



Facts and figures –  
The status of  
global agriculture

Nearly **9 billion mouths to feed** by 2050;  
 the **ratio of arable land to population declining** by 40-55%;  
**3.9 billion people living under severe water stress** by 2030.

These are a few of the key factors affecting the future of agriculture.

At CropLife International, we work together for sustainable agriculture. The technologies offered by the plant science industry have a long history in improving agriculture and a critical role to play in meeting the challenges in a growing world – from tripling yields and reducing soil erosion to crops that can grow in saline soils and rice that requires less water.

Explore the facts and figures of the plant science industry and global agriculture.

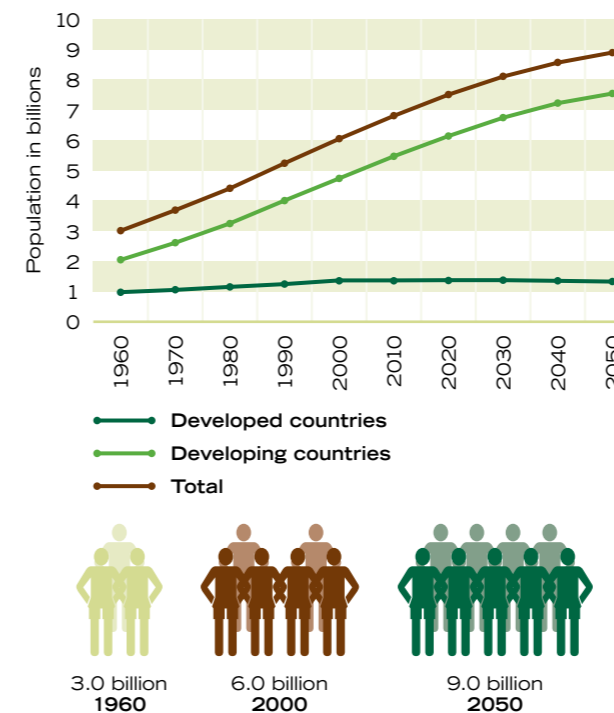
## We face increasing demand on the world's finite resources

As a global community, there are a multitude of issues to overcome along the path to sustainably providing for a diverse, growing population.

### DEMANDS OF A GROWING POPULATION

In the period from 1960 to 2007, the global population has grown from 3 billion to over 6.5 billion. Projections for future growth take that number to nearly 9 billion in 2050.<sup>1</sup>

#### POPULATION GROWTH, ACTUAL AND PROJECTED 1960-2050



The World Bank estimates that **one hectare of land will need to feed 5 people in 2025**, whereas in 1960 one hectare was required to feed only 2 people.<sup>5</sup>

### DIMINISHING AGRICULTURAL WORKFORCE

As rural populations decrease, so does the agricultural workforce. In Europe and North America, agriculture now represents about 5% of the workforce. In Africa and Asia, it is expected that the number of agricultural workers will have decreased from nearly 70% of the population in the 1980s to barely 50% by 2015.<sup>3</sup>

### RISE IN PER CAPITA CONSUMPTION

In the developing world, a factor which has a great impact on the global use of natural resources is the increase in food consumption. Available calories per capita have grown 37% since the 1960s in the developing world. On average, the increase is 21% worldwide.<sup>4</sup>

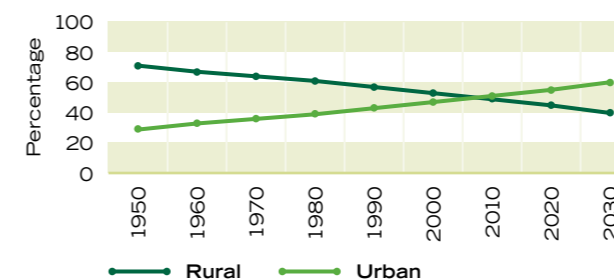
The UN Food and Agriculture Organisation (FAO) estimates that food production needs to increase by 70% if we are to feed nine billion people in 2050. Annual cereals output will have to grow by almost one billion tonnes from about 2.1 billion tonnes to meet the projected food and feed demand.

On top of increasing demand for food, increasing human population and a decreasing farm labour pool, we are also challenged with a dependence on limited resources.

