



1813–2013

*The role of the Royal Swedish Academy of Agriculture and Forestry is, with the support of science and practical experience, to promote agriculture and forestry and related activities, for the benefit of society. The Academy was founded in 1811 at the initiative of Karl XIV Johan and started its work on 28 January 1813.*

## The Academy's 200<sup>th</sup> Commemorative Meeting

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### **Food, scarcity and abundance**

Louise Fresco .....2



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## Louise Fresco – ‘*Food, scarcity and abundance*’

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### **The 200<sup>th</sup> Commemorative Meeting of the Royal Swedish Academy of Agriculture and Forestry on 28 January 2013**

*Your Majesties*

*Ladies and Gentlemen*

It is a great honor 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 unraveling of the centers 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 innovation has changed to 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 laborer. 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 liberated gradually 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 world-wide 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 widespread 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 doubts today 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 laborers 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 is the lack of belief in human learning that separates today 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 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 labor 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 as 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 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*

Watch Professor Louise Fresco's TED talk on  
[http://www.ted.com/index.php/talks/louise\\_fresco\\_on\\_feeding\\_the\\_whole\\_world.html](http://www.ted.com/index.php/talks/louise_fresco_on_feeding_the_whole_world.html)