The
Federal Government

Food for Billions

Research activities of the Federal Government of Germany as a contribution towards global food security

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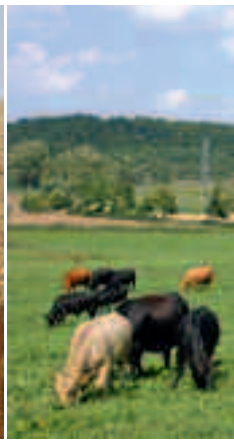
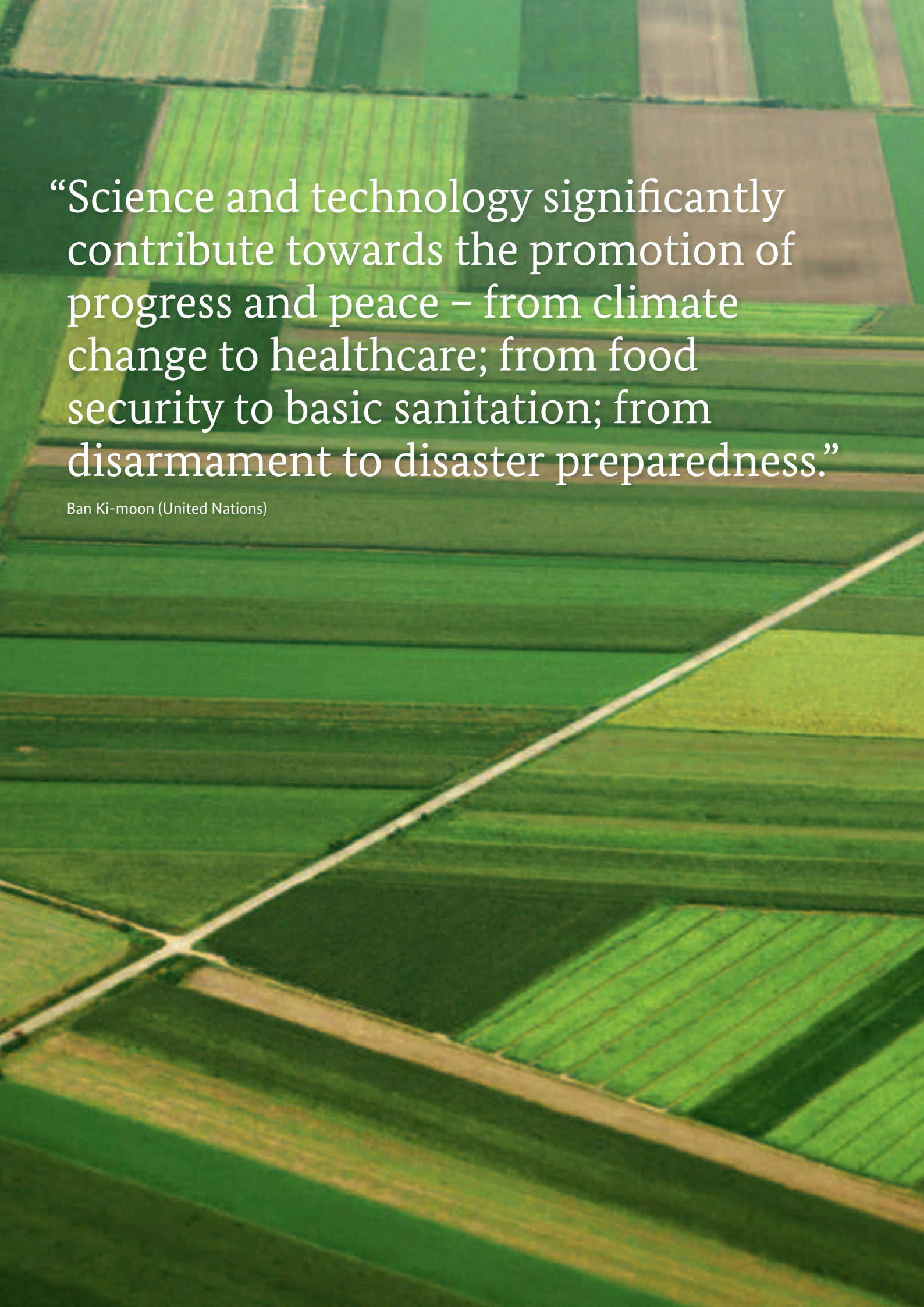
Content









"Science and technology significantly contribute towards the promotion of progress and peace – from climate change to healthcare; from food security to basic sanitation; from disarmament to disaster preparedness."

Ban Ki-moon (United Nations)

The future is a child of the present

Research lays the foundation for a balanced and healthy diet – for all humans worldwide.

Nutrition is a basic need of human beings. A balanced diet is the basis for our health and productivity. According to the current estimation of the Food and Agriculture Organization of the United Nations (FAO), the number of starving people in the world has dropped. Whilst it was still over one billion people who went hungry in 1992, this figure could be reduced to round about 800 million people in the year 2014. During the last decade alone, a further 100 million people could be provided with food. The share of chronically under-nourished people was reduced from 19 percent to 12 percent in the reference years.

Despite these successes, the world faces huge challenges with regard to the food problem. Currently, three pressing nutrition problems exist in parallel. Solutions to these issues need to be addressed in unison. In addition to 800 million starving people, a further billion people suffer from a lack of vitamins and minerals. Added to this are 2.1 billion people who are overweight or even corpulent – in other words obese – and increasingly so also in developing countries. Taken together, this means that about half of the world population does not or cannot feed itself adequately. At the same time these figures illustrate that a proper and healthy diet is not just a problem of quantities. The issue is far more complex. Production, processing, storage, trade or consumption all play a role, whilst health, social, economic, ecological but of course also political factors need to be considered and integrated as well.

For the Federal Government of Germany the fight against hunger is of utmost priority. That is why it tackles these massive and continuously worsening food problems also in form of research projects. These projects have the goal of providing a variety of affordable and high-quality foods that can be produced in a sustainable fashion. But they also serve the fight against poverty, since poverty still counts as the number one reason for hunger and malnutrition. The Federal Government of Germany thus assumes global responsibility and contributes towards overcoming these global challenges. The population increase is one of these. While in the year 1990 about 5.3 billion people populated this planet, it is already more than 7 billion today. This trend prevails. However, with the help of research as well as extensive investments in the development of countries afflicted with hunger, the Global Hunger Index fell by about 34 percent during the same period. Yields were continuously increased and harvests better secured. Especially infants, for whose development nutritional deficiencies and malnutrition can have devastating consequences, profit from this progress.

So far the achievements in the fight against hunger and poverty are unequally distributed. While the economic upturn in newly industrialised Asian countries such as China has freed many people from poverty, the situation in other countries has hardly improved. In some, it even got worse: Due to an enormous growth in population but also on account of an increased number of conflicts, the absolute number of the extremely poor south of the Sahara rose from 290 million to 414 million people in the stated time period.

Therefore, Africa is one of the focus regions in the funding initiatives of the Federal Government of Germany. Locally adapted sustainable solutions are desperately needed here. The questions are: How can yields on the existing agricultural areas be increased in a sustainable fashion, losses after the harvest be reduced as well as agriculture and nutritional science be geared towards the people's requirements? The creation of basic conditions and standards is a further important aspect. An ever increasing number of people have to be fed appropriately, but cultivation areas cannot be expanded at will. In some regions the yield potential of the agricultural areas decreases due to a deterioration of the soil properties and a reduction in soil fertility. Contributions towards the solution are offered, for

example, by the diversification of the cultivation and the breeding of new plant varieties that are resistant to pests or more tolerable against drought or salt. What also counts is the reduction of post-harvest losses. To reach these goals, the appropriate conditions need to be created. Parts of these are the creation of a responsible management of soil and land use rights, of fishing grounds and the sustainable use of forests. However, the framework for responsible agricultural investments equally needs to be promoted. Besides an improved participation in scientific progress, the Federal Government of Germany increasingly supports the mobilisation of the partner countries' own capabilities with its funding instruments.

Long-term, it can only be done sustainably

To secure the world's nutrition situation long-term, it is vital to protect the resources that are necessary for this purpose – such as soil, biodiversity and fresh water – and to handle them efficiently. Stable yields will only be possible if these natural resources are used in a sustainable fashion. Livestock that is used for food production should equally be kept healthy and in an animal-friendly way – not just for ethical reasons but also for economic reasons. If animals fall ill, not just their productivity is diminshed, but also the quality of the products. So it is not just necessary that enough food is produced worldwide. In fact, this needs to happen without destroying the environment, under an efficient use of the natural resources but also in an ethically and morally acceptable way. Such a sustainable productivity increase demands adapted sophisticated solutions on a global and local scale.

Still, even good harvests do not guarantee that the food reaches the consumers. Therefore, scientists investigate in which regions a lack of infrastructure leads to malnutrition, if for instance missing transport routes or unfavourable storage lets goods spoil prematurely. Whilst food in Africa often spoils during or shortly after the harvest, a different problem presents itself in industrial countries. Too much edible food ends up in the garbage bins. These losses, referred to as post-harvest losses, are biggest on the end consumer side. Only about half of the products cultivated worldwide are actually eaten. Enormous food losses and wastage are pressing issues. Next to technological solutions, consultancy and education are required to counteract these grievances.

Bioeconomy secures income

What is more, cultivating food has to remain profitable for people. Some of the research projects presented investigate how additional value is created, for instance, through processing and finishing processes. Additional sources of income for farmers also result from an increased use of plant remains such as hay or molasses as raw materials for a biobased economy or as biofuels. Establishing a biobased economy also harbours the chance of increasingly replacing raw materials harmful to the climate such as coal, crude oil or natural gas. For the Federal Government of Germany one principle prevails: Securing nutrition has priority! This is also taken into consideration in the orientation of research projects.

The research projects introduced in this brochure address an improved production, a better supply with staple foods as well as fruit and vegetables, with the development of nutrition-physiological high-quality foods and with an improved livestock husbandry. In this matter, the Federal Government of Germany counts on scientific technical progress, an increased consumer education and an approach that has the right to food at its core.

"The Green Revolution has already taught us that an increase in productivity alone is not enough to supply all people worldwide with healthy and affordable food." Dr. Rafaël Schneider (Welthungerhilfe e. V.)

Food production in the long run

Sustainability in the food industry is more than just a trend towards natural products. Hidden behind this is the global task of using resources efficiently and carefully to preserve them for future generations. Besides, as few pollutants as possible should be emitted. In addition to ecological goals, a sustainable development also encompasses economic and social ones. An economy counts as sustainable when it can be practised long-term. For a sustainable food production, we need strategies and production forms that are socially responsible, economically profitable and ecologically feasible, and that guarantee a variety of foods and raw materials in sufficient quantities.

In this context, the sustainability principle does not only apply to production in agricultural enterprises but to the entire supply chain: to the cultivation of crop plants and their harvesting, to the production of food of animal origin, storage, transport, processing, and finally to trade and consumption.

The basic conditions for such a sustainable food production are different in industrial nations, emerging economies and developing countries. That is why we need research and knowledge-based approaches, which also consider social concerns and requirements of those population groups affected by hunger and malnutrition, to develop the most productive and resource-friendly production methods for the different regions of the world.

The brochure “Food for Billions” presents current approaches from research and science. Research projects from the areas plant research, animal research, nutrition sciences, food security, social economics and trade introduce new technologies and possibilities to establish more sustainable production methods worldwide, to reduce the loss of foods and improve the quality and safety of our food products.

Worldwide, one in nine suffers from hunger. That is more than 11 percent of the world population. Of the around 800 million starving globally, 98 percent live in developing countries.

Source: FAO (2014): The State of Food Insecurity in the World (www.fao.org)

Water and land for the daily bread

A particular appreciation of foods evolves when you visualise how much water, farmland and energy is necessary for their production. Rapid population growth leads to an increasing shortage in resources worldwide. Dietary trends in affluent societies and emerging economies, such as an increasing consumption of meat and milk products, aggravates the situation. What is more, through the overuse of the world oceans the pressure on wild fish populations increases. The agriculture and fishing industries need to find ways to preserve ecosystems whilst producing sufficient and adequate food for billions.

The shortage in water resources and soils is one of the largest challenges in agriculture. But fresh water is also the number one in basic foods. In countries such as Germany, it therefore is considered to be the most controlled food. Compared to 1990, two billion people more have access to clean drinking water worldwide. Nonetheless, still 700 million people have to do without clean drinking water. Only about 3 percent of the water on Earth is fresh water, of which more than two thirds are frozen in glaciers or the polar caps. Theoretically, the available quantity of fresh water is sufficient to supply all claims of utilisation sustainably and to maintain our planet's ecosystems. However, our handling of this resource would have to change fundamentally.

Agriculture, which has to feed ever more people, has the largest water demand. Looked at globally, about two thirds of the fresh water used by humans is utilised for the irrigation of agricultural areas. The irrigated area has increased fivefold over one hundred years. But also the water demand of industry and cities grows. On the other hand, there are as of yet unused potentials – especially in the rainy regions of the temperate zones – to increasingly use water for the production of food, for example in aquacultures.

Fertile ground – a scarce resource

Until 2030, the population will increase by about 20 percent and require more food. Soil erosion, the transformation of fields to industrial land, the cities'

Wheat	1972	1992	2012
Africa	0.992 t/ha	1.655 t/ha	2.418 t/ha
Europe	1.886 t/ha	3.209 t/ha	3.610 t/ha
World	1.605 t/ha	2.505 t/ha	3.133 t/ha
Germany	4.038 t/ha	5.931 t/ha	7.328 t/ha

Maize	1972	1992	2012
Africa	1.379 t/ha	1.137 t/ha	2.066 t/ha
Europe	3.378 t/ha	4.204 t/ha	5.618 t/ha
World	2.687 t/ha	3.901 t/ha	4.916 t/ha
Germany	4.660 t/ha	7.235 t/ha	9.786 t/ha

Potatoes	1972	1992	2012
Africa	8.900 t/ha	11.018 t/ha	14.872 t/ha
Europe	14.011 t/ha	14.969 t/ha	19.481 t/ha
World	13.410 t/ha	15.138 t/ha	18.998 t/ha
Germany	23.641 t/ha	30.270 t/ha	44.757 t/ha

Comparison of the productivity per unit area between industrial and developing countries or rather intensive high-tech agriculture and the production systems of developing economies.