### SHIFT FROM A RURAL TO URBAN POPULATION BASE

For the first time in history more people are living in urban areas than in rural areas. In fact, the share of rural population is expected to be about 40% by 2030, with less than 25% of that in Europe, North America, Latin America and the Caribbean.<sup>2</sup>

#### RURAL VS. URBAN POPULATION GROWTH 1950-2030

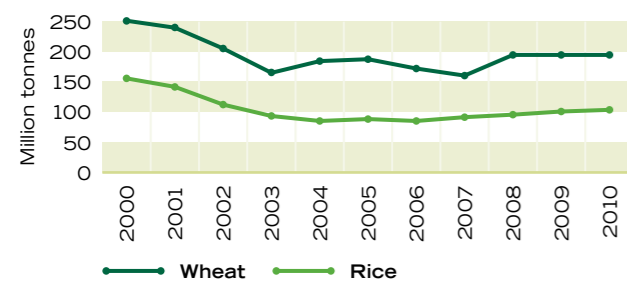


## Food crisis and sustainable development

### PRICES DRIVEN BY DECLINING STOCKS, POOR HARVESTS, AND GROWING DEMAND

Global commodity stocks have been steadily decreasing, contributing to increases in commodity prices. Between 2000 and 2008, global end stocks for wheat have decreased by 24%, reaching a long term low. Global end stocks for rice declined by 39% during the same period.<sup>6</sup>

### GLOBAL STOCKS (kt) FOR WHEAT & RICE, 2000-2010 (OECD-FAO)

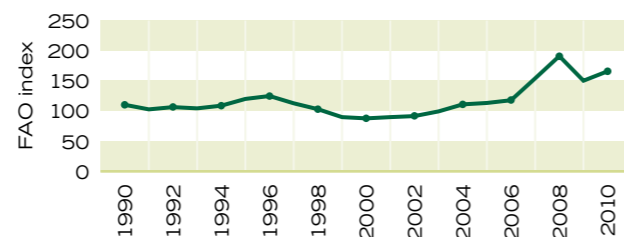


Global stocks of key crops have hit long term lows.

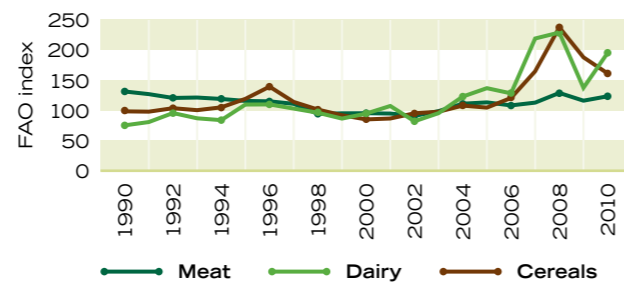
### HIGHER PRICES MAY PERSIST

The OECD forecasts higher than average prices for agricultural commodities over the long term. Potential for price stabilisation or decline could be severely hampered by many factors, such as those linked to climate change, price of gas and increasing water scarcity. The IMF estimated in April 2008 that food prices represented 44% of global inflation in 2007, and as much as 67.5% in Asia.<sup>7</sup> During 2009, following the impact of the global financial crisis and increased harvests, crop prices declined from the peak values of 2008, and have recovered only modestly.<sup>8</sup> However, prices have remained above that of the 2006 period.<sup>9</sup>

