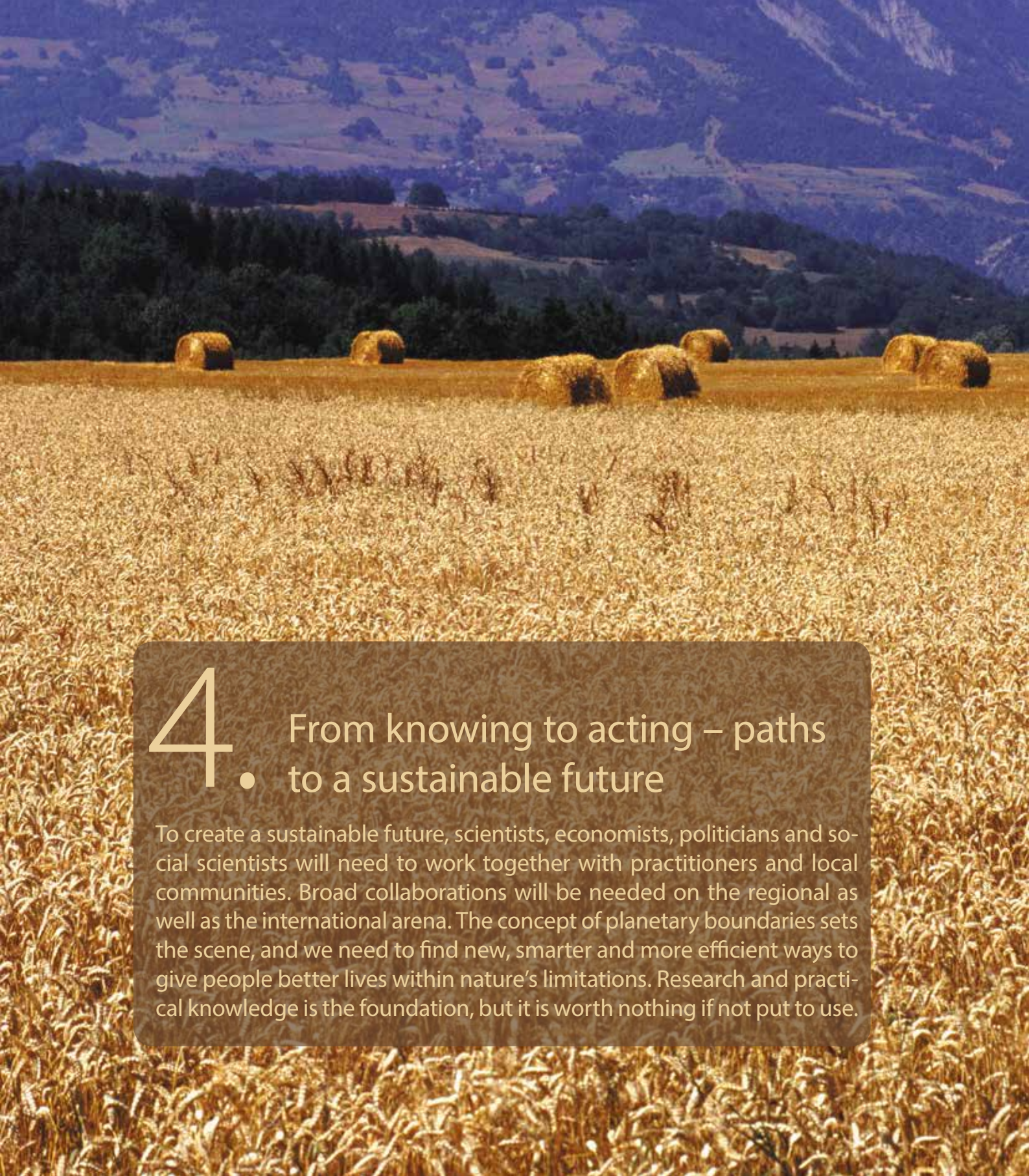
Ambassador Lennart Båge: There has been work going on for some years with governments and civil society organisations that resulted in *Voluntary guidelines on responsible governance of tenure of land, fisheries and forests*. The guidelines were adopted last year. Will they be of any use? Or is it just more words on paper?

Jan-Erik Nylund: In South America, there is no land grabbing anymore. Land grabbing takes place when the rainforest or cerrado ecosystems are cut down, and that is a matter of the past. Today it is more a question of how the market functions. Since forest land has become so expensive, companies cannot afford to buy more land. Instead, they are trying to outsource work to contract growers, but the problem is that there are not so many people that are interested in working in the forestry sector.

August Temu: Maybe most land grabbing is taking place in Africa. This is very sad because it is not a situation where companies are genuinely interested in buying and operating the land fairly. Land grabbers act in collusion with corrupt leaders, to get unbelievably low prices. Land has been sold at the price of USD 7 per hectare, and a lot of money has filtered away into the pockets of corrupt leaders. Genuine and honest buying of land is not an issue. It is a question of how you do it, of transparency and openness in everything that is done.

Sten Nilsson: As long as we have non-transparent actions and corruption it does not matter what documents we produce, land grabbers will go on grabbing anyhow.

The Symposium was held at Stockholm City Conference Center Norra Latin, with more than 300 people in the audience.



4. From knowing to acting – paths to a sustainable future

To create a sustainable future, scientists, economists, politicians and social scientists will need to work together with practitioners and local communities. Broad collaborations will be needed on the regional as well as the international arena. The concept of planetary boundaries sets the scene, and we need to find new, smarter and more efficient ways to give people better lives within nature's limitations. Research and practical knowledge is the foundation, but it is worth nothing if not put to use.

Creating a sustainable future – how to get more out of less on the only earth we have

H.E., Dr. Jacques Diouf.

Global food consumption will be 60 percent higher in 2050, FAO projects. This raises concerns about how and where such an increase in production can be achieved, but also on the relevant constraints of land and water. The former Director-General of FAO, Jacques Diouf, nowadays Minister and personal adviser to the President of the Republic of Senegal, identified the key question for policymakers, scientists and farmers as: "how can we get more out of less?"