Source: FAOSTAT (2014): Agricultural Production (http://faostat3.fao.org/home/E)

Prior to the industrial revolution, a farmer fed four people. In 1950, it was already ten. Today, a single farmer in the industrial countries is able to feed 129 people. Optimised irrigation, fertilisers, pesticides, modern machines and intensified animal husbandry have contributed significantly to an increase in productivity.

Source: Federal Ministry of Food and Agriculture (BMEL), Annual Abstract of Statistics on Nutrition, Agriculture and Forests (2013)

growth and other forms of sealing and land degradation make agricultural areas ever scarcer. Whilst an average of 0.5 hectares of arable land was available per person in 1960, it is now only 0.2 hectares. According to the FAO's prognoses, the area available worldwide for agriculture can only be expanded by a further 13 percent, for example through the inclusion of fallow areas. This means that agriculture needs to become more productive on the existing available areas.

Fertile grounds are not only the basis for our food. They also take on important ecological functions, for example as habitat for soil-dwelling organisms, water reservoir and pollutants filter. Erosion and salination have lead to a low-quality classification of 20 percent of Europe's arable land already. Therefore, developing new cultivation and usage management strategies and finding paths to retain the soil functions are part of the most important tasks of the international agricultural research.

Balancing power – the forest

Forests are threatened in many regions and must yield to agricultural land. Afterwards, the soils are often overused, and their fertility as well as the biodiversity vanish. The disappearing forests in the world result in less power to balance the effects of climate-impacting emissions and the use of water in agriculture. Without a balanced ratio between the use of forests – for example in form of agroforestry systems – and their preservation, a sustainable agriculture and feeding the world are not conceivable.

Food from the ocean

The oceans are under pressure. The changing climate affects the habitats, for instance by increasing the water temperature. Whilst the increased emission of the greenhouse gas CO_2 acts physically in the atmosphere, it is a chemical reaction in the ocean. The seas acidify,

which has an influence on the entire food chain. Added to this are pollutants, which are mostly washed in from the rivers. But there are also problems on the side of politics. Many different interests compete on the high seas: fishery, shipping, offshore plants for the generation of energy and raw materials, aquaculture, nature preservation and recreation. With all this the catch levels of wild fish are reaching their limits: Many fish populations are strongly overused, in many parts of the world there is no regulation and monitoring of catch levels. An international management of the populations that regulates sustainable fishery – for example through fishing quotas – is imperative. This requires a transnational coordinated monitoring, just as the International Council for the Exploration of the Sea (ICES) does in European sea areas. In the Franco-German project "AWA", for example, a strategic partnership is established in several West African states, which aims in that direction. Off the West African coast, which is rich in fish, it is supposed to lead to a comprehensive fishery management under the consideration of the marine environment. To head off the threatening overfishing, aquaculture is deemed to be an alternative. But it too must bow to the strict criteria of sustainability to be successful.

Diversity as a resource

Biodiversity is another prerequisite for a sustainable food production. The diversity of animal and plant species as well as ecosystems supports many agriculturally relevant processes such as natural pest control, pollination of cultivated plants through insects and the accumulation and degradation processes of humus in the soil. Moreover, the genetic diversity is an indispensible reservoir for new and improved characteristics in animal and plant breeding, which are based on recombination of existing genetic material. Many important traits can only be found in the wild forms of our cultivated plants. This genetic diversity needs to be introduced in a targeted fashion into already existing varieties and livestock breeds to rear improved varieties and livestock. Only if we succeed in preserving biodiversity, can we continue to develop high-performance breeds and livestock races that are ideally adapted to their habitat.

The use of diversity thus contributes towards increasing the productivity and adaptability of agriculture. It also forms the basis for varied food sources, which in turn make their contribution to an adequate supply with sufficient, healthy and nutrient-rich foods.

“There is no blueprint that works at all locations”

Dr. Rafaël Schneider is the Deputy Head of the Department for Politics and External Affairs at the Welthungerhilfe e. V. in Bonn. Through his work, he wants to help shape fair conditions for a sustainable food security. The Welthungerhilfe is currently active in 39 countries, mainly Latin America, Asia and Africa.

Never has as much food been produced as today and in the industrial nations obesity is a widespread disease. At the same time, the number of starving people remains on a high level. What is going wrong?
More than 800 million people starve because they themselves cannot grow enough food nor have enough money to buy food with. Locally, the governments have the responsibility of ensuring access to food for their citizens. But we too influence the worldwide food security, for example through our consumer behaviour, our bioenergy and trade politics and the climate change caused by us.

What can research do to secure the worldwide supply with food?
Research must not only have profit orientation as its goal, but must also offer solutions and concepts that contribute towards a sustainable food security to less wealthy clients in remote regions. The Green Revolution has already taught us that a productivity increase alone is not enough to supply all people worldwide with healthy and affordable food.

But when farmers harvest more that is good, isn’t it?
Yes, but the harvest often does not reach the consumer. In addition to a sustainable agriculture, value creation systems must also be created that take the local social and cultural specifics into consideration. If, for example, an African market traditionally takes place every four days, food has to be produced, stored and transported in such a way that it does not spoil in the meantime. This requires good local concepts because you cannot draw conclusions from the observations in one region for the next.

Will the significance of research and technology increase in questions pertaining to food security or are predominantly political solutions required?
We need both approaches. During my stays in hunger regions I could always feed myself very well, because I had enough money to go shopping at the market. This shows that – in addtition to a yield increase – also the stabilisation of fragile political systems is an important factor.

Is there a realistic possibility of realising the human right to food?
Yes, definitely – and the way to it is known: working social systems, agriculture adapted to the local conditions, economic upturn especially in rural areas and an improved legal position for poor people. In China and Brazil, for instance, hunger was combated at a rapid speed – even if it hasn’t been entirely overcome yet. Unfortunately, the political determination is often missing.

How will climate change affect food security?
In many places, climate change will worsen drought, floods, storms and the insecurity in cultivation conditions. We have to respond to this by promoting local adaptation measures and the appropriate research. There is no blueprint. Humans and their specific local conditions must be the starting point of these efforts.

Is there a highly productive and "gentle" path in agriculture?

Supplying a fast-growing global population with a variety of high-quality foods long term is one of the most important tasks of our time. We can only meet this challenge when we invest in an agriculture that is highly productive and at the same time friendly to the environment and animals. Most developing countries still only produce a fraction of the acreage yields that are produced in the industrial nations. The high-tech agriculture of the industrial nations is often connected to high ecological costs. Modern research must therefore develop food systems for all countries, which are ecologically as well as economically and socially sustainable. It is necessary to combine research, education and effective consultancy to create gainful employment in agriculture and the food industry.

The goal of a sustainable development is to secure and improve the ecological, economic and social productivity of a society. But what exactly does sustainable production mean in agriculture?

Is "a lot" sustainable?

In Germany, 94 percent of all agricultural products are produced through conventional agriculture. With the help of the most modern technology, pesticides, fertilisers and livestock stabled all year, this type of cultivation or management also achieves the highest yields per unit of area worldwide. For many countries, intensive agriculture is a chance to reach higher yields. This is how China, for example, through the use of new and particularly productive varieties of rice, managed to rise to the position of the worldwide largest rice producer in the past decades.

But the high use of resources in intensive agriculture is also connected with ecological disadvantages. In most cases, the potential of high-yield varieties can only be fully exploited with the use of fertilisers, pesticides and in many parts of the world artificial irrigation. The high consumption of water in some countries makes dams, channels and deeper wells necessary, which represent grave intrusions into ecosystems. Intensive irrigation transports nutrients from the higher soil layers into the deeper ones, which can lead to leaching from the soil. Another problem is the salinisation of soils due to inappropriate irrigation systems combined with high evaporation rates. On the other hand, soils as well as surface and ground water can be contaminated through improper use of fertilisers and pesticides. The influence of agriculture is not the sole but by far the most significant entry path for the high nitrate concentrations in the ground water close to the surface. Emissions from ammonia, a gaseous compound of nitrogen, contribute towards overfertilisation and acidification. About 95 percent of the emissions stem from agriculture. What is more, ammonia reacts with other gases in the atmosphere to form harmful particles – referred to as fine dust.

To combine maximum productivity with minimal environmental impact, agricultural research and measures for a transfer of the research results into practise are called for. For each crop an optimised cultivation system appropriate for the respective location must be developed. Modern plant breeding makes an important contribution by developing more resistant and efficient varieties that deliver good yields even when using less fertilisers and pesticides.
In livestock production, farmers are assisted by animal breeding, animal research or agricultural engineering, for example through the development of optimised concepts for housing animals.

Besides, in cooperation with government services, farming cooperatives and other organisations, access must be enabled to such improved varieties. Beyond this, agricultural consultation is one important service which can transfer the knowledge on optimised and locally adapted cultivation systems into application.

Healthy animals – safe foods

Compared to crop production, animal husbandry is land and resource intensive. A large part of our crops is grown for animal feed. Intensive and extensive forms of livestock production can be differentiated. In intensive agriculture, livestock farming is highly

productive. The area requirement per animal for the cultivation of food is less than in intensive livestock farming. This is an ecological advantage. Through intensive livestock farming about 700 million tonnes of greenhouse gas emissions are saved in a year (CO_2 equivalent). In less intensive farming systems, these would be set free, as more animals would be required to produce the same amount of milk, meat or cheese. But intensive and especially highly concentrated livestock farming can lead to regional environmental strains.

Other focal points in research are the improvement of the health and wellbeing of livestock, without losing sight of the productivity of the system. Livestock owners get a better overview of the status of their animals' health as well as possible weak points in their businesses through modern health monitoring, which in turn helps them, for example, to reduce the use of antibiotics. The research on animal welfare indicators allows an objective assessment of the husbandry methods with regard to animal protection. Investigating the conditions of livestock farming and the production processes can also create new incentives along the entire supply chain. Therefore it is important to invest not only in animal-friendly farming but also animal-friendly transport and slaughtering conditions. In view of global goods flows the security of food from its point of origin, to production and transport and all the way to the use by the consumers must be guaranteed.

Aquaculture plays an increasingly important role in the supply of the world population with animal protein and high-quality fatty acids. The production of aquatic organisms, for example shrimp or fish, has risen rapidly: according to the FAO from 3.6 million tonnes in the year 1975 to currently more than 70 million tonnes. The driving force behind this development is Asia.

Extensive agriculture and organic farming: can less be more?

Seen globally, more than 90 percent of all farms are family businesses. They farm around 70 percent of the arable land available. There are large differences in the size of these farms. Approximately 88 percent of the land in question is used by 16 percent of the family businesses. The remaining 84 percent are mostly poor smallholders. They farm the remaining 12 percent of

184 litres of water are necessary for the production of one kilogramme of tomatoes. This almost equals ten times the amount of water available per day for one person in Africa.

Source: Service Centres for Rural Areas (www.dlr.rlp.de)

land. In total, family businesses produce 80 percent of the food consumed. Agriculture was and is a family business.

Amongst the farming systems, extensive agriculture, which requires large areas, dominates in many regions. Until today, smallholders in most developing countries produce only for their own family consumption or at most only for local markets. This type of agriculture is called subsistence economy. Extensive production forms have stood the test as long as the growing population could exploit more and more new areas. The use of capital and resources of smallholders in extensive management is low and the area productivity does not reach that of intensive farming by far. Whilst farmers in the poor countries of Africa harvest 200 to 500 kilograms of maize per hectare, twenty times that is produced in the five most productive European agricultural countries on the same area. Weather extremes, pests and weeds often lead to massive pre-harvest losses and crop failures. Through the growth in population these production methods often cannot meet the increased demand in food. Especially for the poorer population groups the supply with food has deteriorated in some regions.

Innovations, adapted techniques and the creation of working market structures let these smallholders in particular profit from science and research. But it not only requires research. Also, designing framework conditions and making necessary infrastructures available are important elements for the increase and security of production. Only through the combined effect of research, politics and the private sector are research results turned into innovations. Infrastructure projects, such as the construction of fortified roads, are important accompanying measures that help realise market access for farmers and thus access to technical aids such as fertiliser and tools. Take, for example, fertilisers: Through simple fertilisation measures it is possible to not only increase yields, but also to disable damaging factors – for instance witch weed (*Striga hermontica*), a parasitic weed that afflicts the roots of important types of grain such as millet and maize in many regions of Africa. Again and again, Striga is responsible for devastating crop failures. Through fertilisation, the crop plants are strengthened and the weeds inhibited in their growth. Especially in poorer regions with bad infrastructure it is of particular importance to stabilise yields, as it is more difficult to locally counterbalance failed harvests.

Smallholder farming is not only relevant for the supply of the families and the local markets with important foods, but in many countries acts as an important social security system. With adequate political support and respective public investments, smallholder farming can unfold its potential and effectively contribute towards food security, economic growth and the creation of workplaces.

Contrary to extensive agriculture, certified organic farming, with currently less than one percent of the global arable areas, represents a special form of land use. Also in Germany, its shares are very low with 6.4 percent of the entire arable area, 6 percent of food production as well as 4 percent of the food trade. With an annual growth of 7 percent, “organic” is a positively developing market in German trade. Compared to the extensive farming in developing countries, organic farming in Europe achieves several times the productivity per area. Through more favourable climate conditions, modern technologies, high-yield varieties, keeping to crop rotation and cultivation methods optimised to the location, European organic farmers achieve for some crops, for example rapeseed, almost similarly high yields as conventional farming does. For grain and most vegetable types, however, only about 70 to 80 percent of the yields compared to conventional farming are achieved, even in good agricultural locations such as Central Europe. Seeing agriculture as a system of interlocking cycles of crop production, livestock husbandry, production of energy and fertilisers, is a promising approach. Under the highly diverse regional and local conditions, the interaction between research and practise must further develop everywhere.

Stable structures for a sustainable food production

Socio-economic, cultural and behaviour-based aspects also play an important role in the development of a sustainable food sector. Each year, about one third or 1.3 billion tonnes of the food produced for human consumption are destroyed or wasted.

