“We need a green

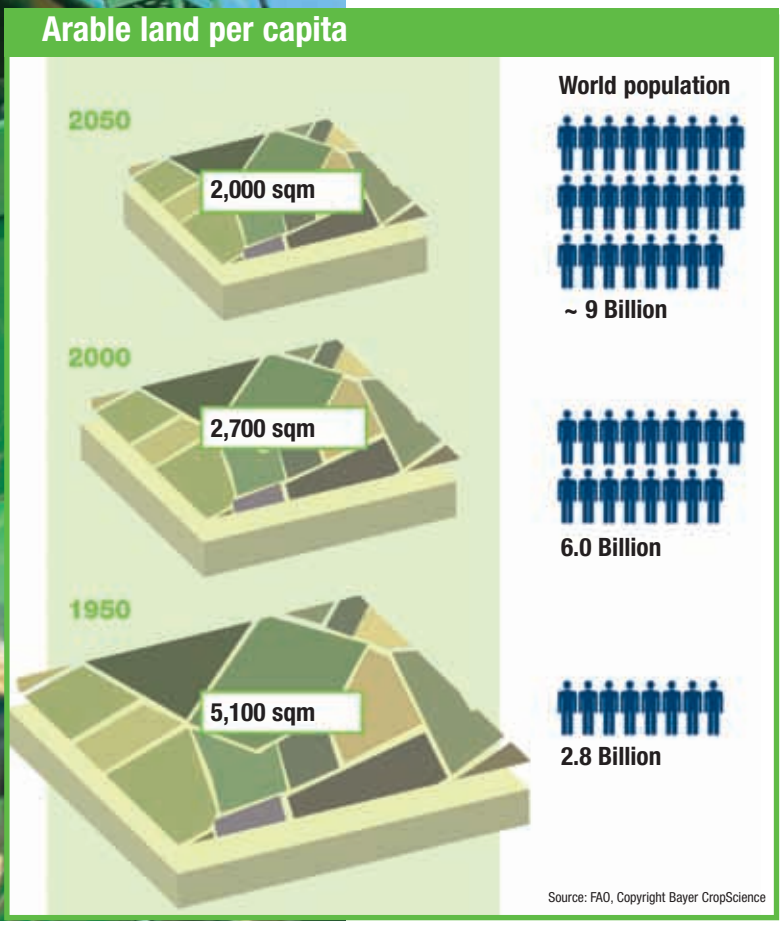
Safeguarding food for a growing world population

Modern agriculture: Combine harvester in a cereal field

Bayer CropScience

second revolution”

Our numbers are growing! By 2012, the world population is forecast to top the seven billion mark. In 2025, the number of people is even set to hit eight billion, with this rapid population growth taking place almost exclusively in developing countries, where over 80 percent of all people already live. And it is precisely these countries that are already hit by food shortages. The World Bank estimates that the number of hungry people in the world could shoot up quite soon from 850 million at present to 950 million. United Nations forecasts, meanwhile, show that only 40 percent of the land that was available for growing food in 1950 will be available per capita for safeguarding the supply of food in 2050.



Securing food with less land

Of the approximately 13 billion hectares of land covering the Earth's surface, around 1.5 billion hectares are used for agriculture, with a further 3.5 billion hectares being used for meadowland and pasture. This area of land cannot be increased. Every year, around seven million hectares of agricultural land are lost as a result of building construction, erosion, desertification and other causes. Without modern crop protection measures and fertilization, we would already need significantly more arable land, namely around four billion hectares. As a result of population growth, agricultural production must increase by around two percent per year in order to be able to safeguard the amount of food required to supply all people.

This figure does not yet take into account the increases in demand for meat. In China, for example, meat consumption has doubled in the last 15 years. For one kilogram of beef, it is necessary to produce well over seven kilograms of animal feed – this also drives up the demand for animal feed, which increases the competition for arable land for food production.

On top of this, worldwide food reserves have now dropped to their lowest level for 30 years. The main problem is that there is hardly any potential left for expanding the growing areas for wheat, rice or millet. In many parts of Asia, every last hill which can possibly be used has already been covered with fields and rice terraces. In many regions of Africa, it is likewise almost impossible to expand the amount of arable land. This is partly because the soils are simply not suitable, and partly because intensive farming would lead to desertification.

Extreme weather phenomena threaten harvests

Another problem is that meteorologists worldwide are registering extreme weather events with increasing frequency – the absence or displacement of tropical rainfall as well as abnormal ocean current phenomena. One well known example is El Niño: every three to six years, torrential rains devastate whole tracts of land in South America, while at the same time extreme weather leads to droughts in South East Africa, Indonesia and Australia, and frost in Florida, causing enormous harvest losses for farmers.

But it is not just natural catastrophes that cause billions of dollars' worth of agricultural damage each year: persistently unfavorable farming conditions such as water shortages, increasing salination of arable soils and extreme heat and cold are prime causes of enormous harvest losses. Corn, rice and wheat are no longer able to withstand the extreme environmental effects. Climate change is adding to the stresses to which plants are subjected, with grave effects; even with the best of care for their fields, farmers regularly lose 30-70 percent of their harvests.