– The 1996 World Food Summit's target of halving the number of undernourished by 2015 will most probably not be achieved, Diouf said.

– But we could still take comfort from the fact that the projection, which showed that the 1996 target would only be achieved by 2150, has been readjusted to between 2040 and 2050.

According to Diouf this welcome development is due to the expected sharp decrease in population growth, the recent reversal in the declining trend in per capita food production and the emergence of sub-Saharan Africa in the group of fast growing economies. However, the fight against hunger is especially challenging, since the highest demand for food and nutrition will come from countries that are at present unable to satisfy their demand. Developing countries use a large share of their income for basic needs. The evolution of GDP in third world countries will therefore be important in assessing the global demand for food, feed, fibre and fuel, Diouf explained.

Diouf also mentioned that there will be a qualitative shift in dietary patterns, with greater consumption of livestock meat, milk, eggs and vegetable oil. The consumption of cereals

has declined since the middle of the 1990s, but its overall use, including seeds, animal feed, ethanol, starch and bio-fuel, will continue to increase. What then are the implications for planet Earth of the finite natural resources, land and water, that sustain our livelihood, Diouf asked. At present, only 1.5 billion hectares, out of 7.2 billion hectares of land having a potential for rain fed cultivation, are being used for crop production. Forests, environmentally protected areas, and urban settlements limit the agricultural use of the other huge potential areas. Land potential is also characterized by an uneven distribution in favour of sub-Saharan Africa and Latin America, which account for 90 % of such land.

– The availability of water is a cause of even greater concern, as only 2.5 % of the world's water is fresh water. Moreover, almost half of the world's population lives in trans-boundary river basins and almost all live in countries with basins that cross international borders, thus creating serious potential for conflicts, as the demographic pressure grows.

– The first challenge for a sustainable future is, therefore, the level of efficiency that will be achieved in the use of land and water, in terms of input and output ratio, but also in relation to environmental impact, Diouf continued. For water, it is necessary to increase infiltration of rainwater into soils, limit the over-extraction of groundwater, but also reduce the negative effects of water logging and salinization.

As regards land, farmers need to manage fertility, nutrient retention capacity and depletion, soil structure, depth, slope and erosion. Management practices have to improve. Policymakers should also address the challenge of urban and peri-urban agriculture, as 200 million people are involved in this activity and related enterprises, thus providing the supply of 800 million urban consumers. In developing countries, the yield gap between farmers' fields and research experiment centres needs to be closed, not to mention the huge difference in relation to the results obtained in international and developed countries' institutes.

– It is well-known that livestock is the largest user of agricultural land, and a major source of overgrazing and deforestation. Beyond the ongoing work on biological and animal health improvement there is a need to improve the technologies for feeding animals. The rate of deforestation is still high. But, due to the compensatory effect of afforestation and natural expansion, the net change has been brought down by a third since 1990, Diouf stated.

He also commented on the subject of food wastage. One third of all food produced goes to waste. Per capita waste is between 95 and 115 kg a year in Europe, North America and Oceania, compared to 6–11 kg in sub-Saharan Africa, South and South East Asia. In the developing countries losses occur mainly in harvesting, storage and distribution systems, and may reach 40 % for some products.

Diouf continued by highlighting the importance of preserving biodiversity. Its effective use for plant breeding can increase productivity, resistance to drought and floods but also resilience to insects, diseases and viruses. Adoption of integrated pest management would lessen the use of harmful pesticides.

Agriculture provides primary products for the production of liquid fuel, chemicals and materials like natural fibre composites. The agro-food system represents around a third of end user available energy. It is possible to improve efficiency in the areas of enzymes, fermentation and organisms for processes and products, in the energy, chemical, pharmaceutical, food, textile, pulp and paper industries. But Diouf

criticized the policies of subsidies and trade protection, which has led to a doubling of liquid biofuel between 2006 and 2011.

– The subsidies need to be seriously amended. Not only did they drive the increase of 45 million hectares in land use, but they also moved 100 million tonnes of cereals away from human consumption.

Diouf further called for investments to promote the development of irrigation systems and make agricultural production less dependent on the vagaries of rainfall. In sub-Saharan Africa, only 4 % of the arable land is irrigated. Another high priority area is to reduce transportation costs by the construction of rural roads, for example, and by building storage facilities to reduce the huge food losses. Diouf then underlined the need for women to be given equal access to land and water, technology and inputs, credits and markets. As a consequence, 100 to 150 million more people would get adequate food, he said.

– Last but not least, agriculture contributes around a third of global anthropogenic emissions of greenhouse gas emissions. It is thus a key factor in climate change. Methodologies are needed for adaptation and mitigation, in particular through conservation agriculture, Diouf stated.

Good governance will be vital to make the relevant balancing of divergent short and long-term interests. It will require ethics, vision, strategy, plans, programs and projects, but also laws, regulations, as well as budget evaluation, control and audit.

– Such decisions are hard and difficult, but they have to be coherent and consistent.

Despite the hopes raised at the first World Food Summit in 1996, and the alarm triggered off at the second World Food Summit in 2002, the awareness raised in the framework of the Millennium Development goals and the calls on the G8 and the G20, there still are almost one billion hungry people in the world. The emergency meeting, that followed the food crisis in 2007–2008, and the third World Food Summit in 2009, did not fundamentally change the situation. Fortunately, at national level, good policy and governance ushered many countries in Asia, Latin America and now in Africa, out of this plague of ancient times, without destroying our environment.

– But regrettably, the basic international and regional policy flaws have still not been corrected.

International food and agriculture trade flows are characterized by volatility and upward trends in prices. In response to this development the G20 created an Agriculture Market and Information System and a High Level Panel of Experts in 2011.

– The trade in agricultural commodities is, however, neither free nor fair. Agriculture in developed countries is getting state support of around one billion dollars per day. Tariff escalation is depriving developing countries of the opportunity to expand their agro-industries.