In this matter, a key factor are the post-harvest losses, which in Sub-Saharan Africa alone lead to a loss of about 15 percent of the produced grain – caused by outdated processing methods, losses during transport and predominantly through incorrect storage. Investigating and using new agricultural, transport and storage techniques in countries with large losses in the

post-harvest period offers the chance of drastically lowering these losses.

Building and expanding such structures as allow the refining of foods produced in the production country, provides a further approach towards a sustainable agriculture. This applies in particular to products for which the raw material prices on the world market fluctuate strongly or have remained on a low level for years. 70 percent of the cocoa beans cultivated worldwide are still harvested in Western Africa, but only 20 percent are processed there. By refining products in the countries of origin, the share in the overall supply chain increases through locally rendered services. Complex supply chain systems in the countries of origin are to be established. Alternative possibilities of employment and additional income thus result for local people. Projects such as "RELOAD", "Sorghum Bread" or the "Biomass Supply Chain Networks in Africa" build a bridge by including different stakeholder groups along the supply chain but also by considering social and cultural aspects. They thus go far beyond natural science and technological questions and support the building or expansion of complex networks and a sustainable development of rural and urban spaces.

The establishment of productive and efficient administration and service structures are also central for the set-up of sustainable forms of production. Without legal security, consideration and protection of human rights of the native population and beneficial institutional framework conditions, resources and chances remain unused. There is the risk that the increase of production does not contribute towards an improvement of the food situation for the local population. Research projects that have their sight on cultural, socio-economic and institutional aspects of sustainability are therefore of utmost importance. They can achieve holistic development-policy solutions which conform to the various challenges. Examples of such research works are the projects "UrbanFood^{Plus}", "Wetlands", "Trans-SEC" or "AGMEMOD goes Africa".

"The sustainable production of biomass is one of the biggest challenges on the route to a bioeconomy."

Olivier Dubois (Food and Agriculture Organization of the United Nations – FAO)

“The Earth’s potential is sufficient to sustainably produce enough food”

The Food and Agriculture Organization of the United Nation (FAO) is to help secure the world’s food security. In the Interview Divine Njie (Working Group Agricultural Economy and Food Industry), Olivier Dubois (Working Group Natural Resources and Energy), Panagiotis Karfakis (Working Group Agricultural Development Economics) and Brian Thompson (Nutrition Specialist for the FAO) report on which efforts are necessary to be able to feed over nine billion people in the year 2050.

Can we really combat hunger in the world?
Panagiotis Karfakis: Economic growth must reach poor people so that they cannot only invest their income in more but especially in higher quality food. The governments have the responsibility of investing in the social security and the primary care of their citizens.

What contribution can research and development make?
Divine Njie: Research and development can contribute towards the breeding of crops with higher yields that are resistant to biotic and abiotic stress. And there continues to be a large research demand in the development of new production systems that adapt to the ever changing growth conditions caused by climate change and can minimise its negative effects. But research and development can also contribute on another level to combat hunger in the world. Not just the primary production can be optimised with innovative methods but also the post-harvest processes, processing, storage and the marketing of food.

A considerable amount of food gets lost on the way from the producer to the consumer. How can this be avoided?
Divine Njie: By facilitating access to the markets. Contracts with guaranteed purchase or simply passable roads, electricity and modern communications technology strengthen producers and help them sell their wares. And we also have to teach farmers on harvest and storage methods to similarly minimise losses here.

How does the FAO perceive the change in the use of biomass?
Olivier Dubois: The sustainable production of biomass is one of the biggest challenges on the route to a bioeconomy. Increasingly, even biological waste products are seen as a valuable resource. However, the FAO thinks that another competitive situation arises here. Non-edible plant parts usually are returned to the soil as nutrients or used as fodder. Therefore, food and sustainability must come first also in the use of waste material.

What role does Africa play in the global bioeconomy?
Divine Njie: The continent could advance to being the main player. In parts of Africa we witness a growth of unprecedented magnitude. Eleven African countries have already reached the millennium goal of halving the number of starving people between 1990 and 2015. Many countries in Africa try to improve their infrastructure, facilitate research and innovations and further private economy. The region is becoming aware of its valuable natural resources.

How does the FAO rate the food situation in the past decades and what expectations does it have for the future?
Brian Thompson: According to the recommendations of the WHO, the food situation has improved almost everywhere. There are still big problems in Central and Southern Africa where particular population groups are economically pushed to the margins or are socially excluded and where the food security has not improved. But the FAO expects that humankind can feed itself until the year 2050 and beyond. Earth’s potential is sufficient to sustainably produce enough food.

"The future ability of our society depends on the development of sustainable solutions, the promotion of the systemic changes which are required for this and the strict use of new technologies."

From the welcoming address in "Food for Billions"

Understanding complex relationships to improve production

In the past, modern technologies and new breeds have lead to an enormous increase in yields in the industrial nations. However, these production methods cannot be transferred one-to-one to developing countries and emerging economies. In fact, production forms need to be developed that are locally adapted and that pay tribute to the different climatic conditions, infrastructures and social demands. Whilst there is too much fertiliser and pesticides in some regions, nutrients or water can be the limiting factor elsewhere. To develop regionally adapted technologies and cultivation systems, we need knowledge-based innovations in all areas of agriculture and in the entire supply chain.

Hardly a single consumer knows that a farmer in Germany only earns 1.5 cents from one kilogram rye bread that costs 2.30 euros at the baker's. A sustainable production must also affect the price. Hidden behind the production of foods, there are complex supply chain systems. They reflect the connections between agriculture, wholesale and retail, food industry, gastronomy and all of us as end consumers. Realistic and fair agricultural prices enable investments in the agricultural production and are thus the prerequisite for a sustainable intensification of farming. In the past, low prices for agricultural products led to the land lying fallow or being given up entirely. Increasing demand leads to rising prices, so that investments will become profitable again for many farmers and that the value creation potential will be sparked in the regions.

Application-oriented research for a sustainable development

For many years, Germany has been supporting the international research partnership CGIAR (Consultative Group on International Agricultural Research), the largest network of development-oriented agricultural research worldwide. Today, more than 8000 scientists and employees in more than 100 nations work for CGIAR. The Federal Government of Germany has supported the network since its foundation with more than 350 million euros. In the year 2014, the Federal Government of Germany made round about 29 million euros available and is thus currently the largest donor.

The centres carry out application-oriented research for a sustainable development of rural regions and agriculture. The research projects have a broad thematic scope. Analyses of politics as well as the research into important livestock diseases or the breeding of improved crop varieties for the smallholders of developing countries are all part thereof. In order for research results to find their way into application as quickly as possible, the German development cooperation not only strengthens the centres but also national research facilities, which are purposely integrated into research projects. With financial support from the Federal Government of Germany, specific knowledge transfer platforms were created in Africa, which are to significantly speed up the exchange of information between applied agriculture and science.

Global challenge – local approaches

Only those who understand the value chains and their interconnections in detail, recognises how the value creation is distributed and where possibilities for optimisation exist. In the project "AGMEMOD", European agricultural economists model how politics, population development and economic growth affect goods flows and food prices. Together with African colleagues the system is also adapted to African nations. Scientific analyses make interrelations visible that are causes for social grievances, and show starting points at which the value creation can be lastingly developed further for specific groups. Framework conditions such as land use or water rights, investments in the farming sector, in processing or in trade but also lacking education and training can thus be causes. Those points are tackled, for example, by GlobE, a research programme on food security from the Federal Government of Germany. In this programme researchers from Africa and Germany work in all of six joint projects. The international researchers of the GlobE research group "RELOAD"

(Reducing Losses Adding Value), for example, look at the entire production chain of East African foods. The goal is to make more food available in the region. At the same time, refinement of raw materials is to be strengthened in these countries. By involving local companies and promoting them according to their requirements, the value creation is to be kept or developed in that country.

In total, there are six international agricultural research institutes of the CGIAR network involved in GlobE. They receive round about 2.4 million euros of funding from the Federal Government of Germany. At the same time, the GlobE projects can rely on and use the results and structures from previous CGIAR projects.

Alliances for independent action

Another example are the "Research Cooperations of the Federal Government of Germany for World Nutrition", which are also jointly organised with the international group of agricultural research centres CGIAR and promote bilateral partnerships between agricultural research facilities. The programme contributes towards a demand-oriented development of a productive and sustainable agriculture in the partner countries. The aim is not just scientific progress and exchange but also the creation of functioning international alliances. The cooperations make a significant contribution towards the "Capacity Development" und thus to independent acting in the developing countries. One bilateral research project, for example, has the goal of promoting the national seed sector in Ethiopia. German scientists work closely with the national agricultural research in Ethiopia, and jointly create the basis for the breeding of locally adapted, drought-tolerant varieties of grain. But not just drought-tolerant crops are important for a better adjustment to climate change. As proven by recent studies, heat also, damages plant growth and leads to high yield losses. A German-Israeli research cooperation therefore dedicates itself to the triad of drought stress, heat stress and optimised irrigation procedures. They are creating knowledge and technologies that can also be utilised in other regions. In the European joint project "MACSUR", scientists investigate how climate change will aggravate the pressure on global food security even more in future. They are evaluating possible scenarios, creating adaptation strategies and developing options for action for the political decision-makers.

Resource protection through efficiency

In most countries, higher yields can no longer be achieved by a random expansion of irrigation and farm land. The challenge of a sustainable production is achieving increasing yields with the same or even declining resources. As the population grows and with it its demands, it is the only way to preserve natural resources for coming generations. In some regions, in which there is a lack of water, large quantities of rain water are lost through surface runoff. Even small structural changes and facilities can already help collect and store water for utilisation in agriculture. New irrigation systems, which distribute water targetedly and thus more sparingly, use the available water in a more efficient way. To develop such techniques and cultivation systems adapted to the respective location, holistic and knowledge-based approaches are necessary.

"Agri Benchmark", a global network of agricultural economists, consultants and producers, allows the comparison of production systems and their economic efficiency with internationally standardised methods. International data and varying information become comparable and assessable because experts from many countries compare and adjust the evaluation standards.

In the dry regions of the world, about 90 percent of the available water is used for irrigation; dependent on the deployed technology with large losses through evaporation and negative effects such as salination of the soils. An efficient form of subsurface irrigation is therefore being developed by the "ComASI" project. ComASI stands for the Comprehensive Analysis of Subsurface Irrigation. Subsurface irrigation is a very efficient and environmentally friendly irrigation procedure. "ComASI" networks research projects in the Ivory Coast, Namibia, Kenya, Algeria, Turkey and Germany. Not only is the testing of subsurface irrigation techniques in the field part of the project funded by the Federal Government of Germany but also socioeconomic investigations on the implementation of the procedure, the development

Agriculture starts before sowing

It is a long way until a handful of wheat grain turns into a bread roll. Many processes with numerous participants from different sectors form complex supply chain networks that already begin long before the actual production. Belonging to these are plant breeders or the developers and manufacturers of agricultural machines, fertilisers or pesticides. Plant breeders, for instance, guarantee farmers high-quality seeds, which are adapted to the respective purpose and the regional requirements. Farmers are responsible for the cultivation and harvest of crops in sufficient quantity and quality. The next link in the supply chain network is formed by the agricultural trade – the place where agricultural goods get from the producer to the processing industry. Agricultural goods are traded – just as any other industrial product – on the global market. The producers of agricultural raw materials and the processing industry are frequently located in different countries and often on different continents. Transportation and logistics therefore play an important role along the entire supply chain. The processing industry is often called the “finishing level” of the supply chain. Grain, for example, can be used as cereal for baked goods or muesli, as coarse grain for the production of starch or as animal feed for the processing industry. Components that are not used for the production of food serve as animal feed. Waste products will not be disposed of but used for the generation of energy or for the extraction of specific recyclable materials, for example proteins, fats and oils for the cosmetics industry. The finished products are tested, packaged and brought from the wholesalers to the retailers and ultimately the consumer. In industrial nations, the individual links in this supply chain network are connected and synchronised in such a fashion that the losses in production and processing are low. The highest losses occur at the end of these chains – with us, the end consumers.

of locally adapted techniques and various activities on the information and further education of potential users locally.

The preservation of ecosystem services and ecosystem functions is a key factor in the management of forests and wetlands: Overexploitation comes at the expense of biodiversity, the forest is lost as well as the carbon fixed in the wood and soil. Draining of moors lessens biodiversity, and large quantities of greenhouse gases are set free. The preservation and restoration of moors have therefore become important aspects in sustainability in Europe.

The wetlands of East Africa comprise about 20 million hectares. Due to the year-round availability of water and fertile soils, the regions offer excellent prerequisites for agricultural production. However, wetlands also fulfil important ecological functions. They are the habitat of many animal and plant species and provide clean air and water. The German-African cooperation project GlobE "Wetlands" investigates paths to manage these regions carefully without draining and destroying them.

Soils as a sustainable resource

Key factors in the protection of resources are the preservation and improvement of the soil's fertility. A sustainable soil management creates the basis for this purpose. About five billion hectares of agricultural land are available worldwide. The production of plant biomass for all forms of use is almost exclusively dependent on the management of soils. At the same time, soils fulfil various ecosystem services. They store water, carbon and nutrients and the soil structure provides the habitat for many groups of organisms. The funding initiative "BonaRes" (soil as sustainable resource for bioeconomy) develops locally adapted solutions by combining, analysing and thus better understanding computer-based prognosis models with the aid of long-term field trials with the biological, chemical and physical knowledge of the interactions in the system "soil". Moreover, Germany is a member of the FAO Global Soil Partnership and with its knowledge and know-how here also supports the sustainable use of soils, amongst other things.

