

RECOMMENDATION REPORT

FOOD FOR ALL FOREVER



THE DANISH ACADEMY OF TECHNICAL SCIENCES,
COPENHAGEN, SEPTEMBER 2010



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SUSTAINABLE FOOD SYSTEMS – FOOD FOR ALL FOREVER:**

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Design & production: Westring + Welling A/S

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ISBN: 978-87-7836-059-5



PREFACE

It's actually very simple - there is no simple solution to sustainably feed 9 billion people.

The world is facing a major challenge: Match the fast changing demand for food from a larger and more wealthy population; do so in ways that are environmentally, economically and socially sustainable; and ensure that the world's poorest people are no longer hungry. Such a challenge requires changes and new solutions in the way in which food is produced, stored, processed and distributed but also reformed policies. The right technological solutions and massive investments in research combined with the right policy directions are in ATV's opinion the key to success.

These themes were analysed and discussed at a conference held in Copenhagen by CAETS (the Council of Academies of Engineering and Technological Sciences) in June 2010 which was hosted by the Danish Academy of Technical Sciences (ATV). Here, ATV facilitated an open debate, a free exchange of ideas and a discussion of new, future-oriented solutions.

As part of the CAETS working method, a brief statement with recommendations was issued shortly after the conference. It is available for download at the CAETS homepage (www.caets.org.)

ATV decided to publish its own in-depth report building among other sources on the CAETS statement with the clear purpose of facilitating the continuation of the debate about this important topic and to find solutions to the forthcoming challenges.

This report, which is based on the discussions at and the outcome of the ATV conference 'Sustainable food systems - Food for all forever', summarises the most up-to-date knowledge about our food system and the challenge ahead. Our joint challenge on the conference was to identify the real problems and the effective answers which, at the same time, will increase food production, reduce poverty, hunger and over-exploitation of natural resources.

The conclusions and views presented in this report are those of ATV and can in no way be attributed to the speakers or participants at the

conference; they are not conference proceedings. This report expresses the views of ATV based upon input from the conference. The writing team has, in addition to presentations and speeches at the conference, drawn upon recent publications in scientific literature as well as insight from the committee members to create this report.

While no single conference can transform our society, ATV hereby passes on our recommendations and findings to international and national policy makers, food stakeholders from international organisations, industry and agriculture to scientists, economists, engineers and humanities scholars. ATV will use our voice to tell food stakeholders, policy makers and world leaders why it is important to ensure food for all forever and what ATV will do to achieve the goal.

ATV would very much like to thank the organising committee for its huge contribution throughout the entire process, including both conference and report. The lecturers at the conference as well as the writing team have all been valuable assets for the outcome of this recommendation report. We would also like to thank all the participants at the conference for providing the discussions with questions and input and for enthusiastic participation in the interactive question-and-answer sessions.

We owe special thanks to Karl Pedersen and Wife's Industrial Fund and The Carlsberg Bequest to the Memory of Brewer JC Jacobsen for economic support and without whom this project would not have been possible. The Danish Ministry of Foreign Affairs and the Technical University of Denmark supported the project with full in-kind sponsorships and for that we are most grateful.

Finally, we would like to thank Danish Minister for Development Cooperation H.E. Søren Pind, and former EU Commissioner for Agriculture and Rural Development, Mariann Fischer Boel, for opening the conference with words of reality, concern as well as optimism.

Lasse Skovby Rasmussen, managing director of the Danish Academy of Technical Sciences



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INTRODUCTION

Food security, climate changes, efficient supply chains, policy reforms and research – these topics are all entangled.

In our high-tech, globalised world it is easy to forget that mankind still suffers from basic problems such as hunger and malnutrition. The truth is that possibly as many as 1 billion out of the 6.8 billion people on Earth today either have too little to eat or live under conditions where hunger is an imminent threat.

At the same time, in wealthier parts of the world, much food is produced but never eaten due to problems in the distribution chain or because large amounts of excess food are simply thrown away.

Damage to the environment caused by intensive, non-sustainable agriculture is a problem that rich and poor countries share. On top of this, the food sector economy is characterised by subsidies, trade barriers and export restrictions.

Bearing these facts in mind, it can seem an impossible task to feed the ever-increasing number of people on our planet. Forecasts show that by 2050 9 billion people will inhabit this earth and all of us will need sufficient food every day.

Can the world actually produce enough food, have it available in the right place at the right time and make sure that no one has to go to bed hungry? Can it be achieved without causing damage to the environment? How can it be done without disrupting the economy by short-sighted solutions such as subsidised prices and levies?

The purpose of this report is to provide, for a broad range of stakeholders, some options available for society to respond to the challenge of feeding 9 billion people in a sustainable manner.

The problems are serious and the challenges difficult. Nevertheless, the report is optimistic. The problems can be solved and the challenges overcome. However, there is no single agreement or technological “silver bullet” that will quickly and painlessly transform our global food system into a sustainable and equal global food system.

It requires continued efforts to identify technological solutions to some of the problems, targeted and massive investment in research, and political will to act when it comes to solve structural and political issues such as trade barriers, infrastructure problems and allocation of financial means.

With only five years left until the 2015 deadline to achieve the Millennium Development Goals, UN Secretary-General Ban Ki-moon called on world leaders to attend a summit in New York on 20-22 September 2010 to accelerate progress towards the Millennium Development Goals. The meeting offered a unique and timely opportunity to start such a transformative journey towards a sustainable food system. There is no single solution to obtain the goals of this ATV-recommendation report but they call for united actions to enable food for all in 2050 and beyond.

The organising committee members all support the recommendations presented in this report. We are all hoping that if society is successful in meeting the suggested recommendations, a sustainable food system is within reach.

Michael Stevns, Executive Director, Danish Agriculture and Food Council, Chairman of the ATV organising committee



Future politics must be guided by science

- Michael Stevns, Executive Director.





One-size-fits-all strategies don't work. The main successes have been country driven

- Shenggen Fan, Director General, International Food Policy Research Institute



There is no credible evidence for saying that we need to double food production by 2050. An increase of 60-70 % or less than 1.5 % annually over the next 40 years is a more likely scenario.

That is doable without damaging natural resources

- Per Pinstrup-Andersen, Professor, Cornell University

POLICY BRIEF – WHY THIS TOPIC CONCERNS ATV

It is estimated that the world population in 2050 will amount to 9 billion people. Possible solutions as to how we can meet the increasing demand for food were discussed at the conference 'Sustainable food systems – Food for all forever' hosted by the Danish Academy of Technical Sciences (ATV). The urgent need for more food must be satisfied in a sustainable way both socially, economically and environmentally. This calls for corporation at a global level and integration of the newest technologies within the field of food production.

Feeding the world is now recognised as one of the key issues for the next decades. Society will have to rise to the challenges of the next 40 years.

The increase in world food prices in 2008 and the increasing number of people lacking sufficient food have been met with a sense of urgency leading to a number of international high level commitments focused on food security.

Nevertheless, the number of people being hungry is now rising instead of falling affecting an estimated 1.02 billion people, the highest number since 1970. The steep increase in the number of hungry people in 2006 –09 highlights the devastating effect that higher food prices and an economic crisis can have on the world's poorest people.

Increasing demands for food, fresh water, timber and fuel are rapidly altering ecosystems – in many places leading to irreversible losses of biodiversity. An estimated 14% of greenhouse gas emissions stem from food production. Cutting down forest and draining wetland in order to be able to grow more food would be only a short-term solution as the effect would lead to drastic increases in greenhouse gas emissions which would in turn have a detrimental effect on food production. Many staple crops are not tolerant to large temperature rises and climate changes are expected to worsen water shortages which will also cause serious problems for producers worldwide. Therefore, sustainable management of natural resources must be a major factor as to the question of securing food for an ever increasing number of people.

How do we increase food production in this context? The answer calls for increased productivity in agriculture and better management of resources that are becoming ever scarcer. Society will have to implement interventions in order to obtain increasing yields in food production and raising efficiency in energy production and utilization.

Agriculture has returned to the centre of international policy debates. Years of declining investments, inadequate extension services and the availability of subsidised food exports from the developed world have undermined agricultural production in many developing countries.



Society needs to go beyond commitments and identify new policy directions. There is a need for a global partnership and for greater coherence at international level.