In spite of the many challenges ahead, Diouf's final conclusions had an air of optimism:

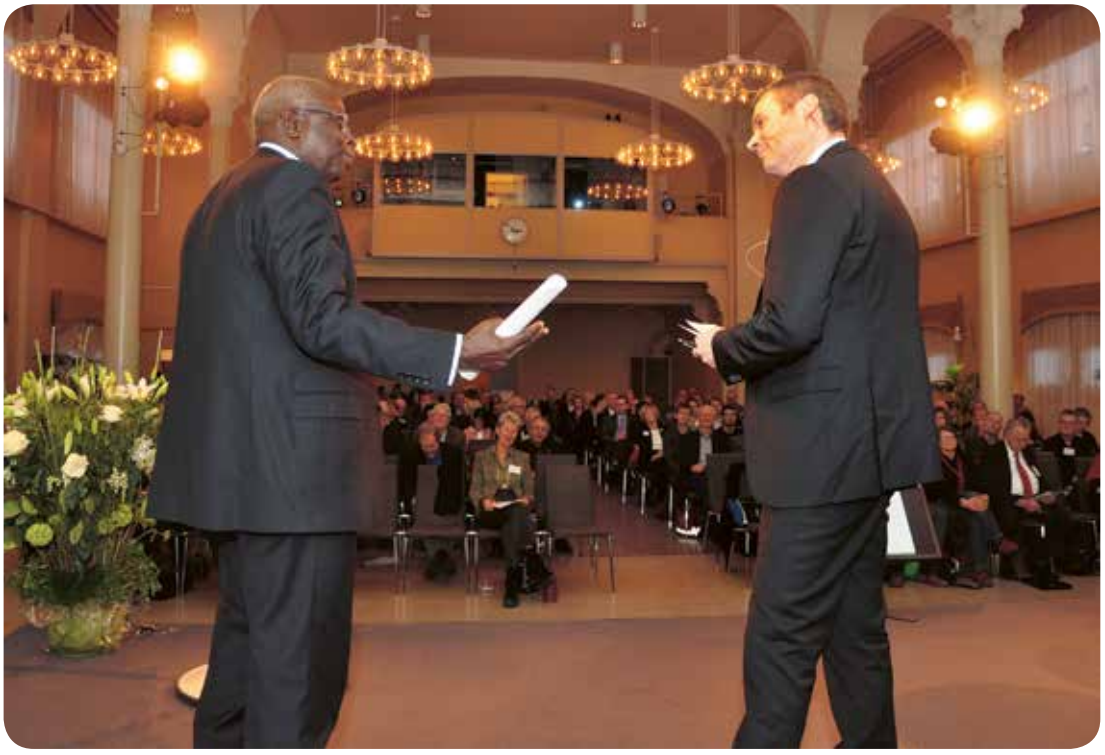
– Humanity has the knowledge, experience and means to address these problems in an equitable way. We should have the imagination, foresight and wisdom to put in place an international system which allows people in agriculture, from developed as well as from developing countries, to earn an income allowing them to lead a decent life, in line with the conditions of workers in other sectors of their respective countries.

– The rural population is indispensable for feeding humanity. The rural population is also

the guardian of lands, water, forests, and wildlife, the foundations of a sustainable environment and of our culture, and therefore of our civilization. They therefore deserve compensation for the environmental services rendered to our planet.

Diouf ended by answering his initial question of how to get more, out of less:

– All along our history, science, through technology, has been the cornerstone of human progress, providing greater efficiency and productivity. But the means and tools it makes available cannot set the goals and priorities. Other actors, in particular at social and political levels, need to ensure that these enhanced capacities are rooted in ethics, justice, fraternity and generosity; that they are used for the benefit of our fellow human beings. "*Science sans conscience n'est que ruine de l'âme.*" ("Science, without conscience, is soul's complete devastation.")



After his speech Dr. Jacques Diouf had a short discussion with moderator Johan Kuylenstierna.

Inspired by nature – how science and knowledge of nature's own materials, methods and mechanisms can give us a sustainable future

Professor Paul Alan Cox, Institute of Ethnomedicine, Wyoming, started by showing a photograph of the 30 % recession of Storglaciären in Northern Sweden. Humanity is taking carbon that has been sequestered over 500 million years and releasing it very rapidly, heating the atmosphere, he explained.
– Whatever sceptics of global warming say, the glaciers tell the truth. From Northern Sweden to the Alps to my home in Grand Tetons, glaciers are retreating. Clearly, our current mode of life and consumption is not sustainable.

Professor Paul Alan Cox.

Professor Paul Alan Cox showed a cartoon from Stockholm Environment Institute to illustrate the urgent need for action, and stressed that there will be winners and losers in this changing climate.

– The dilemma is that we are not totally sure what the effects are, but we do know that the best time to act is now. And if we fail to act now, climate change will be out of our control. We need to find new ways to live happily and sustainably.

Cox used climate challenge to start a discussion on possible paths for developing sustainable lifestyles. His major thesis was that humanity should go back to nature to get inspiration and ideas for sustainable solutions, not because it is better or more beautiful, but because it could be incredibly efficient.

He gave numerous examples of smart solutions to be found in nature. In Denmark the tradition of using eelgrass (*Zostra marina*) to thatch the roofs of houses is still alive. There

are cottages thatched with eelgrass that has remained intact after 450 years. It is fire resistant and waterproof, but only a handful of people still know how to construct seagrass roofs that can endure for centuries. The blades of eelgrass abscise under water, and wash up on the beach, where they were sustainably collected for thatch and insulation. Eelgrass in Sweden was used for packaging and insulation; and in the USA the remarkable acoustic properties of Carnegie Hall are attributed to eelgrass insulation. Eelgrass in Sweden was also used as a fertiliser for crops. Eelgrass is also the world's top sequester of carbon, beating even sugar cane.

– The plant requires no cultivation, no fertilisation, and it is out there right now. Why are we not using it more widely?