Waste is turned into a resource – efficiency through multiple use

A further important solution approach of sustainable food production is cascade or multiple use. Nowadays, cereal grain is coveted not only by food and fodder producers, but also by energy producers who, for example, ferment the cereal into bioethanol. In view of the resource scarcity, we will have to use the whole plant as valuable raw material in future. According to the declared will of the Federal Government of Germany, food production still ranks first. Therefore the non-edible parts are to be used preferably – firstly for a material use, for instance as a chemical resource for bioplastic, and finally energetic as electricity, heat or biofuel. Besides straw, such plant parts are for example spelt or molasses and bagasses, the residual material from sugar production. Analogously to petroleum refineries, which produce various products from the raw material crude oil, plants and plant components are processed in biorefineries into source or raw materials for industry and bioenergy. The production of bioethanol from plant remains and cell wall components cellulose, hemicellulose and lignin is particularly promising. First demonstration and pilot plants already exist. What is left over from the refining still is not waste but can be used for the production of methane in biogas plants. The mineral nutrients, however, are to be returned to the fields in form of fertiliser to counterbalance the nutrient losses. As part of the research project GlobE "Biomass Web" scientists investigate which utilisation cascades are the most successful under African conditions. Their goal is to at the same time meet the increasing demand for food and for biomass.

Livestock as a basis for agriculture

Worldwide, livestock husbandry represents another supporting pillar of agriculture and food production. On the one side, it serves as an important source of food and raw materials, which supplies us with proteins, micronutrients, and animal fats but also leather and wool. At the same time, it requires large quantities of resources, animal feed and arable areas. Using the required fodder more efficiently is important, because the production of food made from animals requires many plant calories for feeding. Only about one third of the energy made available via plants

is transformed into muscles, fat, milk or eggs. Simultaneously, a large part of the used agricultural areas serves the production of animal feed. In Germany, this is actually about 60 percent. Additional areas in other countries of the world, on which fodder is produced for our animals, must be added to this. The causes are a high consumption of meat and other animal products and meat as well as their export. Technical innovations help to optimise feeding processes and using the feed in a more efficient and needs-oriented way: Intelligent automatic fish feeders fitted with sensors, for instance, detect the size of the animals, the water temperature and other factors, to calculate the best feed amount. There are analogous technologies in barns.

Further demand for improvements in livestock farming does not only exist in Europe. In many developing countries and emerging economies, producers are faced with the challenge of a growing demand for eggs, dairy and meat products. The quality and security of fodder is therefore of great importance. In the project "Tannisil", for example, the protein quality of roughage such as hay, straw or green fodder for dairy cattle is investigated to deduce specific recommendations from the findings. Another example is the joint project "ZooGloW", which concerns itself with possible damage scenarios along the global product chain using pork and poultry as models. Risk profiles are created and analysed for accidental contaminations with pathogens that can be transmitted to humans from animals. New testing methods and optimised examination strategies are developed and allow officials to make their decisions based on realistic scenarios.

Animal protection and animal health at the centre of farming activities

In addition to a sufficient supply with products made from animals, the wellbeing and health of the animals play a central role for the industry and the consumer. Species-appropriate livestock farming is the key that secures a sufficient supply of high-quality foods for people, takes into account animal health and animal protection and at the same time goes easy on the resources. Therefore, new approaches in livestock farming are being investigated against the backdrop of animal health and protection as part of the European research initiative "ERA-net ANIHWA". The "ERA-net ANIHWA" project coordinates and networks the European research activities in the areas of animal health and animal protection with the goal of developing modern measures against the introduction of pathogens, new diagnostic methods and vaccines. For this purpose, the researchers combine approaches from the fields of genome analysis, genetics, veterinary medicine, behavioural biology and further departments in livestock breeding, livestock housing and animal protection.

Competence networks stop pests and ensure healthy animals

Securing food production also means minimising losses in yields, for example, through drought, pests and diseases. Even in Europe, weeds and pests cause harvest losses of up to 35 percent in some crops in specific regions. To combat these successfully, effective plant protection methods are required that are also environmentally friendly. The focus topic in the German agricultural competence network "WeGa" (Horticulture Research Network) is a sustainable production security in intensive plant cultivation, for example, through the development and integration of biological plant protection methods. But there are also significant losses in livestock and fish breeding, which are often caused through feeding that was not adapted to the individual animal, through inadequate keeping methods or diseases. These losses affect the income of the businesses but also the quality of the food. Only an animal that feels comfortable stays healthy and leads to high-quality products. Animal health and animal protection are directly related to the health of the consumer.

Improved varieties for stable and higher yields

An important success factor in the development of new cultivation systems are also new crop varieties that are characterised, for instance, by a higher tolerance against salt in the soil or drought. The national and international funding initiatives of the Federal Government of Germany are building an international knowledge network for the development of new agricultural cultivation and production methods with improved plant breeding strategies. The goal of this research is the enhancement of crops, so that they will not only

require less water and nutrients in the future, but will also become resistant to pathogens whilst remaining high in yield. What matters here are not just genetics but also the local growth and environmental conditions of the individual plant. The applied plant research within "PLANT2030", "PLANT-KBBE" or the "Wheat Initiative" is dedicated to this cause. These funding initiatives aim at gaining an improved understanding of the molecular relationships and regulatory mechanisms in the plants and the interactions with nature, to make these usable. Their findings are available to scientists across the world.

Agriculture 4.0

The support of humans through machines contributes towards precise and efficient production methods in modern agriculture. This applies in particular to high-technology industrial nations. Satellite-controlled machines spread fertiliser and pesticides exactly where they are required. GPS-based control systems help farmers plan and monitor the management of their fields at the computer, whilst tractors and combine harvesters make their rounds on the field.

However, the concept of Agriculture 4.0 goes beyond computer-based cultivation. Self-control, self-optimisation and self-configuration are three characteristics of the fourth industrial revolution – concerning the execution of work and activities as well as self-control, whether the oil of a hydraulic pump needs to be changed, for example, or a specific component needs to be exchanged. By and by, computer-assisted devices and machines will take over more and more tasks and carry them out independently. This includes, for instance, the automated spreading of fertiliser or pesticides. Their precise composition and targeted spreading also takes into consideration the respective developmental stage of a plant or factors such as the current and forecast weather. Selected production processes are already fully automated today. May it be in milking, mucking out or feeding – more and more often humans receive support from technology. Automated milking systems simultaneously gather information on the productivity and quality of the milk and the cows' health. Researchers want to create something similar for plants now. The technology platform CROP.SENSe.net, which cooperates closely with the German plant phenotyping network (DPPN), develops methods that quickly and non-invasively analyse the condition of plants in the laboratory, greenhouse or field. Although researchers can precisely trace the water content and, for example, the flow of nutrients in the xylem of the plants, the plants are not destroyed but keep on growing. If we know how field crops such as barley, sugar beet or grapes adapt their metabolism and growth to changing environmental conditions, this information can be transferred to more efficient cultivation concepts.

“We ensure that innovations reach the poor segments of the population”

Dr. Detlef Hanne works as a Project Manager in the Department “Southern and Eastern Africa” of the KfW Development Bank. Dr. Jürgen Fechter is an economist at the “Competence Centre Water, Energy, Agriculture”, which also belongs to the KfW Development Bank.

What were the initial functions of the KfW Development Bank?
Detlef Hanne: The KfW Development Bank finances, counsels and accompanies development projects worldwide. But we do not directly fund research and development; instead, we ensure that innovations reach the affected population groups.

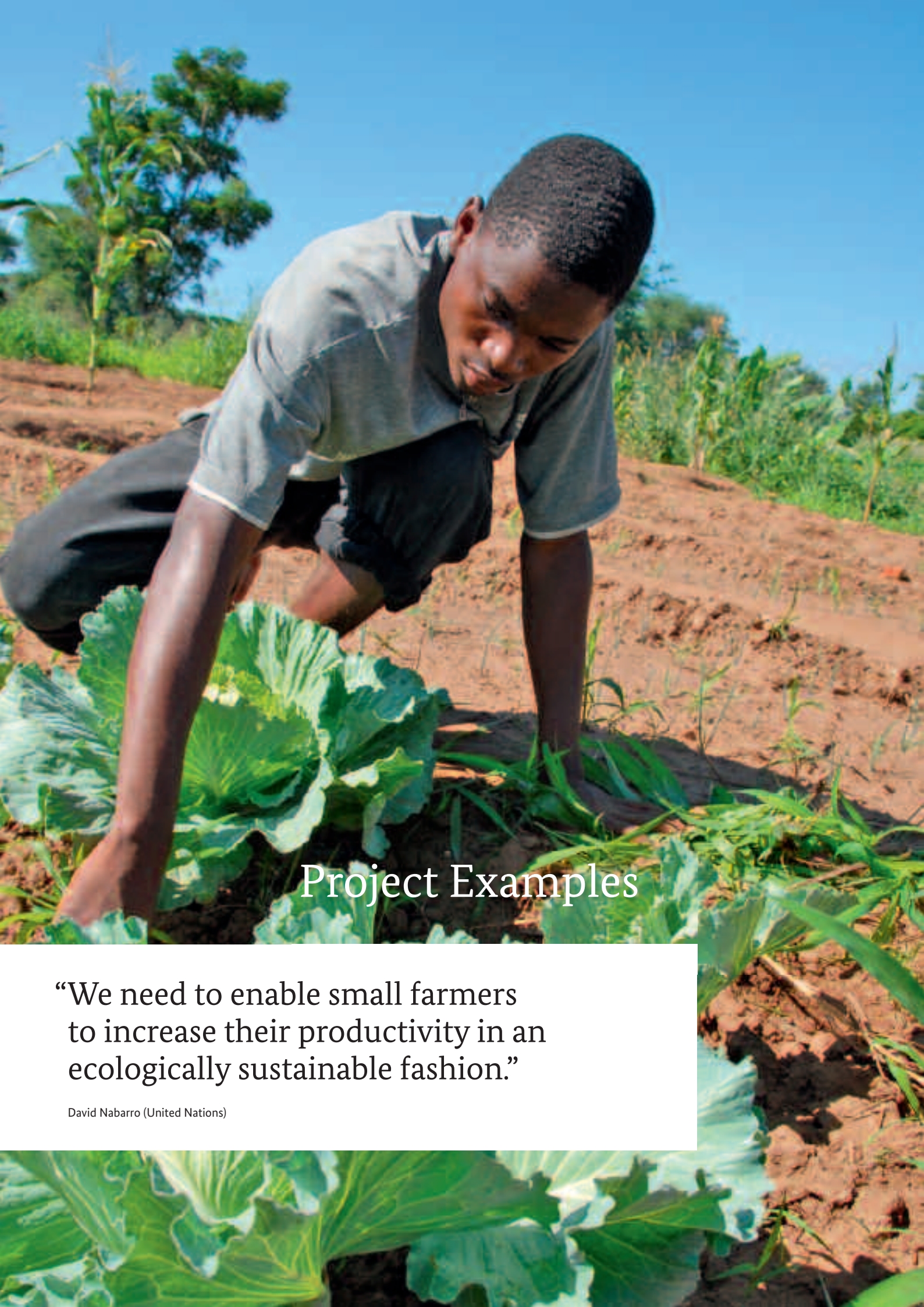
What can the KfW do against hunger?
Jürgen Fechter: Nowadays, from our point of view, it is rather a question of combating poverty than a problem with the production of food. Therefore, we concentrate on improving income and creating employment. Investments in the resource-friendly intensification of agriculture in developing countries play a central role in this matter.

Where does this commitment stand in comparison to your other fields of business?
Detlef Hanne: For projects which contribute towards an improved food security, the KfW makes approximately 400 million euros available annually on behalf of the Federal Government of Germany – this is the equivalent of about 5 to 10 percent of our annual commitments. In the narrow sense, agriculture is our most important funding sector with 20 to 30 percent.

Where does the money flow and what is it spent on?
Detlef Hanne: The KfW invests in partner countries of the Federal Government of Germany. Put simply, round about 35 percent of our investments in the area of food security go to Africa, about 40 percent to Asia and Oceania and 20 percent to Latin America and Europe. Today, the investments strongly focus on the areas of transport infrastructure and irrigation, but also the energy sector and better access to knowledge and education are in demand. Here, there is much room for innovations and technical improvements which must be geared to the conditions in the developing countries. In that aspect, projects that have conclusive national overall concepts are generally much more successful.

Especially in the food sector, some banks have been criticised for example because of speculation or with regard to “land grabbing”. Is this criticism justified?
Jürgen Fechter: Without doubt, agriculture is a lucrative and global field of business for the most diverse stakeholders. With a responsible commitment from banks, we predominantly see an opportunity here. However, clear environmental and social compatibility guidelines must be complied with.

How much money would be necessary to supply the 800 million starving today as well as the growing world population with sufficient food in future?
Jürgen Fechter: In the year 2008, the FAO stated 30 billion euros annually; other organisations estimate one to two billion euros per country, which would have to be invested in the modernisation of agriculture. But what these figures share, is that they have little informative value. They often only highlight partial aspects of the overall problem and do not say where this money is to come from.



Project Examples

"We need to enable small farmers to increase their productivity in an ecologically sustainable fashion."

David Nabarro (United Nations)

Fewer post-harvest losses in East Africa – GlobE “RELOAD” (Reducing Losses Adding Value)

Through post-harvest losses, up to a third of the food produced in East Africa is lost. This usually happens in regions that are already afflicted with food scarcity and supply issues. The causes are manifold. The GlobE research project “RELOAD” dedicates itself to this problem and aims at identifying the different problem areas as well as weakness points along the supply chain and developing solution strategies. Amongst these are especially cultivation, logistics and storage. Whilst it is important, for example, to take into consideration the seasonal temperature and precipitation fluctuations in cultivation, to avoid losses occuring in this first phase, protecting plant and animal products from premature spoiling is a key priority in logistics and storage. Not only are losses reduced and the food supply improved through the development of new approaches for the packaging and processing of the products, at the same time, new work and income opportunities are created in the region. Due to the fact that poverty is one main cause of hunger, this circumstance is of particular importance.

http://reload-globe.net

Cascade use means using synergies – GlobE “BiomassWeb”

To secure the global food supply, it is not only important to improve the production but also to facilitate the access to food. Since poverty is one of the main causes of hunger, income plays a key role. One principle of the strategy therefore is to create new income opportunities and jobs by reusing and processing biomass from agriculture for the making of new products. In doing so, biomass can be used, for example, for the generation of energy, as component for cosmetics products or in the textile production. Through cascade and coupled use animal and plant products from agriculture or its by-products are – as far as possible – reused instead of thrown away, which in turn frees up cultivation areas for crops that are bred for food production. The researchers in the government-funded GlobE research project “BiomassWeb” work hand in hand with partners from Africa in the development of new production techniques and methods, through which new biomass sources can be opened up and the quality and reusability of biomass is optimised.

www.lap.uni-bonn.de/forschung/forschungsprojekte/GlobE_BiomassWeb

Biomass value networks in Africa

Productivity and efficiency gains as well as the effective and efficient use of biomass play a role in improving food security. Value chains are transformed into value networks. The project is to contribute towards a stronger integration of African countries into the evolving international biomass networks and enabling their participation in the bioeconomy. To this end, the knowledge of respective strategies and the capability of utilising these are necessary. Scientists therefore work on approaches on the assessment of strategies on the development of biomass value networks. They focus especially on those which are aimed at intensifying the production and processing of African crops for food and feed, for raw materials for energy and industrial use.