Reform of the agricultural support systems in the developed world is essential. It is important that there will be a continuous effort to push for reforms of the agricultural policy both at national, European and international levels.

Right now the international society does not know how to fully succeed in meeting the goal of assuring food security and ensuring long-term sustainable use of the natural resources upon which we all depend. This way of thinking about food for all and long-term sustainable use of the natural resources is new – but it is the right way forward. Thoughts need to be explored and actions taken before it is too late.

International research indicates that efforts to assure food security for all need not be at the expense of the environment. That is a good start. The ambition is that the plausible talk of a “multiple win” is within reach if the international society is able to work together and stop thinking in ways such as ‘business as usual’ and choosing weapons depending on the given challenge.

Overall, ATV believes that the right policy directions and massive investments in research combined with the right technological solutions are the key to success as to assuring food security. Also, we need to ensure long-term, sustainable use of the natural resources upon which we all depend. For all these reasons, “Food for all forever” can be a powerful tool for achieving the Millennium Development Goals, particularly those related to poverty reduction and environment.

Key recommendations identified by ATV are listed in the following.



We need to go beyond commitment; we need to go for reform

- Soren Pind, Danish Minister for Development Cooperation



Protectionism has appeal to some people but, in the long run, it is leading to a dead end

- Mariann Fischer Boel, former EU commissioner for Agriculture and Rural Development.



RECOMMENDATIONS

The following recommendations are the results of the work and analysis of ATV.

Some aspects of ATV's recommendations have already been successfully implemented locally but they need to be scaled up and extended globally to obtain a real impact on assuring a sustainable food system.

1. USE APPROPRIATE TECHNOLOGY AND OPPORTUNITIES OFFERED BY SCIENCE

Full advantage should be obtained from emerging technologies. By increasing the use of the most appropriate and smartest technology in the given situation together with the newest opportunities offered by science, the productivity of the food sector can be improved dramatically. In order to harvest the potential of increased productivity, it is necessary to invest massively in rural education.

Through technological development and research targeted at increasing yields and reducing production risks, the farmers of the developed countries have reached a very high level of knowledge. An essential prerequisite for this is investment in targeted education, both towards to agricultural and general knowledge to enhance the educational level.

If the developing countries are to gain the same benefits in the future – and this is essential in order to solve the residing hunger problem – they must not necessarily undergo a development similar to that which has taken place in their richer counterparts. Instead they may undergo a smarter development process taking into account the experience and lessons learned. By increasing the use of technology and through continued technological development compatible with sustainable management of natural resources, the productivity of the food system can be improved.

All technologies should be made available to those who need them at prices which allow for a free choice among different options. The entire range of different technologies should be taken into account in order to find the best suited technology to any given challenge. This includes new technologies such as GMO and other areas of biotechnology as well as agro-ecological methods.

Continued emphasis on technology is also critical for the developed countries. The agricultural and food industry in developed countries is already a high-tech business and investment in this field must continue in order to provide results. The developed countries have a particular responsibility in developing efficient methods and technologies for agriculture that are sustainable. These methods should be developed in close collaboration with institutions in developing countries where the focus should be on the development of solutions to smallholders' problems.

Some of the needed technology already exists or is in the process of being developed or refined. The real challenge is to convince decision-makers that the technology gap between developed and developing countries must be closed or at least narrowed if the hunger issue is to be solved. This again points in the direction of new policies such as research and technology transfer.

The technology used in agriculture and food processing is knowledge intensive. Massive investment in education in rural areas is needed to harvest the full potential of agriculture and induce growth in the developing countries. This will enhance productivity in agriculture, ease adoption of new technologies, improve extension services and pave the way for labour intensive high-value activities. Education can substantially enhance the multiplier effect of growth in the food system, thus inducing growth several times bigger than the original cost of education.

2. MASSIVE INVESTMENTS IN INFRASTRUCTURE IN RURAL AREAS TO BE MADE

Governments must increase investments in roads, distribution systems, potable water, electricity, information and communication technologies, storage and post-harvest technologies, and ensure that appropriate standards and regulations are in place and enforced.

Infrastructure is a means towards ensuring the delivery of goods and services that promote productivity and growth. This will in the end contribute to increased quality of life and, therefore, plays a vital role in economic and social development.

In many developing countries, rural areas lack facilities and infrastructure. This means that local farmers have no real 'market' access – not even in their own region, and they become trapped in a situation where they only produce food for their own families. At the same time, there is an unfulfilled potential for food production because there is no incentive to produce more with no possibility of selling the products.

The demand for infrastructure is set to continuously expand significantly in the decades ahead, driven by major factors of change such as global economic growth, technological progress, climate change, urbanisation and growing congestion.

However, part of the food supply problem in the third world is connected with lack of proper storage conditions or knowledge of how to store food correctly which also requires infrastructure. With better infrastructure, life in the rural areas also becomes easier. Alternatives to farming such as different forms of handicrafts becomes possible and would generate employment and alternative income possibilities which again would slow down the flow of people who seek a better future in the cities.

The challenges facing governments are diverse and complex. In order to meet these challenges, governments will need to complement the search for fresh sources of capital. Infrastructure investments are expensive in the short term and political action on several levels is needed. Local governments must use their scarce resources on these investments rather than spending the money on subsidising food and other short-sighted policies. The donor countries should increase their spending on extensive reliable infrastructure projects and demand clear commitment to this strategy from the local governments in the third world.

3. IMPLEMENTATION OF BETTER POLICIES THAT PREVENT DISTORTIONS IN TRADE AND COMPETITION

The world's agricultural trading system is stuck in the past. If there ever was a time to cut distorting agricultural subsidies and open markets for more free food imports/exports, it must be now. Price controls and export taxes could discourage the necessary additional investment in agricultural production; this must be stopped.

The agricultural sector holds a special position. Even liberal countries tend to protect their own farmers through subsidies and levies on 'unwanted' products from competitors in other parts of the world - both from the industrialised and developed countries as well as in the less wealthy and developing countries. It is absolutely essential to create better policies that prevent trade distortion activities for food products.

Targeted and time specific import restrictions in support of emerging industries and productions in developing countries can, however, be justified provided they are part and parcel of well defined and economic viable agricultural and industrial development strategies.

Reducing import restrictions for example in the EU and other developed nations would help create clear incentives for developing country agriculture and food production.

Abolition of for example US-subsidies, free trade over borders and a world market with a genuine market mechanism are the essential tools to achieve the goal of 'Food for all forever', but this cannot stand alone as some of the problems are local rather than global.

Government spending on agricultural research in developing countries has declined. Instead of research, the bulk of public farm spending has often been used on purchasing social peace or electoral support by ensuring low prices for food or agricultural inputs like seeds and fertiliser. Continued high output prices could help many developing country farmers, who are net buyers of food, to become net sellers. Small scale farmers could ultimately even drive up wages for landless labour forces and boost demand for rural goods and services which would generate employment. To help this happen, however, there would need to be greater investments in farmers' associations and rural infrastructure as well as better price transmission mechanisms to ensure that farmers actually feel the higher prices in their own pockets.

Emphasis must also be put on export bans at national level and on the impact and consequences these cause. A situation in which there is uncertainty about whether there is enough grain or not will easily create a situation in which investors get on the move. They will make futures deals based on money speculation in future prices on crops and this may have an effect of raising world market prices higher than they would otherwise have risen. The use of speculative futures must be limited.

Moving towards a market that prevents distortions in trade and competition for food products is not an easy journey but it is vital for achieving the objective of supplying all with food and it inspires farmers to develop their trade. We all have an interest in keeping the most talented farmers in business!

4. GOVERNMENTS AND INTERNATIONAL INSTITUTIONS MUST LIVE UP TO THEIR RESPONSIBILITIES

It is the duty of national governments to provide the public with means to boost income and more importantly: feed its own people. Emphasis must also be put on the responsibilities of international organisations and their cooperation with national governments.

The governance challenge as far as food security is concerned is to persuade sovereign governments to provide the necessary public goods that would ensure access to adequate food. Nevertheless, many national governments in developing countries still do not provide essential public goods such as civil peace, rule of law, transport infrastructure, clean water, electrical power and public research to generate new agricultural productivity - essential ingredients in the effort to boost income.

'Good governance' is a key word in the collaboration between donor countries, international organisations and developing countries when it comes to aid programmes. But a new and wider definition of 'good governance' is needed and should be introduced.