Another example of a sustainable solution is the use of bacteria of the oil-eating species *Alcanivorax borkumensis* to clean up after oil-spills. These bacteria eat hydrocarbons and alcanes, and offer a completely natural way of degrading oil-spills.

A third success story, Cox envisioned, was the use of DNA to store information. Currently hundreds of computers are pooled into server farms, which require massive amounts of power to run and keep cool. The costs, both financial and environmental, are enormous. Researchers recently suggested an alternative: nature's information molecule, DNA. Every book, document and film in the history of the world, could be encoded into a mass of DNA about the size of a box of Swedish fish candy. DNA data storage can be maintained indefinitely, without power consumption, but methods of accessing it are still in their infancy.

The voyage continued via the thermal ponds of Yellowstone National Park, which are only an hour's drive from the cabin where Cox lives. Some time ago, he took a few scientists to the place, and they almost dropped to their knees, overwhelmed by the fact that the enzyme Taq polymerase was discovered in those hot springs. The microorganisms living there have developed ways to protect their DNA in almost boiling water. The enzyme that polymerases DNA was derived from the bacterium *Thermus aquaticus* by the scientist and devoted surfer Kary Mullis, who later won the Nobel prize (1993) for the polymerase chain reaction (the PCR method), one of the greatest achievements in biotechnology.

But even simple solutions can be very profitable. The inventor of Velcro, Georges de Mestral, was walking his dog, and saw the little fruits that got stuck in the fur of his dog. He looked at the fruits and got an idea on how to construct a synthetic hook-and-loop fastener. Velcro now has annual sales of 177 million dollars, and has been essential in zero gravity space flights.

In the area of medicine a small peptide, exenatide, from the saliva of the lizard *Heloderma suspectum* (Gila Monster) has become a real blockbuster for the treatment of type-2 diabetes. The protein that lowers blood sugar, and this new anti-diabetic drug, marketed as Byetta, generates 700 million dollars per year in annual sales.

One of Cox's own recent contributions in the area of ethnomedicine is a possible treatment of motor neuron disease. Scientists at Karolinska Institutet in Sweden have found a fivefold risk of developing motor neuron disease among people who live in southern Sweden compared to those who live in the north. His colleagues at Stockholm University have been studying lakes in southern Sweden and the Baltic, where cyanobacterial blooms are frequent. The increased risk of developing motor neuron disease is due to a single neurotoxin called BMAA that the

cyanobacteria produce. They discovered that BMAA replaces the amino acid serine, as proteins are being formed. This leads to protein misfolding and protein collapse. Scientists at Uppsala University have found that mice fed on BMAA show cognitive deficits and patterns of brain abnormalities consistent with Alzheimer's disease. By adding L-serine to human cell culture or to experimental animals, Cox's colleagues in Australia and California have found that it is possible to outcompete the neurotoxin. FDA-approved human clinical trials on L-serine as an anti-ALS drug have now begun, which might pave the way for a dietary amino acid L-serine treatment to motor neuron disease. The goal is to reduce progression of the disease by 40 %, Cox explained.

Finally, showing a couple of slides of a man suspiciously similar to Dr. Cox, dressed as Carl von Linnaeus, with wig and all, Cox repeated his main message:

– Linnaeus claimed that most of the answers to problems in society could in fact be found in nature. Perhaps Linnaeus was right? I challenge academics to go first to nature. Before we invent artificial means to solve our problems, which may instead result in unforeseen consequences, we should first ask if there is a natural way to solve our problems.

Professor Paul Alan Cox made his point with several slides.

Knowing but not doing. Why changing is so hard even with abundant knowledge.

Professor Susan Baker from Cardiff University, United Kingdom, made it clear that she would not present any answers, but rather throw out some suggestions as to why we find it so difficult to act, and why there is some kind of societal failure to respond to the environmental challenges mankind is facing. She then started to interrogate herself on some of the assumptions we make about knowledge, perceptions of problems and different actors. Is it for instance really true that we have abundant knowledge? It may sound intuitively correct, Baker pondered, but perhaps it is not that straightforward?

Professor Susan Baker.

On the one hand, Professor Baker argued, it would appear that we have an abundance of knowledge. There is a constant reduction in scientific uncertainty, and we have improved the science-policy interface, with better institutional arrangements in place. The time lag on uptake by the policy community of scientific knowledge has also been shortened over time. As well, there is improved communication and accessibility of knowledge, so the knowledge is more readily available than it was twenty years ago.

But on the other hand, Susan Baker pointed out, there are still remaining issues about the idea that we have abundant knowledge. Some knowledge is overly technical in its presentation. It is not readily digestible by the many. There is also a reluctance to engage in what may seem like a current sacrifice for uncertain and distant gains.

– I would like to throw out the idea that we actually have abundant knowledge and to query and question whether that knowledge is acceptable, accessible, or indeed, if we actually possess that knowledge, it will lead to any sense that we ought to move and take action now, about something that appears to be a bit abstract and in the distant future?

Baker then continued by asking herself: Knowledge of what? What is the nature of the problem? We have many different understandings of what the problem is, and different understandings lead to many different logics for action. Some see the problem as mainly instrumental, and their solutions most probably deal with management, markets, institutions and governance. Some see the problem as a moral problem, and a problem of ecology and ethics. Because of these different understandings of the problem and the different calls for action they evoke, people might get torn between different priorities and different actions, Baker said.

Those who see the problem as mainly a technical or managerial problem might want to improve management, enhance planning, boost related business strategies, progress technologies for transition to low carbon economies (carbon capture and storage, renewables) and advance technical specifications in product design. Others who see global environmental change, GEC, as a market problem, and a failure to internalise externalities, tend to focus on activities to quantify costs and benefits of mitigation and adaptation, markets for carbon, quantifying the value of ecosystem services, regional carbon trading schemes, different market instruments and business solutions for low carbon economic growth. People who see global environmental change as a primarily institutional problem might want to incentivize collective action, ensure institutions, enhance institutional capacity, legitimise and democratise institutional arrangements.