Furthermore, the project concerns itself with innovations in the cassava value network. The aim is to investigate and understand interrelationships and mechanisms that affect the management of value networks. For this purpose, manioc (cassava) serves as test plant in Nigeria and Ghana. In both countries, but especially in Nigeria, manioc is not only an important food crop but increasingly also of significance in terms of feed and ethanol production. The project helps decide whether cassava is to be treated as a food or as an industrial raw material in future. It also evaluates how the transition from value chains into value networks affects the food security of smallholder as well as the quality of food and safety of food.

www.iita.org · www.zef.de

Soil as a Sustainable Resource for the Bioeconomy – funding initiative “BonaRes”

Soils literally form the foundation of agriculture and the supply with food. Also the production of biomass, which finds its use in, for example, the chemical or textile industry or for the production of energy, is closely connected to the production factor soil as the place of growth. Beyond this, soil provides further ecosystem services, such as storing water and carbon, which are of inestimable value for nature and mankind. The funding initiative “Soil as Sustainable Resource for Bioeconomy” (BonaRes), therefore analyse, preserve and – if possible – improve the function, productivity and fertility of soil. In this context, not only does the efficient use of water gain importance, but also the use of mineral substances, as for example phosphate, which also has only limited availability and is often used as fertiliser. To reach these goals, a “BonaRes Centre” is to be established. At this centre, the results from the soil research are aggregated in one central data base, the soil information made available on a large geographical scale and over a long-term period and ultimately used as basis for the development of utilisation strategies and measures.

www.bonares.de

Fertile soils must be preserved – the initiative "Economics of Land Degradation"

Fertile soils are the basis for a sustainable development and secure the food supply for a growing world population. However, land degradation and desertification endanger fertile stretches of land and ecosystems that are of importance to us all. The consequences are alarming: reduced availability of clean water, increased vulnerability to climate changes, lack of food security and poverty. If planet Earth is to be able to feed the growing world population in future, the progressive degradation of fertile soil must be stopped. This requires investments in activities that reduce land degradation as well as enable a sustainable land management. Political decision makers, commercial enterprises, farmers' associations, financial institutions and other stakeholders need a robust scientific basis for their decision making, which ensures a long-term productivity of land and soil. This is where the initiative "Economics of Land Degradation" (ELD) comes into play. It makes important data available, for instance on the height of the social and economic costs of land degradation, on short and long-term gains in sustainable land management or on the measures to be taken. The ELD initiative has a global network of experts and partner organisations. Its work combines research, the development of methods, the creation of political awareness and the web-based development of competence. Through its work, it delivers politically usable information and at the same time directly contributes towards the dissemination of methodological approaches.

www.eld-initiative.org

Sustainable use of East African wetlands – GlobE "Wetlands in East Africa"

Water is a scarce commodity worldwide and – as is well known – especially in Africa; on the other hand, there are wetlands there that contain abundant water. However, only a small share of this area is used agriculturally. In East Africa, these wetlands are spread across an area of 20 million hectares. The international GlobE research project "Wetlands in East Africa" investigates the development of new strategies for an agricultural use of these regions, for example close to Lake Victoria in Uganda or in the humid highlands of the Usambara Mountains in Tanzania. The goal of the researchers is the development of regionally adapted strategies, which use ecological, political and social framework conditions for orientation. Besides deciding what crops are to be cultivated, the question is also how to involve stakeholders, such as companies and organisations, as well as politics. Due to the fact that the African highland is home to round about 120 million people, the "Wetlands" researchers also make an important contribution towards the food supply in the region.

www.wetlands-africa.de

Research for an improved supply with fruit and vegetables – the competence network "WeGa"

Against the background of the production of fruit and vegetables, gardening plays an important role for the supply with food, but also, for instance, in view of the breeding of ornamental plants. The competence network "Value Creation in Gardening" (WeGa) therefore aims at increasing the production and product security in gardening to secure yields and reduce losses. The scientists focus on starting points for the prevention of product damages such as skin defects and spots on fruit and vegetables, and the control of diseases and pests. Because the production of fruit, vegetables and ornamental plants orients itself at fixed dates, the resistance of a plant to cold is also of importance, since production in gardening takes place all year round, even in winter. In view of the reduction in the energy consumption for heating greenhouses, the competence network "WeGa" also strives to adapt plants to lower temperatures at the same yield level. As part of their work, the researchers also develop new strategies to increase the planning and product security – and that not just for breeders but also for merchants and consumers.

www.wega-online.org

Plant breeding for horticulture – the demonstration project "KAMEL"

Vegetable crops and fruit as well as medicinal plants and herbs are increasingly gaining in importance for a balanced and healthy way of life. In poorer countries, enriching the bill of fare with horticultural species can contribute towards eliminating deficiency symptoms. However, because of the great number of cultivated varieties, gardening is a particular challenge for plant breeders. Due to a lack of capacities in breeding research and for economic considerations in private breeding, many horticultural cultures have received very little or no attention from breeders. Through a growing awareness of nutrition, broad levels of the population are interested in a large variety of vegetable species. In Germany, for example, carrot varieties are being developed that meet the consumers' current expectations in quality. In connection with important medicinal plants and herbs, which are important for wellbeing and health, the demonstration project on the improvement of the international competitive position of German medicinal plant and herb cultivation "KAMEL" is funded. Its goal is to increase the product quality and profitability of the medicinal plants chamomile, valerian and lemon balm with the help of research and development activities. These serve as model cultures for blossom, root and leaf drugs. In this fashion, an increased added value is to be made possible in Germany by expanding the extent of cultivation or increasing the yield. The systematic optimisation takes place along the entire supply chain with the key areas of breeding, stock establishment and inventory management, harvest and post-harvest techniques and phytopathology. Networking all activities in the aforementioned sectors has already led to a noticeable innovation boost.

http://arzneipflanzen.fnr.de/pl/aktuelle-projekte/demonstrationsprojekt-arzneipflanzen

Innovations for vegetable cultivation in the garden – "HORTINLEA"

The interdisciplinary GlobE research project "HORTINLEA" (Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa) aims to promote horticultural cultivation in Kenya and the border regions of Ethiopia and Tanzania, as well as improve the production of native vegetable species. In this fashion, regional food supply is to be supported and the range of vegetables on offer broadened. The researchers not only concentrate on production but also on the following areas of the value chain, such as processing, marketing, transportation and storage. The quality of food is also of particular importance. It is the prerequisite for a healthy nutrition. Close cooperation with the people and stakeholders from the regions therefore serves the purpose of this research and at the same time encourages the transfer and dissemination of knowledge.

www.hortinlea.org

Healthy vegetables – nourishing cucumbers for Southeast Asia's gardens

New high-quality breeds, which can be cultivated in Asia's vegetable gardens, can improve the local food situation. Cucurbits, in particular bitter melon (*Momordica charantia*) and squash (*Cucurbita moschata*) are widely spread in the vegetable gardens of Asia. As suppliers of essential nutrients, such as vitamins and minerals, and other valuable ingredients they can provide an important contribution towards food security and the prevention of hidden hunger in poorer groups of the population. Fast-growing hybrid varieties are predominantly used in commercial production. These are less suitable for cultivation in small gardens. The horticultural and nutrition-physiological characteristics of new breeds of pumpkins are evaluated for a food-conscious cultivation at home and in school gardens in Southeast Asia in a project funded by the Federal Government of Germany. The goal is the breeding of new varieties that are as easy and cost-efficient as possible to cultivate in small gardens and boast an improved spectrum of nutrients.

www.mri.bund.de/de/institute/sicherheit-und-qualitaet-bei-obst-und-gemuese.html

Improving infant nutrition through food security and nutritional education – "IMCF"

The first 1000 days from conception onwards are particularly important for the mental and physical development of a child. The transition from exclusive breastfeeding to complementary food within this 1000-day window is especially critical. The limited availability of sufficient and varied food as well as the lack of knowledge in nutrition for the appropriate composition and preparation of baby food are often stated as the main reasons for an unbalanced diet in infants. Since 2011, the IMCF project investigates in Malawi and Cambodia how the food situation of infants can be improved locally. Complementary food is to be improved with the help of communication strategies on changing the behaviour in terms of mothers' feeding practises and the training of multipliers (midwifes) as well as a local food-oriented agriculture. Good complementary foods for infants can form the basis for life-long healthy eating habits and prevent diet-related diseases. The project contributes towards finding out how a better interlinking of agriculture, nutrition and the population's health can be achieved. IMCF is the abbreviation for the FAO project "Improving the dietary intakes and nutritional status of infants and young children through improved food security and complementary feeding".

www.fao.org/ag/humannutrition/nutritioneducation/70106/en/

Knowhow on animal and plant breeding – the competence network "SYNBREED"

Securing and increasing the yield and the harvest play important roles in animal as well as plant breeding. Genomic selection uses information from the genetic material for breeding. The foundations are the developments in molecular genetics and diagnostics. The reliable and quick analyses of the genetic material of livestock and plants is the central element in genomic selection, from which precise information on breed values, such as performance, yield or resistance to diseases and pests can be extracted. The competence cluster "SYNBREED" unites and links the knowledge and experience from plant and animal breeding for the improvement of this procedure in cattle, chickens and maize. Beyond this, the researchers aim at disseminating the insights thus gained in form of workshops and training programmes, and consequently put them into practise. In doing so, they support breeders in their work and at the same time contribute towards securing and improving food production.

www.synbreed.tum.de

Applied plant research – "PLANT 2030"

In many parts of the world, not all important nutrients are available in a sufficient quantity and the combination required by our crops to grow. Within the framework of the Federal Government's funding initiative "PLANT 2030" in Germany and the international alliance "PLANT-KBBE" (Transnational PLant Alliance for Novel Technologies – towards implementing the Knowledge-Based Bio-Economy in Europe) researchers are therefore working on making the nutrient absorption of plants more efficient. The insights thus won can be transferred to other types of plants and regions of the Earth. In the "ROOT" project, for example, researchers are working on changing plant roots through breeding so that they are perfectly adapted to different environmental conditions. In the last decades, the yields of numerous crops could be improved continuously. However, the yield potential of plants is again and again threatened by pests and microorganisms such as bacteria, fungi and viruses. Scientists are using barley as a model plant for other cereals, to make these crops, which are important for nutrition worldwide, more resistant to pests. Respective findings are then transferred to other types of cereal such as wheat, rye or even rice, and thus participate in securing food globally. Under the project heading "BARLEYFORTRESS", scientists use the model system barley to increase, for instance, the quantitative resistance against mildew and possibly other harmful fungi. When plants are attacked by parasites such as fungi, they activate their own defence systems to stop the invaders. Harmful fungi belong to the most important pathogens in agriculture. Under suitable weather conditions, mildew, fusarium and rust fungi as well as mould infest plants and tap into their nutrient supply with their mycelial cords. In grain, fruit and grape farming they cause considerable yield losses. An infection with fungi types of powdery mildew can lead to a harvest loss of up to 30 percent in many cereal crops. What is more, some fungus varieties produce secondary products that are highly toxic for humans and animals. Under the project title "dsRNAguard" scientists are working on better understanding the plant defence system and expanding it in a targeted fashion. Through their explorations, the researchers have uncovered new mechanisms with which crops themselves can put invading fungus pathogens out of action in future. In this fashion, they secure the yield and quality of our crops.

Next to the increase of yields, the "INNO GRAIN-MALT" project also concerns itself with the improvement of quality, namely in malting barley. The goal is to increase the brewing quality alongside the drought tolerance. A well-balanced ratio between proteins and malt is key factor for the processing and varies greatly dependent on climatic factors. Researchers are working on identifying the genetic factors this is based on with the aim of developing a new variety that will guarantee yields and the required quality independent of fluctuating weather conditions.