It is absolutely vital that private property is respected. Only when farmers can feel confident that no one will nationalise or even steal their land, will they be willing



to consider long-term strategies such as incorporating new technology and machinery in the production process.

A new definition and introduction of good governance should also put emphasis on a better use of resources by the developing countries' governments when it comes to infrastructure and subsidies. One of the most harmful things for the food production in the poorer countries is that many products are subsidised in order to keep prices low. If the money spent for this purpose was instead channelled into investments in rural areas, more people would benefit in the long run.

It is quite obvious that it will be a controversial policy to follow for many governments but, nevertheless, it is one of the most essential reforms to introduce if the world's food system shall change to the better for the people in developing countries.

Many international organisations exercise influence on food and agricultural sectors; therefore, they must also live up to their entrusted responsibilities.

The 'bottom billion' population are probably the most vulnerable to climate changes and also suffer the most from hunger. Introducing 'good governance' is necessary for envisioning a brighter future for the citizens in these countries. Decisive action and targeted interventions are needed if these countries ever are to break out of the poverty trap.

5. FOOD WASTE MUST BE REDUCED DRAMATICALLY

Eliminating the millions of tons of food thrown away annually in the developed world could lift many people out of hunger worldwide if trade and infrastructure at the same time make it possible to distribute effectively. If we could also save the massive amounts of crops that are neither harvested nor reaching the consumers in the developing world, an even larger influence on battling hunger could be made in the long term. Tackling food waste should be added to the toolbox of policy options to ensure a sustainable food system.

In **developing countries** most waste occurs at stages prior to the retail stages. Investment in transport infrastructure and by aiming for better-functioning markets would reduce the risk of spoilage and could reduce waste, for example by allowing the introduction of cold storage (though this has implications for greenhouse gas emissions).

In developing countries, much of the food consumed is fresh but only a very small part of that food is refrigerated. As a result, high losses occur following harvest, slaughter, fishing and milking during transportation and at markets. Adequate storage is a condition for both efficient marketing by the private sector and for holding public reserves that may be necessary to guarantee food security. Increased access to refrigerated storage and effective distribution systems in developing countries could be significant in reducing post-harvest losses, improving food safety and adding value to agricultural food products. For this to be achieved, important issues related to management of the facilities will have to be addressed. Since cold storage facilities are highly energy-consuming, it is recommended that the implementation is made based on alternative energy sources such as sun or wind energy.

The developing countries are much more influenced by pre-harvest losses than the developed world. Pests and insects can have a gruesome effect on the yield and this calls for alternative agricultural methods. One possibility is to use pesticides although this is known to have unfortunate implications on the environment. Another and more sustainable method could be to introduce endogenously resistant crops as well as cross cultivation of crops.

In **developed countries** food waste is a problem in many parts of the supply chain but the largest amount of waste can be found at the retailers and the end-consumers. These two groups must be addressed with information.

Packaging protects food from damage during its transportation from farms and factories via warehouses to retailing and preserves its freshness upon arrival. Efficient packaging cannot per definition be bio-degradable if it is to serve a proper level of protection from the surroundings. Although it impedes considerable food waste, packaging will by itself always remain a waste product and, therefore, solutions to use less packaging while maintaining the protection should be sought.

Much good, eatable food is thrown away only because consumers perceive it as too old to eat. If food waste is to be reduced dramatically, the consumers are the most important players in this respect.

It is therefore recommendable to include both retailers and consumers in an effort to have common standards for labelling; standards are needed which are much clearer than today and which give a fair picture of the freshness of food products. The consumer needs to be better educated about proper storage of foods to keep them for longer. Consumers also need information about the proper shelf

life of products so that they are able to plan meals more carefully and end up with less spoilt food at the end of the week. There is a need to improve the way in which food is labelled.

Excessive consumption of food in rich countries inflates food prices in the developing world. Buying food, which is then often wasted, reduces overall supply and pushes up the price on food. Food waste must be reduced dramatically in all countries and in all stages of the supply chain from farm to fork.

6. AQUACULTURE HOLDS GREAT POTENTIAL AND SHOULD BE DEVELOPED

Fishing from the oceans' own resources is expected to decrease and, therefore, marine aquaculture could play a large role in feeding humanity in the coming decades. Mankind will also benefit greatly from algae and seaweed from aquacultures which can be a source of both human food products and animal feed.

There are numerous possibilities for incorporating aquaculture in the food production system to a much higher degree than today. The food that comes from sea farming is nutritious and already popular with consumers. Even new products such as sea weed are perceived positively due to the general interest in sushi and other seafood products.

The oceans' own resources are limited due to overfishing and lack of appropriate government policies and regulations. Marine fishery is therefore most likely to decrease. The so-called 'sea farms' and algae farms hold great potential and can become an important part of the solution of the world's food supply problems.

More plants and animals low in the food chain must be cultivated, including more plankton and algae. In addition, sea algae is a considerable source of nutrition well-suited for feed in the livestock industry and, thereby, preventing precious crops, vegetables and more to be consumed by livestock when humans could just as well benefit from it.

Growing marine plants, including algae, as a basis for fodder for farmed sea fish and for bio-fuel production could be done on the basis of nutrients from waste, effluents and other coastal pollution which offer a significant environmental benefit. New technology will also help, by allowing marine aquaculture operations to be expanded into more exposed, offshore locations.

The continued development of aquaculture must be done in an environmentally balanced way. This calls for regulation as to which areas are suitable for this purpose. There will also be a need for further development of multi product aquaculture which includes both fish and sea weed.

7. FURTHER STUDIES INTO THE CONCEPT OF 'FULL COSTING' SHOULD BE MADE

The 'full costing' concept should be introduced as a 'polluter pays' principle where all costs, including environmental, are reflected in the price of a product. It should be analysed how the balance between regulation and incentive should be made.

'Full costing' essentially means that the price on food (or other products) should include all costs related to the product; this encompasses the damage to the environment and the use of natural resources that need to be replaced (for

example by tree-planting projects as a replacement for deforestation). The concept is similar to the 'polluter pays'-principle which is well-known and has been implemented in many countries. At the same time, ecological services and environmental improvements should be deducted from the price of the product.

In principle, full costing should cover the whole supply chain from the field to the dinner table.

Full costing is a principle of intergenerational fairness and sustainability and it will potentially make products that are harmful to nature more expensive; this will be a strong incentive to choose other production methods or even other products. In addition to regulations, full costing is the most viable means by which sustainability can be achieved in the food system.

An important aspect is whether emphasis should be put on regulations 'sticks' or incentives 'carrots'; should farmers for instance be paid for not cutting down trees ('carrot') or should they be fined after having cut down the trees (the 'stick')? This issue depends on how the concept of full costing will be administered. Some models incorporate a tax scheme which might be controversial and difficult to manage across borders.

Full costing might not be easy to implement but the concept holds so many possible advantages that it deserves further analysis. A successful full costing scheme would effectively change consumer behaviour and influence the agriculture and food production sector to become more responsible and sustainable.



FACTS AND THEMES FROM THE SOLUTION SESSIONS

This chapter is based on the three main topics from the Sustainable Food Systems conference in Copenhagen in June 2010:

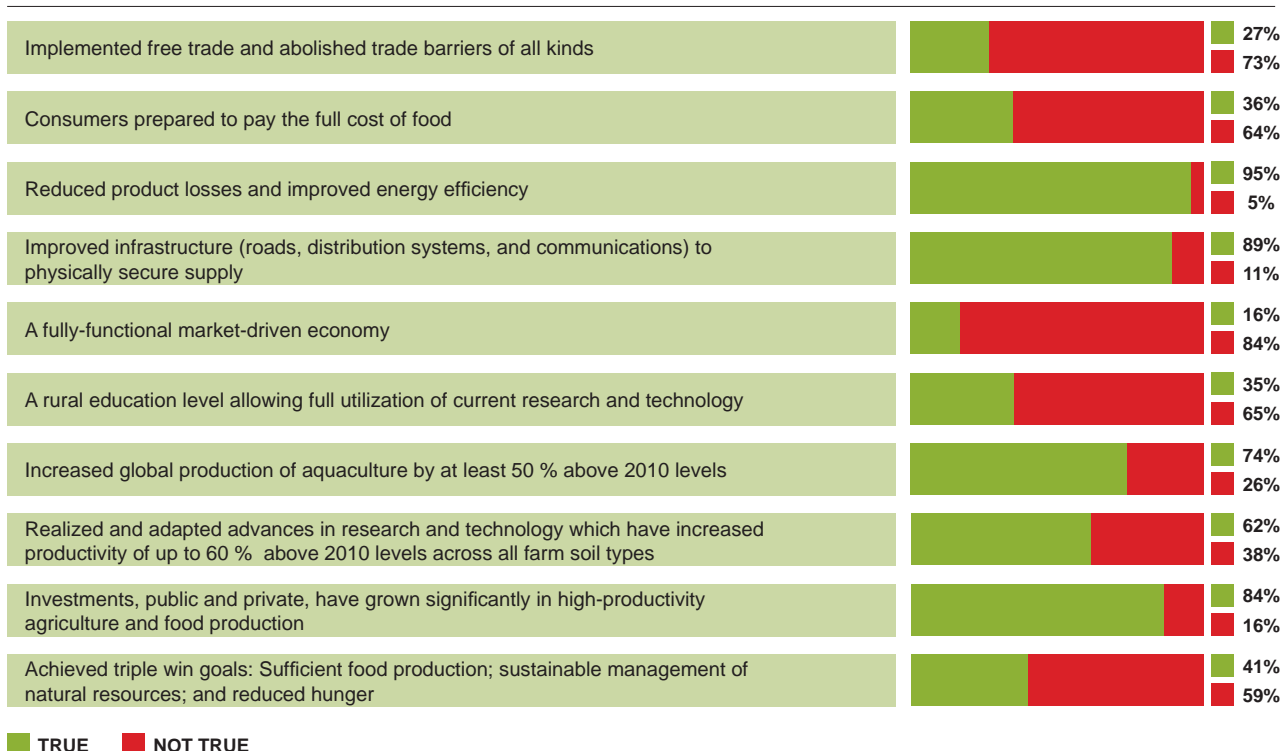
- Reforming the food production system,
- Rethinking the processing and supply chain,
- Moving towards economic incentives and full costing

The findings and discussions are based on the 11 plenary talks given at the conference, each within a specific area needed to get a full image of the challenges as well as solution possibilities when it comes to feeding 9 billion people in 2050. The names of the plenary speakers can be found on the inside cover of this volume. Themes covered in the conference that did not result in a direct recommendation are also discussed here since we cannot afford to exclude any aspects of how to achieve our goal: Food for all – forever.

In the following, it becomes clearer than ever how the increasing demand for food is interlinked with challenges such as poor utilisation of the otherwise high yields, water and energy scarcity, soil degradation and climate changes. The problem is lack of political will rather than lack of productive capacity on this planet.

All 100 conference participants were initially asked to make predictions on the future. Did they realistically believe the changes suggested below would come true by 2050 or not? At the end of the conference, the same questions were asked and the participants indicated when they believed the suggested changes would have been implanted. These final votings are displayed in the following text where fitted.

IN 2050, IN MOST COUNTRIES IN ORDER TO ENSURE FOOD FOR ALL, WE WILL HAVE:



REFORMING
THE FOOD
PRODUCTION
SYSTEM →



We are going to increase our food production because we have the best tropical technology, land availability and we have fantastic farmers

- Roberto Rodrigues, Coordinator, GV Agro, Brazil

TECHNOLOGICAL DEVELOPMENT AND SCIENTIFIC PROGRESS

Technology and the use of scientific results are important factors when it comes to improving the world's food supply systems. This is particularly the case when it comes to production methods; in the developing countries some of the supply problems can be solved through the introduction of new methods to increase the yield or transform new areas into farmland.

The term 'technology' must be understood in its broadest meaning and includes for example:

- Transition from manual labour to mechanised farming
- Developing and understanding new methods for increasing yields and reducing risks
- Transforming new land into farm land by means of modern technology
- Product development
- New technologies such as GMO and other areas of biotechnology as well as agro-ecological methods

New technologies and methods should not automatically be dismissed. Investments are required in research and development (R&D) to upgrade traditional small-scale processing technologies.

Using genetically modified organisms (GMO) is one way to achieve further progress. Modern genetic techniques and better understanding of crop physiology are efficient tools to increase yields in both developed and developing countries.

It is evident that much of the technology needed already exists but there are still plenty of areas that can be researched by the agricultural sector to continue its search for improvements in efficient farming, new production methods, application of scientific results into everyday agricultural production etc.

Brazil has managed to increase its agricultural productivity massively by strategically educating farmers and using modern technology (see case story on the opposite page).



Solutions to achieve an environmental-friendly food production are available by means of increased utilisation of technologies already developed; however, continued improvements and applications of new technologies might help to reach the goal

- Klaus Bock, Professor, President of CAETS and Chairman of ATV





CASE STORY:

BRAZIL DEMONSTRATES HOW TO INCREASE FOOD PRODUCTION

In the 1960's, Brazil was in many ways a backward country when it came to agriculture; the country struggled to feed its own population and coffee beans were by far the most important product and made up 70 per cent of Brazil's export. Today, that figure is only 6 per cent and Brazil is an important net exporter of a vast variety of food products. Brazil has established itself as a world leader in tropical agriculture.

There are three main reasons for this:

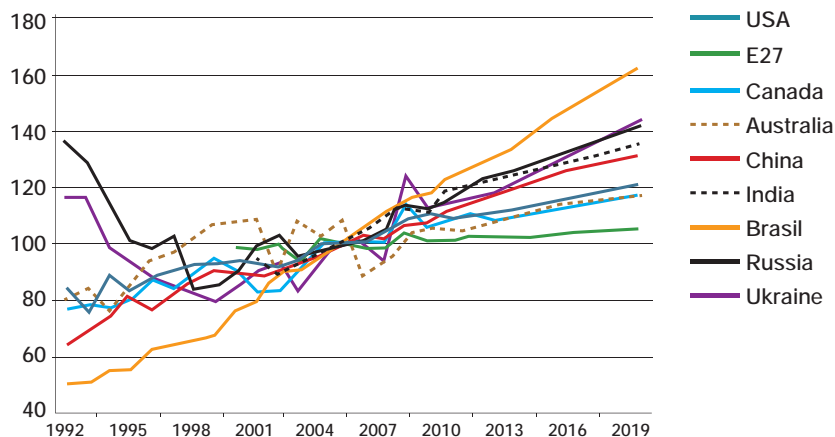
First, a clear strategy focused on creating synergies between scientific and technological knowledge. The use of technology has increased the farmland specific for grain with 25% while the total grain production in Brazil has increased with 154% from 1990 to date. Brazil has consistently educated farmers on how to use the new technologies and how to increase yields.

Second, Brazil has benefited from an increasingly liberalised world trade. Agricultural business exports have tripled in ten years. This success has helped create a positive interest in continued development of the agricultural sector. For Brazil, globalisation is a success.

Third, and most controversially, the increase in farmland has been achieved partly through deforestation. The Brazilian authorities have become aware of this issue and plan to respond to it by increasing the yields of existing areas rather than a continued rapid expansion of farmland into the rainforest.

Brazil is to this day the fastest growing producer of agricultural products with production estimated to grow by more than 40% from 2010 to 2019. In contrast, over the same period the net outcome in the 27 EU countries is estimated to increase by less than 4% in average.

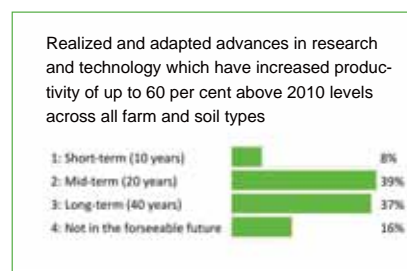
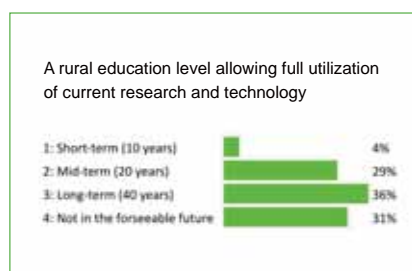
The net agricultural production for selected countries (index 2004-06 = 100). Source: OECD-FAO, Agricultural Outlook 2010-2019



RECOMMENDATION 1

Full advantage should be obtained from emerging technologies. By increasing the use of the most appropriate and smartest technology in the given situation together with the newest opportunities offered by science, the productivity of the food sector can be improved dramatically. In order to harvest the potential of increased productivity, it is necessary to invest massively in rural education.