Baker also stressed that numerous different actors (international governance regimes, states, regional authorities, economic interests, NGOs, individuals) are engaged in global environmental change. These actors, of course, have different competences and capacities to act. They have different tools and visions for action.

– They operate in nested hierarchies, says Baker, so what we can do is in part a product of higher up and lower down scale interactions, and of course power between the different levels is shared unequally. So the locus of action is a quite complex multilevel embedded arena to investigate.

– None the less, having said that, there is a lot of action out there, Baker admitted. In the 21st century environmental policy has become part of the legitimate business of government. There is an array of international, European and national regimes, laws, institutions, policies and programmes. Environmental authorities and scientists have become incredibly sophisticated at monitoring and evaluating environmental decline. There is also plenty of economic and corporate action. In Western Europe, particularly in Sweden, there has been a period of ecological modernisation, especially in the industrial sector. Production has become cleaner, and more energy and resource efficient. Product design is more environmentally directed, and management of waste is much improved

– So it is true to say we have moved forward from those dirty days of the sixties and seventies, Baker explained. There has been an internalisation of pollution and resource costs into production. Many corporations have gained from green products, and societies have an array of initiatives operating across scale in relation to corporate social and environmental responsibilities. Even at the individual level, there is plenty of action. We have countless debates and discussions on consumer behaviour, informed consumer choice, information campaigns, "reduce-recycle-repair" and eco-labelling. So we seem to take a lot of action, Baker concluded:

– It seems that we are very, very busy. But the story is never that simple.

– I am not really happy with any of these solutions. In this preoccupation with instru-

mental reasoning, we have ignored some deeper, more fundamental issues that we find hard to talk about. For example, the relationship we have with nature. We tend to say, "Oh, yes, we will have to talk about that." But we never do.

If we believe we should use an instrumental response, we minimize the degree of social and cultural change that is actually necessary to address global environmental change, Baker reasoned. None of the instrumental occupation does address the basic ecological contradiction in capitalism, i.e. that capitalism requires constant expansion of consumption in a world characterized by finite resources, she elaborated.

– We get very uneasy when we put that card on the table, and instead we see growth as part of the solution. In many ways we have decades of action, decades of engagement, lots of new and interesting understandings of the problem, but the problem is getting worse, not better. Our actions don't seem to be getting us anywhere.

Baker called this instrumental engagement a form of moral nihilism, denying the ethical dimensions of what we are doing.

– Maybe it is not about acting, but about thinking differently to act differently?

According to Baker global environmental change is primarily an ecological problem. Over-consumption is leading to resource depletion. Humanity is disrupting ecosystem functions and services. Planetary boundaries are put under stress. So the logic of action is about reduction of growth and consumption, to find safe operating space for humanity and develop new politics and economics of limits.

– But beyond seeing the problem as an ecological problem, we need to see it as a moral problem. Our moral code is very preoccupied with individual gain and we tend to have a lack of understanding of the common good.

Baker also criticized traditional ethics for ignoring the spatial and temporal aspects of the environmental challenges, displacing problems elsewhere, or pushing a problem, for example that of nuclear waste, onto future generations. Instead, Baker argued for an ethic where we, to take account of inter- and intra-generational equity, revalue our place in nature, allow nature a value in itself, reduce consumption in the West, embrace life style changes and engage in social innovation.

– We need to think differently about our moral codes. Our traditional morals are very "other regarding traits of character". They are focusing on inter-personal concerns.

– One of our big moral codes is that we should not harm others. But this is a very narrow scope and objective. If all we come up with is that we should not harm others, it is not very much, is it? Perhaps we need a new virtue ethics?

Going back to Aristotle, Baker believes we might find some insights and advice of what a well-lived life is about, and what characteristics and behaviours a good person should seek to achieve. But all this needs to be placed in a wider context, Baker suggests. Aristotle will not get us far enough, because we also need to develop a consciousness about the environment in which society is embedded. We need a virtue ethics that underpins the development of environmentally conscious characters.

So Baker proposes that instead of being busy fools, engaged only in instrumental reasoning, we should start to think about what we are trying to achieve. What are the ends that we are seeking?

– We need to move from instrumental to ethical reasoning. We need to shift from negative argumentation (what is wrong with knowledge, markets, governance, institutions) to positive thinking about what kind of future

we want to achieve. But it is very difficult to talk about what we want to achieve, because it involves a discussion of values, emotions and ideologies. This makes us feel uncomfortable.

– To act for a sustainable future we need instrumental reasoning, but the instrumental actions have to be guided by more purposeful reasoning, Baker concluded. One way forward would be to set up a virtue ethics, a moral code that asks us what we would like to see as our collective future. This new virtue ethics has to underscore a new planetary boundary economy, based on the notion of limits.

– It is a hard task, but if we don't start to think about purposeful action we will remain as busy fools and we will be sitting here in another 20 or 30 years, becoming more and more capable of monitoring our environmental decline.

Bertebos Prize winner 2013, Professor Philip Lowe, Centre for Rural Economy at the University of Newcastle, UK, was among those in the audience who put questions to the speakers during the final discussions.

Discussion, session 4

Audience: Susan Baker, you are really proposing a change in the global moral and economic order. How shall we achieve this? Under present market economy I do not believe it is possible. But people tried this in the French revolution and the Russian revolution, for example, and nobody became any happier.

Susan Baker: While we face a problem that is difficult we should not be overwhelmed to the point that we become paralyzed and unable to move. We are not hostages to the future. We have the capacity to act, we have the ability to act, we are thinking, caring and communicative beings. While I would like to go back to Aristotelian logic, I would also be very careful not to get embedded in any form of deterministic understanding that might be fatalistic about the future of humans. I am a great believer in the capacity of humans to collectively create a sustainable future.

Moderator Johan Kuylenstierna: What is the role of science in this need for change?