One crop that is rarely cultivated in Germany, but which is of significant importance worldwide and especially in warmer regions, is the melon. Its high water and vitamin content makes it an important food. The European research project "SAFQIM", which is funded as part of the "PLANT-KBBE", investigates the sugar metabolism of melons to preserve and improve their shelf life as well as their fruit and taste quality over a longer period of time. Through their work with melons, the researchers gain fundamental insights into the genetics and biochemistry of the sugar metabolism. As melons belong to the large family of cucurbits (Cucurbitaceae), findings could be of significance in connection with other types of vegetables such as cucumbers or squashes but also for many other crop varieties.

www.pflanzenforschung.de/de/plant-2030/uberblick

International networking – "Wheat Initiative"

Wheat is of particular significance for the human diet, as it is not only the primary source of calories but also an important source of proteins in many parts of the world. Against the backdrop of a growing world population, climate change and the loss of arable land, significant efforts are required to meet the future demand for wheat and secure world nutrition. The importance of wheat and the necessity to increase the wheat production have been recognised by the agriculture ministers of the group of the twenty most important industrialised countries and emerging economies (G20). As a result, the international "Wheat Initiative" was founded in 2011. Together with Germany, a further eleven nations, two international organisations as well as ten globally active companies have joined this initiative. German research facilities are represented in the scientific advisory and steering boards of the international "Wheat Initiative" and – as chairpersons – assume the strategic and organisational responsibility for the shaping of the initiative. The goal of the "Wheat Initiative" is to increase the yield progress from 0.9 percent (2001 – 2010) to at least 1.7 percent per year through breeding and plant cultivation innovations. This increase is necessary to meet the worldwide growing demand in wheat and wheat products. By bringing together experts from all areas of wheat production, research priorities are to be identified and networks created for an efficient handling. As a result, various research projects for the improvement of the productivity of wheat were started in Germany within the framework of the Federal Government's innovations programme. For example, bilateral projects between German scientists and researchers in Ethiopia and Israel are funded.

www.wheatinitiative.org

Departmental research for the improvement of the resilience of crops

Each year, significant losses in yield occur worldwide through pathogens (fungi, bacteria, and viruses), insects and other pests as well as abiotic stress factors such as drought or heat. One important goal within sustainable production and nutrition security is therefore the improvement of the resilience of crops against these damaging factors. The aim of the research efforts is to investigate genetic plant resources with regard to respective resilience characteristics. In doing so, the genetics of these traits are to be uncovered. A further goal is to identify suitable molecular markers with which a transmission of these traits into genotypes is accelerated. This is necessary to develop new varieties that are better adapted to the respective local environmental conditions. This research makes long-term contributions towards the improvement of resilience properties against diseases and environmental influences and thus towards food security. Resistant crops not only have a higher yield stability, but they also encourage an improved resource efficiency, with regard to water, soil or fertiliser. The results of these activities are achieved and published in cooperation with national and international partners – and are thus available worldwide.

www.jki.bund.de/de/startseite/institute/resistenzforschung-stresstoleranz.html

The federal programme Organic Farming and other Forms of Sustainable Agriculture – "BÖLN"

Increasing the effectiveness of organic farming is one of the main goals of the Federal Government of Germany. Since 2002, the funding programme "BÖLN" supports the expansion of organic farming as well as the processing and marketing of its products. To expand the knowledge on this type of farming in all classes of the population is a key objective of the funding programme. Opening this programme to other types of sustainable agriculture broadens this objective. As a result, measures were integrated for the transfer of technology and knowledge for the sustainable production, processing and marketing of agricultural products. With information and education measures specifically aimed at the respective target groups, farmers, processors, trade and marketing but also different consumer groups including children and adolescents are addressed. The other pillar of this federal programme is represented by targeted and practical research projects, with which yields are improved, soil fertility is increased, plant diseases are fought against without the use of chemical-synthetic pesticides, animals are kept in an environment that considers their needs, and farmers' and producers' organic products are successfully marketed. The "BÖLN" project "sustainable agriculture and organic farming in the report of the IAASTD (International Assessment of Agricultural Knowledge, Science and Technology for Development)" is one example thereof; the European research partnership within the ERA-Net "Core Organic" is another.

The results of the heavily application-oriented projects of "BÖLN" are to find a direct path into practise. Knowledge transfer events are specifically offered on particular subjects. During these events, farmers, processor, consultants, veterinarians and representatives of science and research, as well as control bodies and authorities can intensively exchange ideas and inform themselves about current developments. Research results are introduced, discussed and optimised at national and international congresses. They thus contribute towards a further development of organic farming and global food security. But not only that: The cooperation with conventionally operating farmers has increased more and more over time. Numerous results are also being used in conventional agriculture. For example the use of low-copper agents to combat fungal infections in fruit farming and viticulture. Overall, "BÖLN" therefore provides strong support for an agriculture that is aimed at sustainability and the future.

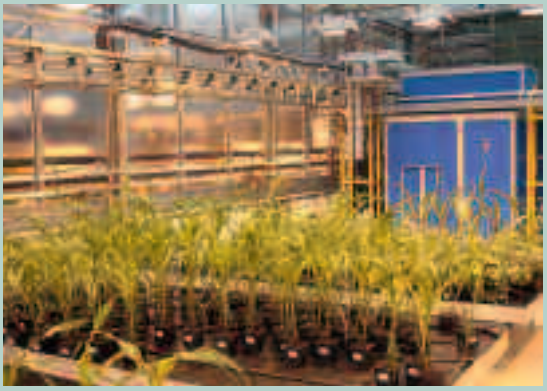
www.oekolandbau.de · www.bundesprogramm.de · www.orgprints.org

Cities as production area for high-quality food – "UrbanFoodPlus^{Plus}"

The research focus of the "UrbanFood^{Plus}" group, which is funded as part of GlobE, is the increase of productivity and efficiency of urban farming in West African cities. The research project has the goal of making a contribution towards the improvement of the local food and income security. It focuses on the development of new cultivation systems and methods. Multiple and cascade uses play an important role in this aspect. One example is the use of biochar as filter for waste water. The water used for irrigation is thus cleaned and the filtered residue is used in combination with the biochar as fertiliser in agriculture. Contaminated water that is used for irrigation purposes in agriculture still poses a large threat to food security. It is therefore important to develop filter systems that are as simple as possible. Urban farming not only supplies the urban population with fresh food, at the same time it also provides employment opportunities. For this reason, researchers not only concern themselves with cultivation and production but with the entire supply chain to create new employment and income opportunities for the population, whilst making their contribution to the fight against poverty.

www.urbanfoodplus.org

Understanding and improving plants – the "German Plant Phenotyping Network" (DPPN)



Not just the environmental and growth conditions alone influence the growth of plants. The plants' genetics also play a key role. Both factors are essential for plant breeding, for example, to achieve stables yields. To gain information and insights on the influence of both factors, plants must be examined and analysed continuously in the laboratory as well as the field. The "German Plant Phenotyping Network" (DPPN) aims at developing new concepts and technologies for phenotyping, in other words the capturing of the overall appearance of plants throughout their entire development period. The knowledge on the relationship between genetics and the environment is an important building block in this context. Today, the technological progress in the fields of sensors, automation, analytics, data capture and processing allows us to characterise plants and gain insights on a hitherto unknown scale.

www.dppn.de

Basis of plant phenotyping – the competence network "CROP.SENSe.net"

Plants are exposed to various and sometimes adverse environmental influences, such as, for example, heat and drought. The focus of the competence network "CROP.SENSe.net", which is funded by the Federal Government of Germany, is the development of new measuring methods and instruments that make it possible to obtain and evaluate plant signals and stress reactions that are emitted in connection with adverse environmental factors such as drought, extreme temperatures or storms. This allows farmers to take specific protection measures in time and well before visible damages occur. Thanks to technological progress and modern sensors, it is possible nowadays to extensively monitor and analyse plants and soils without destroying them. The long-term goal is to develop new strategies and measures for plant breeding and cultivation.

www.cropsense.uni-bonn.de

Healthy animals for healthy food – the network for Animal Health and Welfare "ERA-Net ANIHWA"

The wellbeing of an animal depends on several factors. Infections and diseases represent a serious risk. What is more, climate change and global trade encourage the spread of diseases. Not just farmers but also producers and consumers are affected by this. The European research network "ERA-Net ANIHWA" (European Research Area Network – Animal Health and Welfare) therefore aims to bundle OR to consolidate the knowledge and experiences in the field of animal health and make them widely accessible. As part of their work, researchers not only look at the wellbeing of livestock such as cattle or pigs but also fish and honey bees. Based on this, gaps in knowledge are thus closed and new strategies developed for livestock farming. With their work, the researchers are creating the basis for the development of new and effective protection measures against animal diseases, such as new vaccines or faster diagnostic methods, which enable farmers to isolate sick animals to curb the spread of infections or illnesses. Based on the insights gained, new forms of application and alternatives for the use of antibiotics are also being developed. Ultimately, not only the animal itself but the consumer also profits from this.

www.anihwa.eu

Optimised animal feed for productive livestock as well as healthy and safe food – "Tannisil"

For a balanced and performance-focused animal feed in dairy farming, a combination of basic and concentrated feed stuffs is required. Protein and mineral fodder in particular supplement in-house feed. Through the increased demand for food made from animals, the demand for feed stuffs also grows. Against this backdrop, the protein quality of roughage, the basic feed, is investigated in dairy farming by the project "Tannisil". The changes of proteins during the silage process of grass and legumes are in the focus in this aspect. Tannic plant extracts are used as silage additives in order to reduce proteolysis during the fermentation process in the silo. The aim is to make a contribution towards the reduction of feed stuff imports and their effects on the environment as well as making dairy farming profitable. Condensed tannins are secondary plant substances, which form complex microbial compounds with proteins (tannin protein complex) that are not or only marginally degradable. Through multilateral cooperations of the project partners, the results thus gained contribute towards a broadened understanding of the relationships in the process chain "condensed tannins – feeding – milk composition". As a result, the possibility arises that in the long run less protein-rich concentrated food, such as soybean meal, needs to be bought in addition.

www.bfr.bund.de

Consumer protection starts with species-appropriate animal husbandry – the competence network "PHENOMICS"

Livestock is an indispensible resource for the production of high-quality food. In this aspect, its health plays a central role, and that not only for the production but also for the consumer. Performance and yield increases must not be achieved at the cost of animal health or animal protection. The researchers of the agriculture cluster "PHENOMICS" aim at developing strategies for species-appropriate livestock farming. For this purpose, they investigate the animals from their genes and the related genomic bases down to all life processes, the physiology. In practise this means that they work at the molecular level, to investigate the tissue of cattle and pigs for instance, as well as look at behavioural patterns. The subsequent linking and networking of knowledge from animal breeding, veterinary science, genetics and behavioural biology make a significant contribution towards developing a species-appropriate animal husbandry. To make its results accessible and to promote an open exchange, the agriculture cluster also organises regular workshops and seminars for young scientists.

www.phaenomics.auf.uni-rostock.de

Zoonoses and food safety along global supply chains – "ZooGloW"

Zoonoses, infectious diseases that can be transmitted from animals to humans, present a significant risk to public health if pathogens enter food. The project partners from the joint research group "ZooGloW" therefore investigate current threats through zoonoses in food supply chains and develop prevention strategies. Using pork and poultry products, global goods flows are recorded and the risk to different population groups in Germany due to a random introduction of a zoonotic pathogen is analysed. In a further step, the existing monitoring concepts are tested, optimised and complemented through innovative intervention strategies. To what extent the current legal situation is sufficient to control global supply chains is also assessed. Existing as well as new examination methods in food monitoring are subjected to a cost-benefit analysis. The role of the consumer in food security is also at the focus of the joint research group "ZooGloW", since a comprehensible and effective risk communication can contribute towards better protecting the informed and responsible consumer from food-borne infectious diseases.

www.bfr.bund.de

Research all about milk – the competence network "FoCus" – Food Chain Plus

For several thousands of years, milk has been an important food for humans. The competence network "Food Chain Plus – FoCus" aims at investigating the effect of milk on a person's health. For their analysis, researchers look at the entire production and supply chain and investigate, for example, the links between feeding and animal health. A further focus lies on the investigation of health-promoting traits of milk in view of the development of new functional dairy products.

www.uni-kiel.de/aktuell/pm/2010/2010-087-food-chain-plus.shtml und
www.mri.bund.de/de/institute/sicherheit-und-qualitaet-bei-milch-und-fisch/forschungsprojekte.html

Food safety through reduced post-harvest losses – "Food Metabolomics"

The cultivation of more resistant vegetable varieties could in future contribute towards an increased food security for consumers and at the same time reduce post-harvest losses. Mould on vegetables and thus post-harvest losses are to be reduced. In a joint project, four different types of tomatoes were investigated with regard to their vulnerability to moulds of the Alternaria genus. Very different resistance characteristics were demonstrated. With the help of the most modern analysis methods ("Food Metabolomics") tomatoes were investigated with regard to their components to identify those which result in resistance. It transpired that less susceptible varieties contained an acid, quinic acid, that the highly sensitive types of tomatoes do not contain.

www.mri.bund.de/de/institute/sicherheit-und-qualitaet-bei-obst-und-gemuese

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More potatoes, better nutrition, more money

Potatoes are one of the most important basic foods worldwide. Especially in developing countries, including particularly African ones, the importance of potatoes in the diet increases. The cultivation of nutrient-rich potatoes is ideally suited for smallholdings, because the yield per unit area is relatively high compared to other food cultures. But without the appropriate know-how, the potato yields remain far below what is possible. The project aims to improve the quantity and quality of the potatoes harvested by smallholders in the Kenyan and Ethiopian highlands in a lasting fashion. This has a positive effect on the families' food security as well as their income. It is to be achieved through a sustainable intensification of the overall cultivation system. This concerns predominantly cultivation and soil treatment methods that maintain and improve the soil fertility and health. Equally important are adapted plant protection measures. But the technique alone does not decide whether farmers will utilise the new methods long-term. That is why the researchers of the International Potato Center (CIP) also keep an eye on the socio-economic environment.

www.cipotato.org

Healthy and safe foods – a remedy against aflatoxin

Many millions of people in developing countries, it is estimated, ingest the mycotoxin aflatoxin with their food. Aflatoxins are produced by the fungus *Aspergillus flavus*, which preferably infests maize and peanuts and cannot even be destroyed through cooking. Aflatoxins are highly toxic. You can neither smell nor taste them. They cause liver cancer and weaken the immune system. In children mycotoxins cause developmental and growth disorders. Cases of death are not uncommon. Products contaminated with aflatoxin are also harmful when used as animal feed. On the one hand, they endanger the animals‘ health, on the other the toxin is not broken down in the digestive system. If cows are fed with contaminated maize, the aflatoxins are found in the milk and thus enter the human food chain.

But you can trick mould. Scientists in Nigeria have developed an antidote. For this purpose, they have examined 4500 fungi strains of *Aspergillus flavus* that occur in Nigeria, and have found 20 that due to a genetic defect do not produce the toxin. From these 20, the scientists have in turn selected four strains, which became the basis of a new fungicide – a biofungicide. Meanwhile, the fungicide developed by the Nigerian researchers with the support of the German development cooperation is employed in several African countries. The aflatoxin load of the products of farmers who use the biofungicide on their maize fields has declined between 80 and 90 percent. The agent retains its effect beyond the harvest and thus protects the stored maize from spoiling.

www.iita.org · www.aflasafe.com

Sorghum bread and argan oil – better products for economic development

The increase of the quality of food products not only has a positive effect on the diet, but can also contribute towards an improvement of the economic livelihood. To this end, sorghum was at the heart of one project. Sorghum is one of the most important crop in Sub-Saharan Africa. In this project, the production of gluten-free sorghum bread was investigated to improve the physical characteristics, the chemical composition and the taste of the bread. Ultimately, this leads to higher sales figures in sorghum bread and the reduction of the region’s dependency on imported wheat. It thus also improves the economic livelihood of the local people.