PREDICTIONS FROM PARTICIPANTS AT THE CONFERENCE

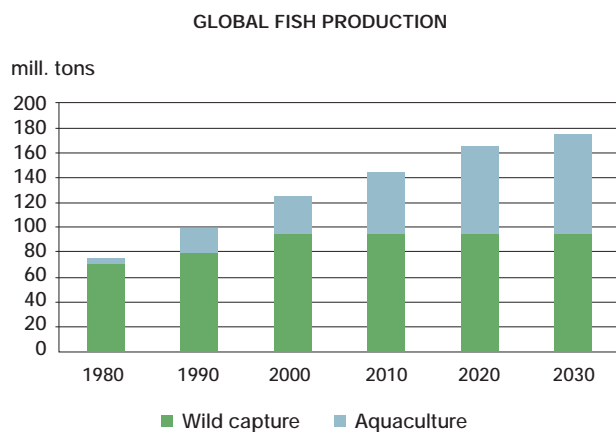




AQUACULTURE AND THE OCEAN'S ROLE AS A FOOD RESOURCE

In 1609, the Dutch founder of international law, Hugo Grotius, boldly announced that “Sea fishing is free for it is impossible to exhaust marine resources”. Unfortunately, we have proven this statement to be false.

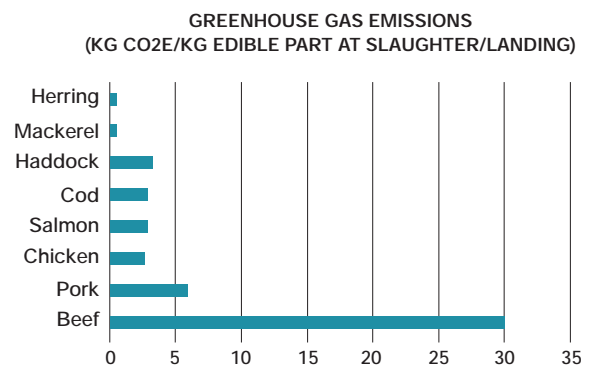
Recent figures show that natural resources of fish and other sea food have suffered immensely from overfishing and modern fishing techniques. In the years to come, fishing as we know it will decline but marine aquaculture can be developed to become an even more important source for food than it is today.



The production of fish by aquaculture must be doubled within the next 30 years if this food source is to keep up with the growing population. Such an increase is possible but the challenge is to do this in a sustainable way; sea farms have a reputation of a negative environmental impact.

A solution can be to replace the present monoculture with polyculture sea farming where the fish feed (for example plankton and algae) itself can be derived from the aquaculture and, thus, form a more natural food chain. It is also a possibility to develop new food products for humans from algae and plankton; sea weed is already a well-known food product and can more importantly be used as energy source in live stock feeds. This will free fields that have previously been used for feed production and enable a higher production of crops for human use.

Fish can replace meat as a protein source at a very low CO₂ cost. For example, the landing of 1 kg of herring or mackerel will only emit 0,5 kg CO₂ as opposed to pork or beef which emits 6 and 30 kg of CO₂ pr kg meat slaughtered respectively. The high levels of green house gas emission as a consequence of live stock farming can therefore be reduced if people are willing to give up their beef for a plate of fish.





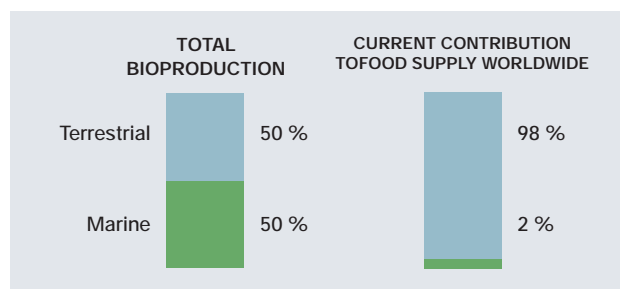
An important aspect is that unsolved pollution problems exist that can limit the potential for marine aquaculture. An increase in desert zones of the oceans and the accumulation of plastic and other garbage in huge waste 'islands' are essentially manmade problems. One of the most extreme cases is the so-called 'Great Garbage Patch', an area larger than France in the Pacific Ocean where plastic waste have accumulated and is a threat to the natural resources.

Aquaculture can help with solving the food problems but it will not solve underlying ecological issues concerning the oceans. Therefore, the limiting factor in aquacultures is the rapidly changing environment and accumulation of pollution originating from all other industries and sources. If the environmental changes are minimised, the marine world holds great potential in the battle for sufficient food production.



The production in the marine environment will play an important role in the future

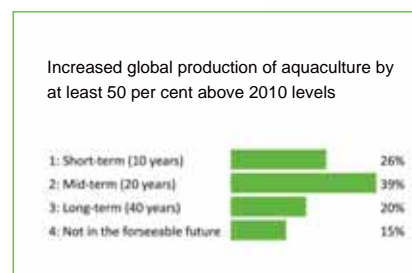
- Karl A. Almås, President, SINTEF Fisheries and Agriculture



RECOMMENDATION 6

Fishing from the oceans' own resources is expected to decrease and, therefore, marine aquaculture could play a large role in feeding humanity in the coming decades. Mankind will also benefit greatly from algae and seaweed from aquacultures which can be a source of both human food products and animal feed.

PREDICTIONS FROM PARTICIPANTS AT THE CONFERENCE





AGRO-ECOLOGICAL METHODS FOR ECO-FUNCTIONAL INTENSIFICATION OF FOOD PRODUCTION

Industrialised agriculture with its dependence on chemical inputs has reached impressive yields per ha and secured food for many over the last decades. However, the costs in terms of pollution, decreasing soil and water quality and reduction in biological diversity have been too high and yield increases are limited now due to, for example, reduced soil fertility and lack of bees for pollination.

In order to achieve food security for all in a sustainable way we need to develop food systems which benefit from synergy with ecosystems and respect and enhance the so-called ecosystem services. Examples of how agriculture depends on ecosystem services are pollination of crops and pest control by beneficial insects; and the capacity of well maintained soils for holding water and nutrients linked to the content of soil organic matter.

Agriculture can be intensified through the improved use of agro-ecological methods using biological and technical knowledge in order to improve the reliance on locally available resources and processes. Examples of this are the management of soil fertility by recycling of organic matter and nutrients from farms, food processors and from society. Planning for increased biological diversity in terms of genetic variation in crops, crop mixtures and agro-forestry at field, farm and landscape levels can improve productivity and resilience in synergy with wild biodiversity and ecosystem services.

Higher agricultural productivity and stability of yields may be achieved by appropriate 'eco-functional intensification'. This means that farming

systems should be 'intensified' by higher input of knowledge, observation skills and management, and improved use of agro-ecological methods. This development may be supported by use of innovative information and communication technologies (ICT) and by automation (sensors, robots) for improved observation and management of crop and livestock health. These modern technologies may also improve for example weed management and harvest or post-harvest processes in mixed cropping systems.

Agro-ecological methods are also part of the basic principles of organic agriculture which has proven to increase yields, income and food security in Africa and other low input regions.

It is therefore important to consider agro-ecological methods as elements in an overall strategy for intensification of food systems based on increased input of biological knowledge and innovative technologies. The goal is to improve soil fertility, nutrient recycling, water utilisation and pest management in synergy with maintenance of biodiversity and ecosystem services. It should be recognized that eco-functional intensification is knowledge intensive and practices need adaptation to local conditions and use of farmers' knowledge. In the development of suitable agro-ecological methods, it is important to link front-line research with local knowledge and needs – the development of the so-called 'vuta sukuma' is a great example on this. It is a system based on intercropping of various crops with different characteristics and roles in the farming system (see case story on the opposite page).