### FOOD PRICE INDEX, 1990-2010 (2002-2004=100)



### ANNUAL PRICE OF MEAT, DAIRY & CEREALS, 1990-2009 (2002-2004=100)



demand

## Food and poverty alleviation

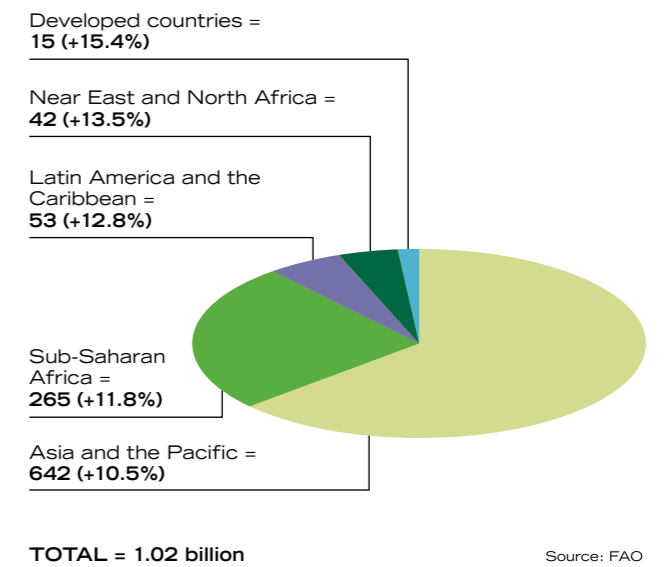
Small farmers are the most vulnerable. At a global level almost 90% of farms are small farms.<sup>10</sup> Higher food prices affect people differently. Some farmers may be able to benefit. But for households that buy more than they sell (net food buyers), higher prices are a threat. According to FAO data from nine developing countries, on average, roughly three-quarters of rural households and 97% of urban households are net food buyers.<sup>11</sup>

### INCREASE IN MALNUTRITION

FAO's projections revealed that even before the surge in food prices in 2008 and the global economic crisis in 2009, long-term trends of increasing hunger were already apparent. FAO estimates that 1.02 billion people were undernourished worldwide in 2009, representing an increase of 178 million from the nearly 842 million in 1990-92.<sup>12</sup>

At the regional level, the largest increases in the number of undernourished people as a result of rising food prices have taken place in Asia and in sub-Saharan Africa. The two regions combined account for 907 million, or almost 90%, of the hungry people in the world in 2009.

### UNDERNOURISHMENT IN 2009 BY REGION (IN MIL.) AND INCREASE FROM 2008 LEVELS (IN %)



Source: FAO

In 2009, the FAO estimated world hunger to have reached a historic high with **1.02 billion people going hungry every day.**

development



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## The limitations of our resources

The challenge of meeting growing demand is compounded by the limited resources at our disposal. Expansion of land under cultivation damages natural habitats and threatens biodiversity while increased water use is making it a fragile and scarce resource.

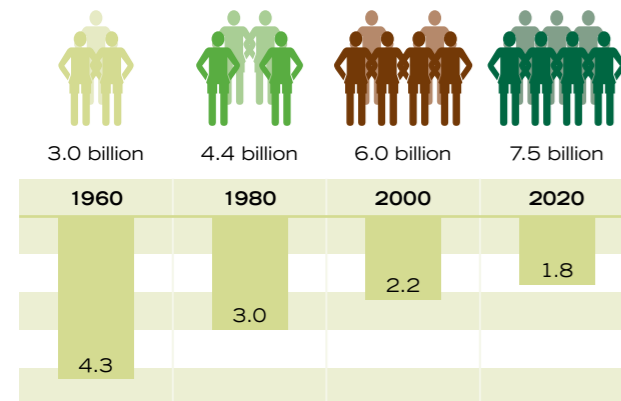
In addition, the effects of climate change are contributing to the challenge of meeting our current and future needs. The increase in droughts, desertification, flooding, soil salinity and soil erosion endangers our capacity to meet demand and more than ever points to the necessity of finding sustainable ways of farming.

### LAND

Around the world, the ratio of arable land to population is steadily declining. Between 1960 and 2000, it declined by about 40%, but in developing nations the decline has been fastest. In Africa, for example, the ratio of arable land to population declined by 55% in the same period.<sup>13</sup>

### MORE FOOD MUST BE PRODUCED ON LESS LAND (FAOSTAT)

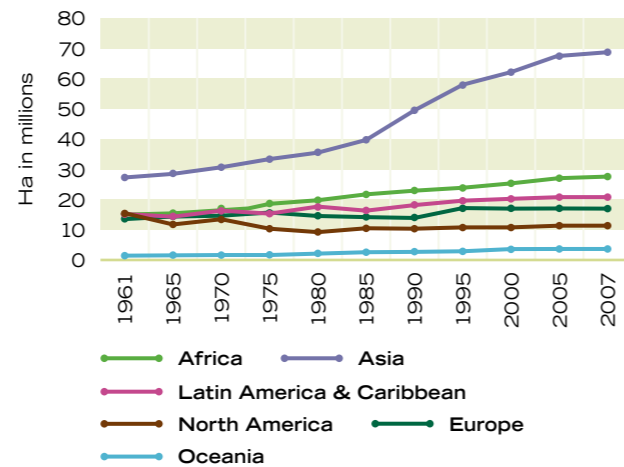
World Population



Arable land per person (hectares)