Jacques Diouf: Science allows us to have effective tools. But science cannot make the policy decisions that allow the tools to be used efficiently. For the benefit of whom, under what conditions and with what consequences, should scientific methods be used? Those are questions for the politicians.

Audience: We need a moral compass to guide us towards the new sustainable future. Why is it so difficult for scientists to talk about moral and values?

Susan Baker: First, we like to present the sciences as neutral and as presenting mere facts. I think the extent to which we believe that science is a value-free endeavour, is the extent to which we wish to continue with this notion that we do not need to talk about the underlying moral or ethical issues. We need to dismantle this notion of science as neutral. Second, for different reasons we live our lives of moral contradictions, and we do not like to have our contradictory lives exposed in public. We feel much more comfortable talking about instrumental tools, rather than displaying our own weaknesses and vulnerabilities in the face of others, particularly in the scientific audience, where you are meant to be both neutral and informed.

Johan Kuylenstierna: How important is it for science to act collectively as a kind of moral compass?

Susan Baker: I think it is very important for scientific bodies and organisation to start thinking about some of those performative contradictions. For example we need new criteria for evaluating success that doesn't necessarily involve large carbon footprints. But we mustn't point fingers at individuals, because we can be constrained by structural factors that make it very difficult for us to narrow the gap between our beliefs and our practices. These constraints (economical, institutional, social, cultural) can impact on us quite directly.

Audience: The Maputo declaration came up with some excellent proposals and decisions.

One is to invest ten percent of national budgets in agriculture. Mr Diouf, you were very instrumental in realizing that work. How did you go about it? How did you convince African leaders who were sceptical about the idea of supporting agriculture?

Jacques Diouf: We started by demonstrating in fifteen countries that it is possible to improve production with small means. But nothing happened, on a larger scale. So we decided to meet African scientists in Rome to discuss how to make sure that these pilot activities were incorporated into national programs for food security. On the basis of their comments we took the matters to the regional conference of ministers of agriculture in Cairo. There we got a decision by the ministers of agriculture. They asked for our support to bring it to their heads of state, which is what we did at the EU summit in Maputo. It was very difficult, since it was not in the program, and we did not even have any rooms to have our meetings in, et cetera. But in the end we were able to bring the ministers of agriculture to meet just before the ministers of foreign affairs. Because the ministers of foreign affairs were not informed of all these things, it just went through. There was no opportunity to debate different proposals. And when the proposal arrived to the heads of state of the African Union they also approved the program, and in particular the ten percent of investment going to agriculture. If the Ministers of Finance had known about this, they would never have approved. Fifteen countries followed up immediately, but unfortunately not all the African countries have followed up on the commitments made.

Audience: What is the role of education when working towards a sustainable future? I think of education in the broadest sense, from schoolkids to politicians?

Paul Alan Cox: Let me tell you a quick story. I was attending the convention on international trade on endangered species in Lausanne in 1989. The debate was about saving the African elephant. It looked like we were going nowhere, but then a group of French-speaking schoolchildren came in, carrying a little poster, with pictures of the cartoon character Babar. They sang a song and then marched out. Tears came down their cheeks. It only took about ten minutes. All the delegates looked at each other. There was not a word, and suddenly the votes were coming in. That one moment in Lausanne, changed the course of African conservation. We should listen more to children and learn from them. What their hearts teach them is the right path. They want to save the environment, and they are the future leaders.

Johan Kuylenstierna: OK, Paul, you say we have it in us as kids. We want to save the environment. But then something happens, obviously. We get gradually destroyed. We go to university and get completely wasted? *(laughter)* How can we change that? Can you say something about that cultural shift, Susan?

Susan Baker: Well, yes, education has a hugely important role to play in developing alternative value sets that are not based upon what one has at the bottom of a plastic shopping bag. It is our role to listen to children, it is also our imperative to block that narrowing of their perception

about what constitutes the good life, and having that equivalence between the good life and consumption. Education has an important role to play in breaking that value chain and stimulating thinking about what one does, and what one seeks to achieve, instead of what one has.

Jacques Diouf: Isn't part of the problem that our teaching system is not educating? It is instructing. We are transferring knowledge. We don't address values. When I was a little kid we had something called civics, in which we were talking about moral and societal values. They are not taught any more, at least not in the schools in Senegal, where I come from. The difference between instruction and education is a potential source of improvement of the way in which we teach values. We should give children a choice of different values, and stimulate them to go beyond their self-fulfilling egoistic needs to a more global social vision.

Audience: It seems like most of the innovations you described in your fascinating speech, Paul, happened more or less by accident. How can we stimulate new innovations inspired by nature, do you have any method to recommend?

Paul Alan Cox: Scientists need to take more time away from their lab benches and computers, and embed themselves in nature. That is anyway where I get my good ideas. It is when riding a bike or going surfing, like Kary Mullis, that we can think out of the box.

Audience: Forty percent of food is wasted, are we focusing too much on production and too little on viability, drought resistance and sustainability?

Jacques Diouf: On the question of yields versus sustainability I do not think there is necessarily a contradiction. There are techniques that allow larger yields, without ruining the environment. The equation looks very different in Africa and many industrialized countries.

Moderator Johan Kuylenstierna finished by reading a couple of written comments from the floor:

"Yesterday we talked about one technique for biological development, GMO, and we got stuck there. Shouldn't we talk, as Paul did, more about new ideas, new products and new solutions that we pick up from nature, and simply stop talking about one technique?"

"It is impossible to give natural resources full consideration unless we find a way of putting an economic value on ecological services and the full cost of using natural resources."

Johan Kuylenstierna: I believe these two comments from the floor are critical to our discussion on a sustainable future. I started off earlier today with a quote, and I have a short one to mark the end: "Managers are people who do things right, leaders are people who do the right things." And you have truly been leaders, being here for one hour answering all these questions. You all deserve a gift. Thank you!