Today, we need to produce in a more sustainable manner in Europe and in the world. For 2050, the challenge is to produce more food (and in a lesser extent non food products coming from agriculture) in a sustainable way regarding the natural resources

- Marion Guillou, President, French National Institute of Agricultural Research





CASE STORY:

COMBATING PESTS WITH AGRO-ECOLOGICAL METHODS

Vuta sukuma – An approach also known as ‘push-pull’ technology for integrated management of stemborers, striga weed and soil fertility. It is based on research into pest and predator behaviour, host reactions, allelopathic effects and their interrelationships and developed in collaboration with farmers. To date over 25,000 smallholder farmers in East Africa have adopted vuta sukuma and maize yields have increased from about 1 t/ha to 3.5 t/ha with minimal inputs. The technology is based on locally available plants, not expensive external inputs, and fits well with traditional mixed cropping systems in Africa.

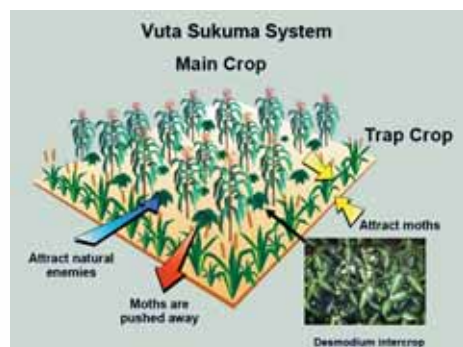
The problem: Stemborer, striga weeds and poor soil fertility are the main constraints to efficient production of cereals in sub-Saharan Africa. Losses caused by stemborers can reach as high as 80% in some areas. Losses attributed to striga weeds range between 30 and 100% in most areas and are often exacerbated by the low soil fertility prevalent in the region. When the two pests occur together, farmers often lose their entire crop. Spraying with pesticides is not only expensive and harmful to the environment, but usually ineffective as the chemicals cannot reach deep inside the plant stems where stemborer larvae reside. Preventing crop losses from stemborers and

striga weeds and improving soil fertility in eastern Africa could increase cereal harvests enough to feed an additional 27 million people in the region.

The solution: The push-pull technology involves intercropping maize with a repellent plant, such as Desmodium, and planting an attractive trap plant, such as Napier grass, as a border crop (see figure below). Stemborer females are repelled or deterred away from the crop (push) by the Desmodium while they are simultaneously attracted (pull) to the trap crop, leaving the crop protected. Desmodium produces root exudates some of which stimulate the germination of striga seeds and others inhibit their growth after germination. This combination results in reduced levels of viable striga seed in the soil. Desmodium is able to exert its striga control effect even when the host crop is out of season, and together with Napier grass protect fragile soils from erosion. It also fixes nitrogen, conserves soil moisture, increases the number and diversity of beneficial insects and improves soil organic matter, thereby enabling cereal cropping systems to be more resilient and adaptable to climate change while providing essential environmental services and making farming systems more robust and sustainable.

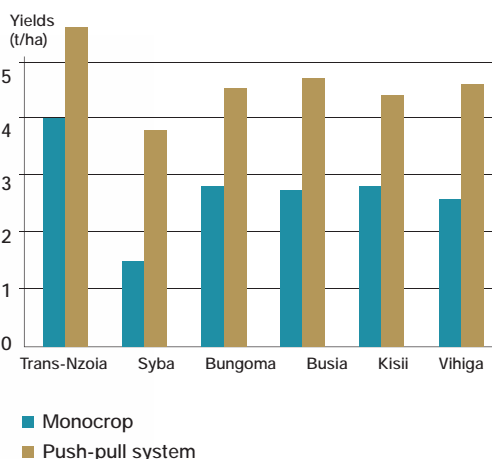
Organic and agro-ecological methods have proven to more than double the yields under low input conditions in African - improving availability of food, natural capital, social and human capital

- Thomas Harttung, Chairman, International Centre for Research in Organic Food Systems



(based on information from <http://www.push-pull.net/index.shtml>)

Maize yields from conventional monocrop cultivation vs the push-pull system at six sites in Kenya.



RETHINKING
THE
PROCESSING
AND SUPPLY
CHAIN →



SUSTAINABLE SUPPLY CHAIN PROGRAMMES

For many years, it was virtually impossible for consumers to know whether the food which they bought in shops and supermarkets was produced in a sustainable way or not. This has changed dramatically since the 1990's as more and more retailers now have introduced schemes that help describe how a product is produced, packaged, stored and transported.

Such schemes can best be described as sustainable supply chain programmes and multinational corporations such as Unilever use them for good reasons.

One reason can be described as idealistic as the companies want to ascertain that they sell food products which have been produced at a high standard of ethics. Another reason is more business-motivated as consumers want to do their grocery-shopping knowing that they buy sustainable products. Thus, a well-functioning and transparent supply chain programme can move market shares from one retailer to another.

But what is a good supply chain programme? First of all, it must be transparent and possible to be tested in an impartial way. It must be an integral part of a corporation's business model, not just window-dressing. And it should in principle cover the entire supply chain including farming,

processing of consumer products, transportation, packaging, retail and disposal of waste. In general, these schemes focus on the use of resources and on the impact of production on the countries and communities involved in the production process.

Unilever has for example introduced 11 indicators including animal welfare, soil fertility health, energy, water and local economy; these 11 indicators are measured to assess the sustainability of a certain supply chain or product.

1. Soil fertility health
2. Soil loss
3. Nutrients
4. Pest management
5. Biodiversity
6. Value chain
7. Energy
8. Water
9. Social / human capital
10. Local economy
11. Animal welfare

There are many areas in which the food suppliers must take responsibility. The goal must be to build up a sustainability programme in which all 11 points are considered.



At the end of the day, consumers prefer to buy products from companies that care about the future

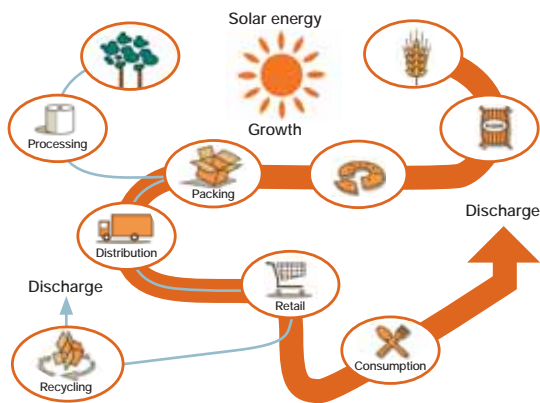
- Jan Kees Vis, Global Supply Chain Director Sustainable Agriculture, Unilever





FOOD PACKAGING

Packaging has gained a reputation as a waste product with excessive packaging being a major problem in the food industry. This is unfair as packaging is an important part of the solution of the world's food problems.



In order to reduce food waste and make packaging more sustainable, we must see the environmental performance of a packaging in relation to what it protects: The packed goods!

A food product without correct and adequate packaging will not survive long in the extensive supply chain that ranges from the farm to the consumers' fridge and dinner table via the supermarket.

Packaging is essential during transportation and with the correct packaging a food product can stay on the shelves much longer; this leads to a more efficient supply system and less food waste (see case story on the opposite page).

However, there are unsolved issues with regard to packaging. Most importantly, there are packaging methods (for example plastic wrapping) that, at present, are impossible to substitute if we want to have fresh and healthy food – but the packaging itself can become a waste problem.

Another important aspect is the package sizes. It has over the last decade become more and more common to see 'family-sized' packages of meat or dairy product in the stores. Large packaging increases the risk of food waste at the consumer level. Smaller sizes are preferred since we today observe an increase in single-person households, both elderly and younger people.

Food waste is very high in the developing countries where packaging often is insufficient or just does not exist, whereas the developed countries have a much lower percentage of food spoilage due to advanced packaging methods and materials used. In developing countries the amounts of post-harvest loss involved are relatively unknown and difficult to estimate.

Consumers in the developed countries throw away huge amounts of food due to low prices that give no incentive to minimize waste at the household level. Reducing developed-country food waste is particularly challenging as it is so closely linked to individual behaviour and cultural attitudes toward food.

Each consumer must become more aware of the value of food and throw less food away, something which can be helped through public information campaigns and also by considering the appropriate packaging sizes from a waste point of view. The land and resources made available by cutting food waste would likely be used for more resource-intensive and expensive foods or bio-energy. Initiatives targeted at consumers could also have other effects: not only will informing consumers about food waste reduce pressure on their wallets, it would also lead to fewer trips to the store, thereby saving petrol and reducing carbon emissions at the same time.