Another project concerns itself with the investigation of the effect of individual processing steps in the supply chain on the quality of argan oil. To this end, the composition of unwanted and wanted ingredients as well as aromatic substances, the sensory quality and the storage capability of high-quality argan oil are examined “from tree to bottle” in this project. project. The results will lead to a qualified definition of different processing steps for the production of argan oil and thus help Moroccan producers bring high-quality products to market.

www.mri.bund.de

Health care starts with nutrition – the joint project "glucosinolate- and selenium-enriched broccoli"

A good diet is not just tasty; it also has a positive influence on health. Earlier studies already provided clues that the plant substance glucosinolate may prevent cancer. This substance occurs in high concentrations in broccoli and cabbage. Under the management of the German Cancer Research Centre in Heidelberg, one joint project concerns itself with the preventative effect of glucosinolate on prostate cancer. The researchers managed to prove, amongst other things, a link between eating habits or rather the glucosinolate intake and the number of prostate cancer cases. According to their findings, the number of cases amongst the men with the highest intake of glucosinolate was up to 30 percent lower than amongst the men with the lowest intake. The researchers also found out that the preparation plays a role. They observed that eating raw broccoli had a greater effect than eating the cooked vegetable. Dosage and presentation influence the effect and possible risks. The insights gained help develop functional foods and foods that promote health, foods, which can also contribute towards a prevention of cancers.

www.dkfz.de

Join together against hunger – the GlobE Research Network "Trans-SEC"

The fight against hunger can only be won by joining forces. Therefore, new solutions are jointly studied in the German-African research network "Trans-SEC". The scientists concentrate on the particularly vulnerable rural population of Tanzania and aim for an improvement of the nutritional situation for 4000 local households. To this end, the researchers work together with farmers, entrepreneurs and non-governmental organisations and scrutinise the entire supply chain from production, to processing and finally marketing. Next to the identification of problem areas in the food supply, "Trans-SEC" concentrates on developing, with the involvement of the population, new regionally adapted solutions that contribute towards food security. A further goal of the researchers is to make the gained knowledge accessible and to disseminate it, for instance through trainings or workshops.

http://project2.zalf.de/trans-sec/public/

Knowledge on agricultural markets as crisis prevention – "AGMEMOD goes Africa"

High food prices have alarmed African organisations and governments. They want to develop strategies to improve the local food situation. For this purpose, they need to know what factors influence the supply situation and how they can be controlled politically. With the project "AGMEMOD goes Africa" German agricultural economists support the development of this analytical competence in different African regions. Jointly with scientists from Ethiopia, Kenya, Uganda and Rwanda, they further develop the market model AGMEMOD, to predict the future supply situation in regard to local and imported foods. AGMEMOD stands for AGricultural MEmber States MODelling. Hidden behind this is a computer-based system of mathematical equations, which describes the dynamic of supply, demand and pricing in agricultural products in the member states of the European Union and its candidate countries as well as other states. With the help of influencing factors such as politics, demographics and economic growth these relationships are projected into the future.

www.agmemod.eu

Understanding agriculture worldwide – the international network "agri benchmark"

How will global markets for beef and pork change when new free trade agreements come into effect? How do dairy farms in Norway with the highest yields in Europe manage to fulfil the strict rules on animal wellbeing? With which problems will rice producers in Asia be confronted? "agri benchmark", a global network of agriculture economists, consultants and producers, addresses such questions. Using internationally standardised methods, it compares production systems, their profitability, driving forces in production and markets. From this cooperation, perspectives are to be won for the world's most important agricultural goods. Thanks to "agri benchmark", international data and information is comparable and assessable for everybody. It is investigated how typical companies produce, what costs and incomes are accrued, what framework conditions are relevant in each case and in what direction production is expected to move. The unique data depth and quality guarantees exact information and helps companies, producers and institutions to make effective decisions. Politics also uses these results. The global challenges in the agricultural sector cannot be overcome without such expert networks. Currently "agri benchmark" comprises more than 40 countries.

www.agribenchmark.org

Responsibly using the West African richness in fish – the trilateral research initiative "AWA"

The shelf areas off the coast of West Africa are particularly rich in fish. However, fishery, especially through large trawlers from third countries, takes place largely in an uncontrolled fashion. Added to this is the fact that it is not known how climate change will affect the worldwide fish resources and the coastal fisheries of the neighbouring states. The German, French and African consortium "AWA" makes a start here. The goal of the project is a strategic partnership that will be able to develop an "ecosystem approach to the management of fisheries and the marine environment in West African waters". To this end, not only do experts of fishery and ecosystem research, biochemistry, oceanography and climate sciences work closely together. A cross national cooperation – mainly with the affected African states – is also practised, together with "training on the job". On board the research vessel "Walther Herwig III", a first expedition into West African waters in June/July 2014 brought together scientists from Morocco, Mauretania, Senegal, Spain and Germany. A second will follow in 2015. "AWA" created the basis to better understand the key ecological processes in this marine region. Building on this, monitoring methods are to be established and the decision makers to be provided with options for action for a sustainable management of the marine resources.

www.awa-project.org

Healthy eating for all

An adequate supply with food of good quality is a human right. Not just the qantity of food, but also the quality increasingly becomes the focus. A lack of minerals and vitamins, especially in childhood or even in the womb, can lead to irreparable damages. But also a different trend has begun to stand out over the past decades – overeating. In 2013, approximately 2.1 billion people worldwide counted as overweight, 671 million of these as obese. Many people in developing countries and emerging economies increasingly adapt their eating habits to those of industrial nations. As a result, the question is not about sufficient food for all. It is about making a diet possible that is varied, diverse and adapted to the respective life situation.

What we eat plays an important role in our wellbeing. An adequate supply with energy from carbohydrates and fat satisfies hunger, however, for a healthy and balanced diet this alone is not enough. Fruit and vegetables, whole grain, pulses as well as foods rich in protein, as for example fish, meat or protein-rich plants, also belong in a healthy and varied diet. The necessary foods are readily available in these parts. It's a different matter in developing countries and emerging economies where the availability of fruit and vegetables as well as protein often is a problem. The fact that food may not be available, accessible or appropriate is one of the main reason for sometimes grave deficiencies in micronutrients such as vitamins and trace elements. This type of malnutrition, which is referred to internationally as "hidden hunger", often leads to serious diseases caused by deficiencies. A varied and diverse diet provides the basis to confront this hidden hunger. As a supportive measure, foods can be supplemented with nutrients to avoid serious deficiencies. One example is an insufficient supply with vitamin A, which generally increases the perceptibility to infectious diseases.

250 million children at preschool age suffer from this, mostly in developing countries. The World Health Organization (WHO) estimates that each year between 250 000 and 500 000 of these children will go blind and about one million of them will die. The development of a genetically modified rice variety is one approach with which science wants to combat vitamin A deficiency. The "Golden Rice" variety is particularly rich in the natural dye beta carotene, a precursor of vitamin A. In future, the seeds are to be made available free of charge to smallholders. The targeted supplementation of crop plants with important nutrients for a balanced diet is possible not only with genetic engineering but also with the classical method of plant breeding. Many crop plants are optimised in their composition through breeding. The primary objective of all approaches must be the development of a sustainable, productive and varied agriculture and food industry as basis for a sufficient, comprehensive and balanced food supply.

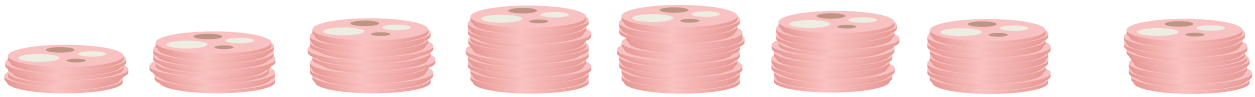
The research initiative "Nutrition – Diversified Agriculture for a Balanced Diet in Sub-Saharan Africa" by the Federal Government of Germany directly involves African farmers in research activities. The projects concentrate on Eastern and Southern Africa. The goal is the improvement of the diet through a greater variety in the supply and actual consumption. The projects increase the significance of native and increasingly displaced local varieties of fruit and vegetables. Through the additional plant-based foods the nutrition status of the population is to be improved.

Obesity: the heavy weight amongst widespread diseases

Whilst the worldwide battle against hunger and malnutrition is by no means over, two other nutrition problems rage at the same time in the affluent societies of the industrial nations and increasingly also in the middle class sections in emerging economies: excess weight and obesity. Obesity is a nutritional and metabolic disease that leads to severe excess weight. Already the WHO ranks adipositas as the fastest growing health problem and refers to it as the "global obesity epidemic".

Although the possibilities of a healthy diet and an active lifestyle are manifold, we still too often help ourselves to

Worldwide the average per capita consumption of meat lies at about 43 kilograms per year.



Consumption of meat and meat products per capita in Germany:

1950	1960	1970	1980	1990	2000	2010	2012
37.0 kg	59.7 kg	76.8 kg	100.5 kg	10.1 kg	90.7 kg	89.5 kg	87.0 kg

One example of the effects of a growing prosperity on the diet is the meat consumption in Germany. During the times of economic upturn after the Second World War, meat consumption increased sharply and stabilised on a high level. With a consumption of 87 kilograms in the year 2012, Germany lies considerably above the global per capita consumption of 42 kilograms of meat (with regard to the slaughter weight of the animals).

Source: Statistics and reports from the German Federal Ministry of Food and Agriculture (www.bmel-statistik.de);
FAO (2014): Food Outlook (Note: The figures from the years 1950 to 1980 refer to former West Germany.)

curried sausage, burgers & co and too infrequently to fruit or vegetables. We also spend too much time in front of televisions and computers. In Germany, 67 percent of men and 53 percent of women are overweight. Every fourth (23 percent of men and 24 percent of women) is obese. Obesity promotes vascular diseases and joint complaints. With the increased bodyweight the risk of diseases such as Diabetes mellitus type 2, high blood pressure and cardio-vascular diseases but also cancers increases. Already the young generation carries a heavy load for the future: Seen in total, the number of school beginners who weigh too much has doubled over the past 25 years. In the meantime, every fifth child and every third adolescent is overweight in this country. Recent surveys found a stagnation of the number of overweight people and register a first slight downturn in this trend in some age groups. However, within the group of overweight people the number of obese people noticeably increases. Particularly young adults are affected. According to the WHO, excess weight and obesity already represent the fifth most frequent cause of death worldwide. We live in abundance, but we do not live healthily. To get to the bottom of this phenomenon, consumer and behavioural studies with socio-economic and social science-based approaches provide valuable aids. One example are the “nudging” measures, the hidden “encouragement” of consumers to change their behaviour, for example through better positioning and presentation of healthy products in shops and markets.

Abundance and deprivation go hand in hand

However, the number of overweight people does not only increase in industrial nations. The typical diseases of affluence, which accompany obesity, are also on the rise in the cities of many developing countries. The consequences are illnesses through malnutrition and overeating. The bad things is, both factors not only add up, they increase each other dynamically. People who suffered malnutrition as children have a higher risk of being overweight and developing associated illnesses as adults. This phenomenon is described with the term “double burden of malnutrition”. It poses considerable additional problems for the public health systems, which particularly in the poorest countries are often in a desolate state.

Not just the income, but also, the level of education in particular counts as a significant factor for healthy eating habits. Comprehensive nutritional education and offers for counselling therefore remain important. The focus lies on parents with small children as well as kindergartens and schools and structures that make it easy for people to make a healthy choice in their everyday life. Both apply to developing countries and emerging economies, but also to us.

In Germany, the Federal Government actively addresses this complex issue, and in 2008 has agreed on the National Action Plan "IN FORM – Germany's initiative to promote healthy diets and physical activity". By linking behavioural and environmental prevention, by setting and distributing standards for a balanced diet outside of the home, for action recommendations on the diet from pregnancy to infancy and for modules on nutrition education in kindergartens and schools as well as networking the respective stakeholders, "IN FORM" also contributes towards bringing findings from nutrition research into practise.

Malnutrition – partly a question of style

Many people consciously want to eat healthily. Today, the food industry offers various products for those who want to orient their diet on the ingestion of specific ingredients – or the opposite, who selectively want to avoid certain components. Especially in affluent countries such as Germany, food allergies and intolerances to individual components have noticeably increased. The causes for allergies and intolerances may be rooted in our genes. One example for this is the absence of particular digestion enzymes. But also environmental factors may play a role in this context.

A genetic predisposition also exists in many widespread diseases such as diabetes, cancers and cardiovascular diseases. Besides genes, also environmental influences, as for instance activity levels as well as eating habits, play a central role in their occurrence. Nutrigenomics dedicates itself to the interplay between food components and the genome. By decoding the genes, researchers hope to be able to provide people with nutrition plans that are tailor-made for their respective bodies. The knowledge of personal risks – as far as the individual wants to know – represents another instrument in prevention. Each individual is thus able to make a conscious decision on how to eat healthily.

But the causes for the increase of nutrition-related diseases are not just to be looked for in the genes. Eating always takes place in a cultural and social context. Through the inclusion of other subject areas, this context is to be integrated more into the scientific and technological considerations.

Stop wasting food!