Stop the self-destruction program in cereals

"There is an urgent need for us not only to make agricultural production more efficient, but also to do it in a way which is sustainable," says Professor Friedrich Berschauer, Chairman of the Board of Bayer CropScience. A key objective of the crop protection scientists is to increase corn, rice and wheat yields and make the plants more resistant to severe heat, cold, drought or intense sunlight. These factors put plants under enormous stress, triggering a process which can even lead to self-destruction: the plant increases its energy consumption and can therefore no longer produce certain energy transport molecules, which are however needed by the cells to survive. The supply gap has dra-

Bayer CropScience research scientists assess enhanced stress tolerance characteristics in a new generation of hybrid rice.

Fruit and vegetables supermarket in India. The wide range of

matic consequences for the plant, which can no longer supply leaves, fruit or stems properly with energy. Individual cells gradually die, followed ultimately by the whole plant.

Stress-tolerant plants are considerably better at coping with climate fluctuations

Researchers at Bayer Crop Science are using a trick to protect rice plants, for example, against a number of stress factors. They have put the plants on a fitness program. "Our idea was to get crops into shape," says Michael Metzlaff of the Bayer CropScience Innovation Center for Plant Biotechnology in Ghent, Belgium. To achieve this, his team is pursuing two strategies: firstly, the scientists incorporate genes into the plants which should help them deal with excessive stress caused by dry and wet conditions. Secondly, they quite specifically deactivate individual genes which trigger excessive stress reactions in normal plants and lower the yield. "Our goal is to enable plants to produce high, stable yields over the longer term in spite of fluctuating environmental conditions," Metzlaff says.

A "second green revolution" is needed

For Berschauer, biotechnology is a vital tool to safeguard the supply of food for the world population in the future. "We need a second green revolution. If we use plant biotechnology in combination with crop protection solutions in a targeted manner, we can achieve significant advances in productivity," comments Bayer CropScience's CEO. Other experts share this view: according to the estimates of the Consultative Group on International Agricultural Research, only with biotechnology can harvests be increased by around 25 percent.

Antifungal agents help wheat plants to grow

In Canada, Bayer CropScience researchers are already using advances in seed breeding to increase canola oil yields by up to 30 percent compared with conventional varieties. In addition to plant biotechnology, new crop protection agents can also increase harvest yields. The latest example is the active ingredient trifloxystrobin. Farmers all over the world have been using this agent for years to protect cereal, vegetable and fruit crops against harmful fungal diseases. But trifloxystrobin, an antifungal agent belonging to the strobilurin group of active ingredients, can do more: it also increases the ability of plants to withstand stress. "Field trials show that crops in which strobilurins are used produce better harvests than those protected with other types of antifungal agent," says Dr. Dirk Ebbinghaus, a Bayer CropScience research scientist. Crops protected with trifloxystrobin also do much better than untreated plants under conditions of drought. "Our active ingredient clearly triggers a number of different positive effects in the plant which result in an above-average increase in yield," says Ebbinghaus. The latest research results have also shown that certain active ingredients, i.e. the Bayer CropScience insecticide Gaucho®, can even make rice plants more resistant to fluctuations in the salt content of water.

Protecting biodiversity

Because the demand for high-quality food in adequate quantities and at affordable prices must not be allowed to jeopardize nature, Bayer Crop Science has committed itself to an important principle: using state-of-the-art technologies, the company wants to help both small and large-scale farmers achieve higher productivity on land already used for agriculture. This protects natural habitats from being converted into arable land. ■

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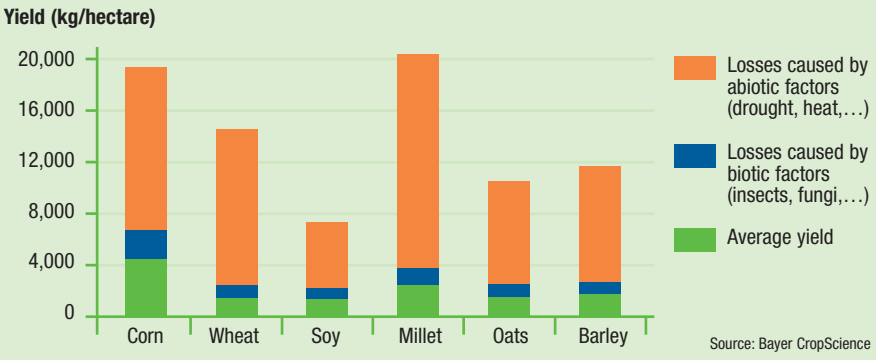
fruits forms a good basis for a healthy nutrition.

Stress causes dramatic harvest losses



Stress reduces harvests dramatically: cereals appear to suffer particularly from abiotic stress caused by heat, cold, drought or the oxygen deficiency that results from stagnant water or compacted soil. The potential harvest (total column length) is partly compromised by insect pests, plant diseases and competition from weeds. However, abiotic factors are responsible for the lion's share of harvest losses.