In the future, 'smart-packaging' may even communicate to the consumer when food is too old, thereby preventing the consumer in unknowingly throwing away good eatable food.



CASE STORY:

WHY CUCUMBERS SHOULD BE SOLD IN PLASTIC WRAPPING

One of the 'classics' when it comes to debating the food industry is the question 'why are cucumbers sold in plastic wrapping'; many consumers view it as much more environmental-friendly to avoid such 'unnecessary' packaging.

It is often ignored that good and efficient packaging is absolutely essential when it comes to prolonging shelf-life for food products; if a product is safely and well packaged, a much larger proportion of the products will survive transportation, storage and stay longer on the shelves in shops.

This goes for cucumbers and other easily perishable products.

The shelf-life of a properly protected cucumber and other fresh vegetables is in the range of two weeks. Without the protection of plastic wrapping, the shelf-life will be halved and the cucumbers are not in an edible state after only one week in the shop.

With less time to sell a product, the risk of more food waste increases. New supplies must be transported to the shop with increased transportation costs and damage to the environment as a consequence.



Good packaging adds to shelf-life for the food which is a sustainable solution

- Ola Svending, Manager Environmental Affairs, Stora Enso

DID YOU KNOW THAT...

4600 kcal/capita/day is produced in the field, but only 2000 kcal/capita/day is available for consumption:

- Post harvest losses: - 600 kcal
- Conversion to meat and dairy: - 1200 kcal
- Losses in distribution and households: - 800 kcal

FACTS:

- 40% of all the food produced in the USA is thrown out.
- USA loses 35% of all meat and dairy to spoilage.
- Japan wastes 100 billion \$ worth of food each year.
- India loses 14 billion \$ of harvest each year.
- In Africa, 25% of crops are lost before consumption due to weather, insect infestations, pathogens or lack of technology.
- In London, 50% of all food bought is not eaten.
- Every single day, the British throw away 4.4 mio uneaten apples, 5.1 mio potatoes and 1.6 mio bananas
- Recovering just 5% of the food that is wasted could feed 4 million people a day.



RECOMMENDATION 5

Eliminating the millions of tons of food thrown away annually in the developed world could lift many people out of hunger worldwide if trade and infrastructure at the same time make it possible to distribute effectively. If we could also save the massive amounts of crops that are neither harvested nor reaching the consumers in the developing world, an even larger influence on battling hunger could be made in the long term. Tackling food waste should be added to the toolbox of policy options to ensure a sustainable food system.





ENERGY EFFICIENCY



15-20 % of the energy used go to the food system. We need an improvement of the energy efficiency

- Dr. Dennis R. Heldman,
Adjunct Professor of Food Engineering,
University of California, Davis

An important aspect of food production and distribution is the amount of energy used. Various studies come up with varying figures but, in general, the food production sector accounts for no less than 15-20 % of the entire energy consumption.

To feed 9 billion people by 2050, an increase in food production is inevitable and this could lead to a massive increase in energy consumption if no actions are made in advance to prevent this. It will be a major challenge with regard to climate and environmental issues as well as the use of non-renewable energy resources that today form the basis of the modern world.

Energy efficiency is therefore most likely to become one of the important factors in a future sustainable food system.

There are several energy expensive stages in the food production processes and there are also many ways to address these issues. One example is processed potato products where experts have identified 14 different stages that each requires energy input. The most energy-consuming steps are transporting (from harvest to storage to production facility to wholesale warehouse to retail warehouse to retail store) and processing (only a few steps are shown in the scheme). In both areas, it would be possible to save large amounts of energy.

THE "FOOD CHAIN"

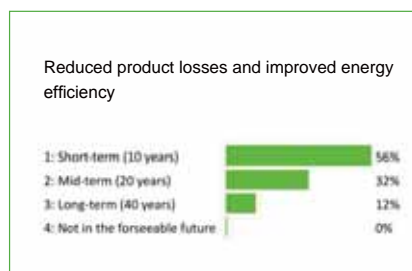
- the processes needed to feed a population.

- Growing
- Harvesting
- Processing
 - Washing, grinding
 - Extracting, fermenting, centrifuging
 - Frying, drying, freezing
- Packaging
- Transporting
- Marketing
- Consumption
- Disposal

By analysing at which stages the energy use is the highest, a targeted effort can be launched in order to minimise the energy use and, thereby, increase the efficiency. It must be taken into account that some processes (for example drying) are essential; a total reduction of energy use in all stages of a food production process is simply impossible.

Sustainability focuses overall on reducing the impact on energy, water resources and climate while still producing high quality foods for all. We must bear this in mind when seeking to make food production more efficient.

PREDICTIONS FROM PARTICIPANTS AT THE CONFERENCE



MOVING
TOWARDS
ECONOMIC
INCENTIVES
AND FULL
COSTING →



FREE TRADE, POLICY REFORMS AND A FAIR MARKET PLACE

It is impossible to make an accurate description of the food markets on a global scale as the differences from country to country and from region to region are immense. Two main trends can be seen though:

- A free and fair market place is vital to create a healthy food sector.
- Limited government intervention is a necessary idea in order to prevent food crises and raise investments.

But what does it mean to have free trade, what is a free and fair market, and to what extent can governments intervene with success?

Free trade essentially means that countries open their markets for each others' goods and services, a process in which the World Trade Organisation (WTO) is the pivotal point. WTO currently has control of the import regulations. When it comes to exports, governments can unfortunately do as they please. Also, the international trade agreements have a tendency to only cover agricultural products to a certain extent which means that the positive results achieved in other sectors do not automatically influence the agriculture and food production sector.

There are winners and losers when it comes to implementations of free trade. The losses are not just short-term. In general, the growing world trade has over the years helped to create much of the wealth in the developed countries – but this trend is less clear when it comes to food products. However, the national income of countries participating in trade liberalisation will increase.

If levies were abandoned and subsidies cut down, the food supply sector could become more international and dynamic – and both farmers, the food processing industry and the consumers would benefit from it.

In some developing countries, farmers have no incentive to sell their products on the market or they simply do not have access to a transparent market place. To create such a free and fair market place will be a difficult process but it is a necessity if the agricultural sector is to have the capability of providing enough food for both domestic consumption and export.

The tendency of people moving from rural areas to look for better opportunities in the cities is not new and will certainly continue. For this reason, it is important to make it possible for farmers to maintain and develop their business so that the migration eventually is based on personal will rather than a necessity to survive.



It will also be a challenge to give all farmers (for example small-holders in the development countries) a fair deal; with limited infrastructure and low level of education, their chance of getting a fair price for their products is not as good as it ought to be.

Therefore, it is necessary to implement safeguards to protect the many uneducated farmers in Africa who have a lot of experience in small-farming and supplying their own family or village but have no or little understanding of how to sell on a market. They need to learn more about how to get a decent price for their products and, possibly, also be motivated to scale up their activities and become more than just small-farmers.

The creation of a free and fair market place does not exclude governments from participating. On the contrary, governments can help to reduce

the risk of food crises and they certainly need to create a good framework for the farming sector through policies, for example by adopting a comparative advantage following strategy.

Unfortunately, it is difficult to create a truly free and fair market place as there will always be a tendency among governments to raise trade barriers or impose new barriers for competing agricultural products from abroad. These trade distorting tendencies must be minimized.

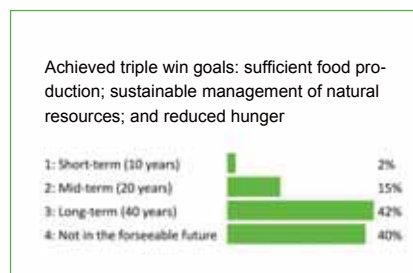
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The central need is to ensure that the poorest and most vulnerable have access to the food they need

- Justin Yifu Lin, Chief Economist and Senior Vice President, The World Bank

RECOMMENDATION 3

The world's agricultural trading system is stuck in the past. If there ever was a time to cut distorting agricultural subsidies and open markets for more free food imports/exports, it must be now. Price controls and export taxes could discourage the necessary additional investment in agricultural production; this must be stopped.