Speakers

The Academy's Commemorative Meeting, 28th January 2013

Louise O. Fresco is a Professor of the University of Amsterdam, The Netherlands. Her career has involved decades of fieldwork in tropical countries, travels to over 80 countries, a PhD cum laude in tropical agronomy (Wageningen), chairs and lectureships at universities such as Wageningen, Uppsala, Louvain and Stanford and the membership of four scientific academies – she is a Fellow of the Royal Swedish Academy of Agriculture and Forestry. Louise Fresco held several leading positions within the FAO. The permanent theme of her life is a strong commitment to international development, agriculture and food. She published eight books and over one hundred scientific articles. Currently, as a University Professor in Amsterdam, she writes a syndicated newspaper column, is an advisor to the Dutch government on socio-economic policy, science and sustainability, including sea level rise. Since 2011 she is a member of the advisory council of The Hague Institute for Global Justice. She serves as a non-executive director of Unilever and on the supervisory board of Rabobank. She is a member of the Trilateral Commission.

Global Outlook – session 1, 29th January 2013

Professor Mats Morell, moderator, has published extensively on early modern and recent Swedish agricultural history and is the author of Part 4 of *The Swedish agrarian history (1870–1945)*. Together with Janken Myrdal he edited *The agrarian history of Sweden from 4000 BC to AD 2000* (2011). He is also co-editor and co-author of the Corn volume *Rural Economy and Society in North-Western Europe, 500–2000: Social relations, Property and power* (2010).

PhD Alan Swinbank is Professor Emeritus of Agricultural Economics at the University of Reading. His research has focused on the farm, food and bioenergy policies of the EU and their interaction with the WTO. He has lectured, advised, and published extensively on these topics. His latest books are *Ideas, Institutions, and Trade: The WTO and the Curious Role of EU Farm Policy in Trade Liberalization* (with Carsten Daugbjerg, Oxford University Press, 2009) and *An Inside View of the CAP Reform Process: Explaining the MacSharry, Agenda 2000, and Fischler Reforms* (with Arlindo Cunha, Oxford University Press, 2011).

PhD Bill Winders, Associate Professor at Georgia Institute of Technology, is a sociologist whose research focuses on topics including the politics of national policies (especially agricultural policy), the world economy, and social movement dynamics. His book *The Politics of Food*

Supply: US Agricultural Policy in the World Economy won the 2011 Book Award from the Political Economy of the World-System, given each year to recognize outstanding scholarship in global or comparative international sociology. His current research examines food crises in the world economy, such as the 2008 food crisis that saw food prices and world hunger rise dramatically.

Dr. Philipp Aerni graduated in Geography and Economics at the University of Zurich and received his PhD from the Institute of Agricultural Economics at ETH Zurich. Subsequently he continued his postdoctoral research at Harvard University and the Institute for Comparative and International Studies at ETH Zurich. His main research interest is innovation for development. In this context he co-founded the organization African Technology Development Forum (ATDF) in Geneva (*www.atdforum.org*). He is currently employed at the Institute for Environmental Decisions at ETH Zurich and the Food and Agriculture Organization of the United Nations (FAO) in Rome, where he coordinates a project called 'Remuneration of Positive Externalities (RPE)/Payments for Environmental Services (PES) in the Agricultural and Food Sectors'.

Global Outlook – session 2, 29th January 2013

Dr. Bo Andersson, moderator, is the vice president of the Royal Swedish Academy of Agriculture and Forestry. In the early 1980s he upheld an appointed professorship in farm business administration at the Swedish University of Agricultural Sciences and is today retired from a position as Senior Vice President at Swedbank, one of Sweden's largest banks.

Dr. Robert Thompson, Professor Emeritus at the University of Illinois at Urbana-Champaign, where he held the Gardner Endowed Chair in Agricultural Policy. Dr. Thompson was formerly Dean of Agriculture at Purdue University and Director of Rural Development at the World Bank. He is a Fellow of the Royal Swedish Academy of Agriculture and Forestry and a Visiting Scholar at Johns Hopkins University's School of Advanced International Studies in Washington, DC.

Professor John Pickett is Michael Elliott Distinguished Research Fellow and Scientific Leader of Chemical Ecology at Rothamsted Research, north of London, which has initiated and implemented research in cropping systems and soil science since 1843. He is Honorary Professor at the University of Nottingham, Honorary Member of the Academic Staff at the University of Reading and a Fellow of the Royal Swedish Academy of Agriculture and Forestry.

Dr. of Veterinary Medicine h.c. Marit Paulsen is a EU-parliamentarian from Sweden. The focus and commitment of her political work has been on issues regarding production and consumption of food from a Swedish as well as from an EU perspective. She is the vice chair in the Committee on Agriculture and Rural Development at the European Parliament.

MSc Agriculture Elisabeth Gauffin runs a dairy farm together with her family 70 km north of Stockholm. Their farm, in collaboration with seven other farms, markets their dairy products in the Stockholm area under their own brand. She is the chairman of KRAV, the Swedish member organization of IFOAM, the International Federation of Organic Agriculture Movements, and she has been vice chairman of Federation of Swedish Farmers (LRF) and a member of the board of Arla FoodsAmba. She is also a Fellow of the Royal Swedish Academy of Agriculture and Forestry.

Global Outlook – session 3, 30th January 2013

Dr. Björn Lundgren, moderator, has a broad international experience, especially from Africa, but also from Asia, Central America and the Caribbean. Among others he is Founder Member and Member Governing Council of the African Forest Forum and was a member of the Board of the African Forest Research Network (AFORNET), Kenya. He has been Director General of the International Centre for Research in Agroforestry (ICRAF) Nairobi and director for the International Foundation for Science (IFS) in Stockholm. He is also an Honorary Fellow of the Royal Swedish Academy of Agriculture and Forestry.

Professor Sten Nilsson has had a distinguished academic career in forest sector analysis with emphasis on policy analysis. He joined the International Institute for Applied Systems Analysis (IIASA) in 1986, where he was Deputy respectively Acting Director between 2002 and 2009. He is a Fellow of, among others, the Royal Swedish Academy of Agriculture and Forestry, and has held a number of consultancies in industry, governments and organisations such as the World Bank, FAO, OECD, European Commission and SIDA.