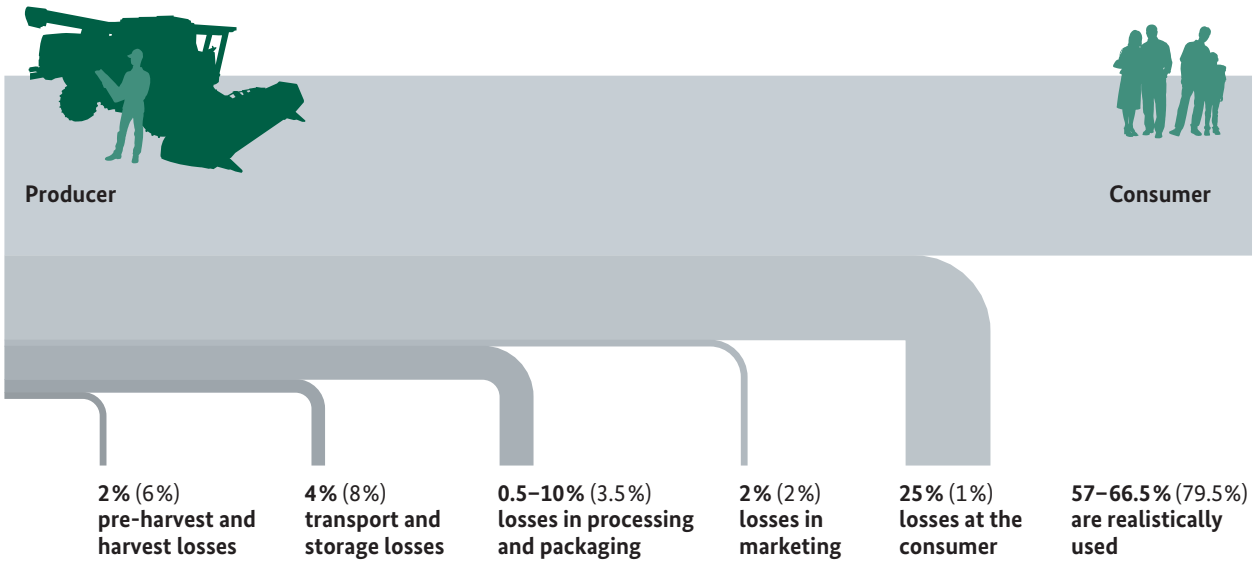
Besides the improvements in the cultivation of crops plants and in animal husbandry, the avoidance of losses and the reduction of food wastage are further important building blocks for a sustainable food production and sufficient food supply worldwide. Currently, about one third of the food produced for human consumption gets lost or is wasted every year worldwide. This nearly equals 1.3 billion tonnes per year. Counseling and education are important factors to preserve these foods.

Losses in foods basically occur on all levels of the value chain: in agriculture, in processing, in trade and finally in consumption. Especially in developing countries technologically caused post-harvest losses are considerable. They occur through inefficient processing methods or a complete lack thereof, losses in transport and predominantly through inappropriate storage. New agricultural, transportation and storage techniques provide the opportunity to greatly reduce these issues. In industrial nations the biggest losses occur at the end of the value chain, in the trade or with the consumers.

The amount is estimated at about 222 million tonnes per year and thus almost equals the entire net production in Sub-Saharan Africa of 230 million tonnes. Research and development support the addressed efforts by developing improved and adapted techniques but also by bringing about behavioural changes through education and targeted measures.

Too good for the bin

In Germany alone, eleven million tonnes of food are thrown away annually by the food industry, bulk consumers, trade, and private households. The majority of this food waste (61 percent or 9.7 million tonnes) is generated in private households. Each person in Germany throws away 81.6 kilograms of food per year. About two thirds of this, in other words approximately 53 kilograms, could be avoided. To tackle the challenge of this food wastage, the Federal Government of Germany started the initiative “Too good for the bin” in 2012. It promotes more appreciation of food and offers helpful tips to private households.



Losses in the European supply chain (Figures for Sub-Saharan Africa stated in brackets)

Source: Gustavsson, J. et al.(2011): Global food losses and food waste – Extent, Causes and Prevention
FAO & Swedish Institute for Food and Biotechnology (www.fao.org)

After all, everybody can contribute towards the reduction of food waste through even small changes in the handling of food – from the conscious purchase, the appropriate storage all the way to the sensible use of leftovers.

The avoidance of waste can also be supported technically. To this end, for instance, sensors in packaging materials can help indicate the freshness of a food. In parallel, innovative processing and preservation methods as well as new packaging materials allow a longer shelf-time for food stuffs – and that without losses in quality. One thing that applies to all innovative techniques and new materials is that their safety for our health must be ensured as soon as they come in contact with foods. Next to technically oriented research and development approaches, economic and social aspects must also be integrated more. But approaches that consider purchasing and consumer habits also deliver important suggestions and much needed impulses.

The waste of foods, however, can also be reduced through a change in the framework conditions, for example through the drafting of standards and regulations. Some fruit and vegetables do not even reach sales as fresh goods simply because of their appearance, for example because they do not meet certain norms. Part of a responsible handling of produced goods is a reassessment of standards and guidelines but also of our own behaviour as consumers.

Changing consumer habits

Over time, eating habits have changed worldwide. In the past, people used to exclusively live off seasonally available foods from their region. Plants and animals, from which foods were made, were adapted to the local natural conditions. Thanks to modern agricultural methods, it was later possible to cultivate crops independent of seasons and regional conditions. Through breeding successes, our crops could become more resistant and higher in yield. What is more, through improved packaging and preservation methods, such as, for instance, vacuum packaging, pasteurisation or shock freezing, normally perishable foods have been given a longer shelf-life, so that they can be traded worldwide without big losses. It was innovative developments and continuous research that made this possible.

In the industrial countries the range of foods on offer is vast, and increasingly more luxury foods, such as coffee and cocoa, are being consumed. For this reason, many resource-intensive foods end up on our bill of fare, which often have to be imported. Moreover, for many people products made from animals are part of a balanced and varied diet. With a more conscious consumer behaviour, consumers could also significantly contribute towards the preservation of resources and the improvement of world nutrition. Seen globally, meat currently delivers 33 percent of the protein required for nutrition. But livestock farming is particularly area and resource-

The diagram shows in which areas production losses occur in global comparison. Whilst the losses are highest at consumer level in Europe and the industrial countries, they are highest at transportation and storage as well as processing level in developing countries and emerging economies. Therefore, different starting points and strategies are required for the reduction of these losses.

- Pre-harvest and harvest losses
- Transportation and storage
- Processing and packaging
- Marketing
- Consumer

Source: Gustavsson, J. et al.(2011): Global food losses and food waste – Extent, Causes and Prevention, FAO & Swedish Institute for Food and Biotechnology (www.fao.org)

intensive. With an equal amount of production resources, the same amount of food can be made available without the detour via animals' stomachs.

Almost two thirds of the grain used in Germany ends up in the feeding troughs of livestock to produce meat, milk and eggs. And even that is not enough. We have to import feed stuffs and thus are also using areas outside of Germany. What is more, cattle, sheep and other herbivorous animals pass a large part of the methane, which contributes towards the greenhouse effect. With less meat on the plate, each individual could contribute towards slowing down progressive global warming – and there would be more food available for all of us.

Making food healthier

Cultivated crops from which foods are made, naturally contain hundreds of different ingredients, such as, for example, proteins, carbohydrates such as sugar or starch, fats, minerals, and many other plant substances. Many components are particularly useful for our health, others rather harmful. An important starting point is to remove the harmful substances in plants or to increase the concentration of healthy ones. Through research and targeted plant breeding we have succeeded, for example, in noticeably reducing the content of toxic solanine in tomatoes and potatoes. The substance makes itself known in the raw fruit through a bitter taste and in high doses leads to symptoms of poisoning. The content of phytochemicals, as for instance anthocyanins, which positive properties are attributed to, can also be influenced in tomatoes. Further approaches are the increase of the content of long-chain omega-3 fatty acids in rapeseed or the reduction of those proteins in plants that cause food intolerances or allergies in some people. Altered enzymes and starches in foods, on the other hand, are to lower the formation of toxic substances. Acrylamide, for example, is formed when foods are heated that contain starch and the amino acid asparagine. To reduce the adverse health effects, there are experimental approaches that reduce the asparagine content in foods through enzymatic treatment during processing.

Furthermore, the abundance of the nutrients and thus the taste are influenced by processing. Coffee beans and tea leaves, for example, contain more than 1000 components. The patterns of components typical for crops, in turn, change with the processing of food. New aromatic substances are thus generated when roasting coffee or fermenting tea. Other substances are broken down. However, we know very little about most of the components. To learn more about the actual relationships between individual components and their health effects, extensive research is required. For this purpose, the various approaches must also take into consideration the regional specifics and be implementable at the local level.

As part of "HORTINLEA", German and African scientists address the regional cultivation of vegetables in some regions of Africa. Their goal is to increase the regional production and the range of vegetables and not just improve the yield quantity, but also the quality of food in these countries. Additional to vitamins, fruit and vegetables contain valuable minerals, carbohydrates, proteins and dietary fibres. There are also phytochemicals such as flavonoids, carotenoids and glucosinolate, to which health-promoting effects are attributed. The project "Healthy Vegetables" follows a similar approach with the aim of breeding nourishing cucumbers in the gardens of South-East Asia, which are to support predominantly the poorer population groups and school age children in a balanced and health-promoting diet.

Understanding the value of food

What value food has for us depends, amongst other things, on how much we know about it. Therefore, stronger consumer information and education about nutrition are important in helping to better gauge the shelf-life and use of foods in daily life. But research also requires additional knowledge about our eating habits. Only when we better understand the interplay of mankind, nutrition and the environment, can we develop strategies suitable in everyday life for a healthier and more sustainable nutrition. Regionally focussed knowledge and research centres are formed with the funding measure "Competence Cluster for Nutrition Research" of the Federal Government of Germany, which dedicate themselves exactly to that subject matter.

Food security comes first

We use plant and animal resources not only to feed ourselves. They increasingly gain in importance as an alternative to fossil raw materials. Biological resources are the basis for a modern biobased economy. But the cultivation of plants for a material and energetic use can compete for valuable farmland with the production of food. Through the prioritisation "food first" it is made clear that food security has to come first. Only then can the material and energetic use of biomass be an alternative to coal, crude oil and natural gas.

Besides the competition for land, it is also the prices on the agricultural markets that is sparking debates. When alternative usage paths exist, prices are based on the highest-priced market segment. Through targeted funding measures and subsidies, it is currently often the energy market that influences the price and thus the cultivation and usage priorities. Increasing prices mean higher income for farmers. Thereby investments and progress in production are possible. The one-sided condemnation of increasing agricultural prices falls short of the mark. In countries such as Germany, where only a small part of the income is spent on food, food remains affordable despite increasing prices. In other countries, however, increasing food prices can critically threaten people's livelihoods. To counterbalance the issue of resource competition, the following applies to the biobased economy: Food comes first, then the chemical material use and lastly the energetic use.

In addition, various aspects of the protection of valuable food must be addressed at the same time: cultivation, harvest, storage and transport, food production, trade and in our homes. Food security therefore is not just a challenge for people in developing countrys and emerging economies. It remains a global challenge, also for us here in Germany.

Under the term "bioeconomy", we understand the movement away from fossil raw materials towards the use of biological resources. It comprises the sustainable and efficient use of biological resources such as plants, animals and microorganisms as an alternative to fossil and finite raw materials such as coal, crude oil, natural gas or uranium. The bioeconomy influences many economic sectors. The prerequisite is that biological resources are produced, treated or processed. New technologies, processes and methods are necessary to produce numerous products of the highest quality and with the best utility properties in analogy to crude oil. Securing the global nutritional basis has priority in the bioeconomy. With the "National Research Strategy Bioeconomy 2030" as well as the "National Policy Strategy Bioeconomy" the Federal Government has created the framework for building a knowledge-based bioeconomy as an alternative to the fossil economy in Germany.

“You can only demand what you practise yourself.”

Prof. Dr. Joachim von Braun is one of the two acting chairmen of the Bioeconomy Council, which advises the Federal Government of Germany in the implementation of the “National Research Strategy Bioeconomy 2030”. Between 2002 and 2009, the agricultural economist directed the International Food Policy Research Institute (IFPRI) in Washington and today is the Director of the Centre for Development Research at the University of Bonn.

Why is it important to turn our backs on the oil decade and establish a biobased economy?
The excessive use of fossil resources is not sustainable and damages the environment and climate. A biobased economy on the other hand is based on renewable resources and uses natural cycles of materials. By turning towards the bioeconomy, we create the basis for a sustainable economic growth and also for technologically interesting jobs for the next generations.

What stakeholders are particularly important for an internationally competitive bioeconomy?
In the start phase of the bioeconomy government action is required. Bioeconomy research must be funded long-term, because, in addition to courage, companies require adequate finances and good framework conditions to implement their ideas into practise.

Why does Germany also have to take international responsibility for world nutrition, the raw material and energy supply as well as the protection of the climate and environment?
You can only demand what you practise yourself. Germany is one of the most affluent countries of the world, leading in the research and development of sustainable technologies. We have the duty to help countries with nutrition problems through cooperations and to jointly solve the global environmental issues.

How are the German bioeconomy strategies, in other words the national research strategy and the political bioeconomy strategy, linked and coordinated in the international context?
With the “National Research Strategy Bioeconomy 2030”, the Federal Government of Germany has assumed a pioneering role, which is highly regarded internationally. It is to become part of an international funding network, for example in a UN or G20 context. In the political bioeconomy strategy, the Federal Government commits itself to a congruent policy beyond a mere funding of research. It is a pleasantly ambitious agenda.

How long will it take until a bioeconomy has been set up?
The bioeconomy has already become reality. But its expansion will be a too slow a transformation if it is not purposefully conducted. Time is short. The industry still uses the possibilities of the bioeconomy insufficiently. Today, plastics made from renewable raw materials, for instance, account for only 0.5 percent of the total annual amount of 300 million tonnes. 90 percent would be feasible. The building materials industry only sluggishly moves towards biobased materials, not to mention the automobile industry. But changed consumer preferences, technological possibilities and a shortage in resources are the tough driving forces behind the bioeconomy, which should now be anticipated by politics and the economy.

Plants can either be used as food or used for energy production. How do we have to proceed with regard to the global nutrition situation?
Biomass should not just be burned. The “food or fuel” conflict is real and must be defused. On the one hand, we need changes in the bioenergy policy, especially in the US and Europe; on the other hand, we need innovations to increase the efficiency of the energetic use. At the same time, the opportunities for innovations in plant breeding and along the supply chain from agriculture to consumer must be used – in other words “food first” in harmony with a growing bioeconomy.

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