PREDICTIONS FROM PARTICIPANTS AT THE CONFERENCE





GOVERNANCE

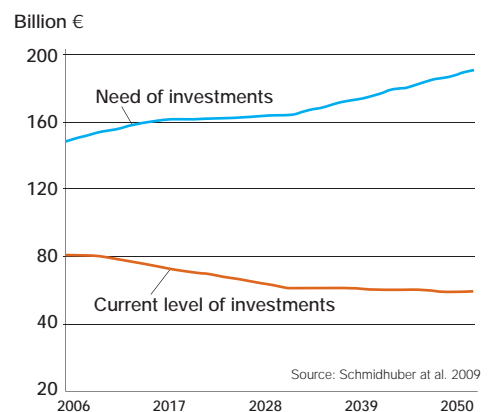
The term 'Good Governance' is frequently used as a reference in the cooperation between governments in developing countries and aid organisations, NGOs and governments. This term usually covers themes such as democracy, respect for human rights, respect for civil liberties, the rule of law and transparency in the public administration. According to Paarlberg, the governance challenge as far as food security is concerned is to persuade sovereign governments to provide the necessary public goods that would ensure access to adequate food.

Infrastructure is for example a means of ensuring the delivery of goods and services that promote prosperity and growth and contribute to quality of life.

'Governance' is also an important factor in improving the food supply systems of the poor countries. The area of food production and distribution is characterised by extensive regulation by governments. Typical areas of regulation are:

- Income and input price subsidies to producers
- Food price subsidies to consumers
- Trade restrictions
- Exchange rate manipulation
- Public investment (infrastructure, research)
- State ownership or control of companies
- Regulatory policies
- Land policies
- Tax policies

Even though the tools used are the same, the implementation and consequences are different in rich and poor countries.



In the rich countries, there is a 'rural bias' with income subsidies to food producers – and more expensive food for the consumers as a result. In the poor countries, there is an 'urban bias' where food prices are subsidised which means low prices for consumers but also low income for producers. The result is high food production as well as high farm income in the rich countries and low food production and low farm income in the poor countries.

This is a particular unfortunate situation in the poor countries where many rural areas suffer from government policies as described.

In the following years, many people from rural areas are expected to move to the cities and, thereby, rapidly increase the urban population. Some consequences are that the demand for food such as dairy products and meat will increase and more people are likely to live in poverty in the cities. In order to minimise the consequences of this development, investment in proper infrastructure between urban and rural areas is highly needed. This will help facilitate the transporta-

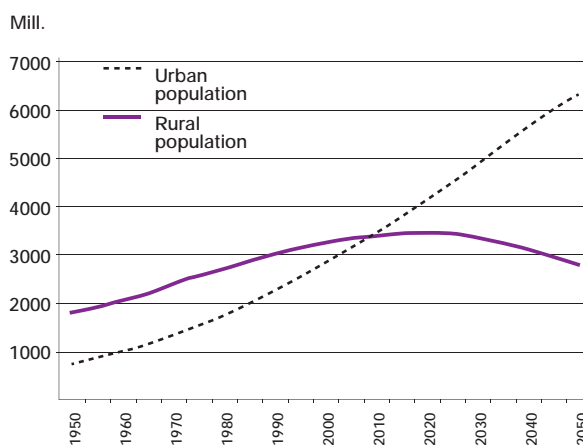


tion of the increased amounts of food needed for the urban consumers. It will also create a natural route from the cities to areas where work is present.

The respect for private property must also be seen as a protective measure against so-called 'landgrabbing' which has taken place in some third world countries. 'Landgrabbing' covers a trend where governments or companies (or both in collusion) 'grab' land with no or little compensation from local small-farmers whose families have lived in the area for generations.

Whose responsibility is it to assure food security in an age of globalisation? Is improved governance at international level our greatest need or are governance deficits more severe at national level? When national governments lag in assuring food security for their own citizens, can outsiders then help to make up the resulting governance deficit? Which role can bilateral donors and international financial institutions, such as the World Bank, play?

If the food supply problems are to be solved in developing countries, there is an urgent need to work towards 'good governance'; that means investments in rural areas where there is a shortage of public goods such as roads, energy supply, clean water, schools and medical clinics. Agricultural research is also under-financed in



The shift between urban and rural population introduces a changing diet: the demand for meat and dairy products automatically increases.
Source: Olesen 2010

many countries despite the fact that research will increase earnings in the long run.

The government action that is needed will of course vary among countries and over time but governments' basic responsibility is to provide public goods. Such government action will in the long run increase food production, reduce poverty and hunger and reduce the over-exploitation of natural resources.



The most serious governance deficit in the poor countries is the failure to provide rural public goods

- Robert L. Paarlberg, Professor Wellesley College

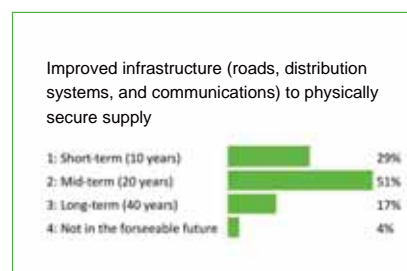
RECOMMENDATION 2

Governments must increase investments in roads, distribution systems, potable water, electricity, information and communications technologies, storage and postharvest technologies, and ensure that appropriate standards and regulations are in place and enforced.

RECOMMENDATION 4

It is the duty of national governments to provide the public with means to boost income and more importantly: feed its own people. Emphasis must also be put on the responsibilities of international organisations and their cooperation with national governments.

PREDICTIONS FROM PARTICIPANTS AT THE CONFERENCE





THE CONCEPT OF FULL COSTING



We should reflect the cost of the damage done to the environment in the production costs

- Per Pinstrup-Andersen, Professor, Cornell University

CLIMATE IMPACT ON DIFFERENT FOODS	
Food in supermarkets	CO2 kg equivalent pr 1 MJ food
Beef	1.47
Firm cheese	0.84
Low-fat milk	0.59
Pork	0.46
Chicken, whole, fresh	0.41
Eggs	0.31
Onions	0.20
Rye bread, fresh	0.09
Wheat flour	0.08
Carrots	0.08
White bread, fresh	0.07
Potatoes	0.06
Oatmeal	0.05

The challenges of the world's food supply system are manifold; one thing they have in common is the difficulties of creating a truly sustainable system – with regard to economic, social and environmental issues.

A concept that could possibly provide a solution is known as 'full costing'; it is basically about including all expenses into the price on food – also the expenses that in the current food supply system are not accounted for, such as environmental damage or use of natural resources.

Full costing is at present not a fully operational concept; it needs to be developed further and there is not just one single way to implement it.

The basic principle of full costing is fairness meaning that any impact through food production on social or ecological systems should be paid for in one way or another. This is not an easy task but there are two possible roads to follow – separately or in combination.

The first option is basically to put all costs onto the price of the goods produced. If for example deforestation is the result of agricultural production in an area, new trees must be planted and such costs put on the price of the food produced.

The other option goes a step further and imposes a tax regime which can be used not only to compensate for the direct consequences of the

agricultural production, but also as an instrument to limit or stop harmful practices and encourage better ones.

These suggestions can be combined in two different approaches. One in which farmers are essentially paid for not damaging the environment, for example if they refrain from cutting down trees; the other one is a scheme where damage to the environment is limited through enforcement of fines.

Fully implemented, the concept of full costing will also address the problems that arise from uneducated small-holders creating damage to the environment to survive. Money from the full costing tax could be used for new technology or in other ways to motivate local farmers to behave in a sustainable way.

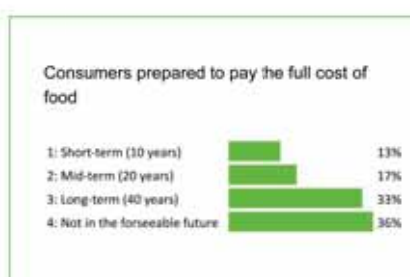
Research shows that farming moves through phases. In the early phases, local farmers tend to make use of methods that are harmful to nature and can lead to depletion. In the later phases, increased use of technology and a higher level of education will lead to a much more sustainable agricultural sector.

Full costing could speed up the process in developing countries and, thus, lead to a fast move from the unfortunate practices and onto a globally sustainable agriculture and food sector.

RECOMMENDATION 7

The 'full costing' concept should be introduced as a 'polluter pays' principle according to which all costs, including environmental, are reflected in the price of a product. It should be analysed how the balance between regulation and incentive should be made.

PREDICTIONS FROM PARTICIPANTS AT THE CONFERENCE



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SEPTEMBER 2010

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