Professor August Temu is Deputy Director General for Partnership and Impact at the World Agroforestry Centre (ICRAF). Earlier he served as Dean of the Faculty of Forestry and Nature conservation at Sokoine University in Tanzania. He has written extensively on forestry, agriculture and natural resources education and research. He established and was the first Executive Secretary of The African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE). In 2000 he was admitted as a Fellow of the Royal Swedish Academy of Agriculture and Forestry.

Professor Jintao Xu is a professor of natural resource economics at the College of Environmental Sciences and Engineering, Peking University. Currently his research focuses on surveys and analyses of forest tenure and regulatory reform in rural China. He has been active in policy dialogue and consultation in China's forest and environmental sectors. He is the leader of the Environmental Economics Program in China (EEPC), where he is building capacity to conduct rigorous economic analysis into China's environmental and natural resource policies.

Professor Jan-Erik Nylund has an MSc in Forestry from Helsinki University and a PhD from Uppsala University. He is teaching Forest Policy in the Masters' programme Forest Industrial Economics at the Swedish University of Agricultural Sciences. He has sandwiched academic work with long term overseas assignments since the 1970s. During the last decade, he has been focusing on social consequences of large-scale pulp ventures in South America, particularly Brazil, but also on forest legislation, land right issues and related conflicts in Sweden.

Global Outlook – session 4, 30th January 2013

MSc Physical Geography Johan L. Kuylenstierna, moderator, is Executive Director for SEI and Adjunct Professor in international water resources issues at Stockholm University. He has held positions within the UN system in Rome, Geneva and New York, focusing on water and climate change issues. Mr. Kuylenstierna has also worked as a consultant for many years with a focus on environmental management, corporate social responsibility (CSR) and communication. Mr. Kuylenstierna is a Fellow of the Royal Swedish Academy of Agriculture and Forestry.

H.E., Dr. Jacques Diouf, Director-General of FAO 1994–2011, has played a decisive role in raising awareness among world leaders about the need for peace and freedom from hunger. Dr. Diouf has tirelessly insisted on the necessity for investments in agriculture as the path to food security and economic growth. After an illustrious career, including 18 year as head of the Food and Agriculture Organization of the United Nations, Dr. Diouf has been appointed Minister and Personal Adviser of the President of the Republic, Senegal, and he is an Honorary Fellow of the Royal Swedish Academy of Agriculture and Forestry.

Dr. Paul Alan Cox is Director of the Institute of Ethnomedicine in Wyoming. He was the first H.M. Carl XVI Gustaf Professor of Environmental Biology in 1997–1998, jointly hosted by the Swedish University of Agricultural Sciences and Uppsala University. As an ethnobotanist, he seeks to explore the cornucopia of nature in search for new medicines, materials, and designs that can lead towards a sustainable society. Dr. Cox is a Fellow of the Royal Swedish Academy of Agriculture and Forestry since more than a decade.

Dr. Susan Baker is Professor of Environmental Social Science at the Cardiff School of Social Sciences and Lead Academic at the Sustainable Places Institute, Cardiff University, Wales. She is deeply interested in the governance requirements for the promotion of sustainable development, especially in the context of global environmental change. She has recently been working on ecological restoration, including the use of restoration initiatives for improvements in ecological integrity (Borneo) and for the provision of food security (Turks and Caicos Islands). Professor Susan Baker was the first woman to receive the prestigious H.M. Carl XIV Gustaf Professorship in Environmental Science and spent 2002–2003 at Umeå University. Dr. Baker is also a Fellow of the Royal Swedish Academy of Agriculture and Forestry.

Utgivna nummer av Kungl. Skogs- och Lantbruksakademiens TIDSKRIFT (KSLAT)

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Nr 4 Return to Eden – future paths to sustainable, natural resources management
Nr 5 Landet utanför – landskapsestetikens betydelse för den urbana människan

2010

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Nr 2 Kungl. Skogs- och Lantbruksakademiens verksamhetsberättelse 2009
Nr 3 Vindkraft, javisst! Men inte alltid och inte överallt
Nr 4 Skogsbrukets bidrag till ett bättre klimat
Nr 5 Internationell skogspolicy – en översikt
Nr 6 International forest policy – an overview

2011

Nr 1 Food security and the futures of farms: 2020 and toward 2050
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Nr 4 The global need for food, fibre and fuel
Nr 5 Hästen i centrum – hästens roll och möjligheter som samhällsresurs
Nr 6 Jorden vi ärvde – den svenska åkermarken i ett hållbarhetsperspektiv
Nr 7 Export av skogligt kunnande från Finland och Sverige
Nr 8 Dags att utvärdera den svenska modellen för brukande av skog

2013

Nr 1 Säl, skarv och fiske – om sälars och skarvars inverkan på fiskbestånden i Östersjön*
Nr 2 Kungl. Skogs- och Lantbruksakademiens verksamhetsberättelse 2012
Nr 3 Framtidsprojektet. Ett tankeexperiment om naturresursbruket 2063
Nr 4 Matens kvaliteter
Nr 5 Global Outlook – Future competition for land and water

With an expected world population of 9 billion people in 2050, the global need for Food, Feed, Fibre and Fuel has become a matter of high political concern. In order to satisfy the ever increasing needs of "the four Fs", there will be a progressively severe competition for limited land and water resources. The international Global Outlook Symposium held in Stockholm 29–30 January 2013 aimed to highlight this from four different perspectives:

1. Agricultural policies over the past 40 years – three cases;
2. Opportunities and challenges for farmers, researchers and business in the agricultural sector;
3. Opportunities and challenges in the forestry sector; and
4. From knowing to acting – paths to a sustainable future.

The Symposium attracted some of the world's most wellknown experts in these fields as speakers. This is a documentation of their speeches during the Symposium, which was arranged as a part of the 200 year celebration of the Royal Swedish Academy of Agriculture and Forestry.

1813–2013

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