While available arable land decreases in developing nations, the area under permanent cropping has remained relatively stable in Europe and North America. In other regions, permanently cropped land has increased dramatically. In Asia the growth is 127% since the 1960s.<sup>14</sup>

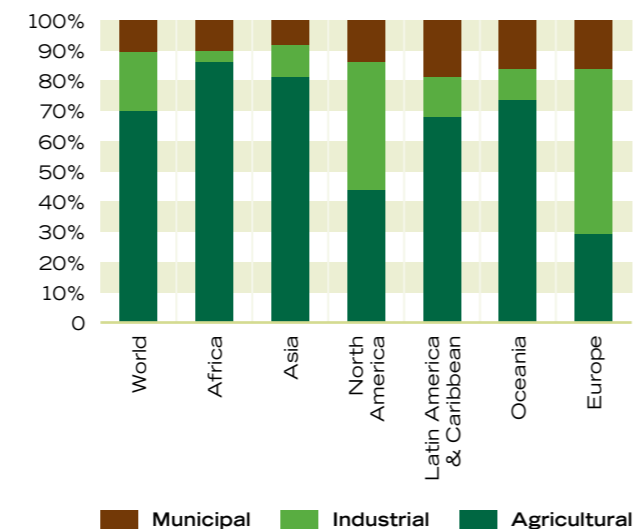
### AREA UNDER PERMANENT CROP (FAOSTAT)



### WATER

Water use has tripled over the last five decades, with demand for freshwater growing by about 64 billion cubic meters a year.<sup>15</sup> Agriculture accounts for approximately 3,100 billion m<sup>3</sup>, or 71% of global water withdrawals today, and without efficiency gains, will increase to 4,500 billion m<sup>3</sup> by 2030 (a slight decline to 65% of global water withdrawals).<sup>16</sup> The key driver behind water use remains increasing demand for agricultural products to meet the food, feed, fiber and bioenergy needs of a growing population.

### WATER WITHDRAWAL BY SECTOR, 2003 (FAO AQUASTAT)



**Agriculture accounts for 70% of fresh-water withdrawals** from rivers, lakes and aquifers – up to more than 90% in some developing countries.



In the U.S., the Field to Market study found that **50,000 fewer gallons of water are needed to grow an irrigated acre of corn today**, compared to 20 years ago. Today, one irrigated acre of cotton requires about 30% less water than two decades ago.

efficiency

The high water use in agriculture is dramatic given that many people have access only to limited water or water of poor quality. By 2030 it is estimated that about 3.9 billion people (47% of the world population) will be living under severe water stress, with Asian, African and Middle Eastern countries encountering the greatest pressure on water resources.<sup>17</sup>

Water scarcity is a critical constraint to agriculture in many areas of the world. In key food-insecure areas, dominated by rainfed agriculture (sub-Saharan Africa and peninsular India, in particular), anticipated reductions in production may have multiple impacts, including loss of livelihoods and displacement of rural populations. This will accentuate demand in global markets and put further pressure on irrigated production.<sup>18</sup>

A 1% increase in water productivity in food production can potentially make available an extra 24 litres of water per day per person. **On average, it takes about 3,000 litres of water per person to produce our daily intake of food.**<sup>19</sup>

More efficient use of water can be obtained primarily through improved application/use of water and through net water gains resulting from increasing yields. Land and water productivity are rising steadily – with average grain yields rising from 1.4 metric tons per hectare to 2.7 metric tons over the past four decades.<sup>20</sup>

Improved techniques, such as increased drip and sprinkler irrigation, combined with best practices such as no-till farming, improved drainage, improved varieties, optimised fertilizer use and innovative crop protection technologies can all contribute significantly to reduce agriculture's water footprint.<sup>21</sup>

## CHALLENGES TO BIODIVERSITY

Due to the increase in cultivated land, population growth and other environmental pressures, the diversity of plant and animal life is at risk. The 2010 biodiversity target to achieve a significant reduction of biodiversity loss, set by world governments in 2002, has not been met at a global level. Across the globe, natural systems that support economies, lives and livelihoods are at risk of rapid degradation, with significant further loss of biodiversity becoming increasingly likely.

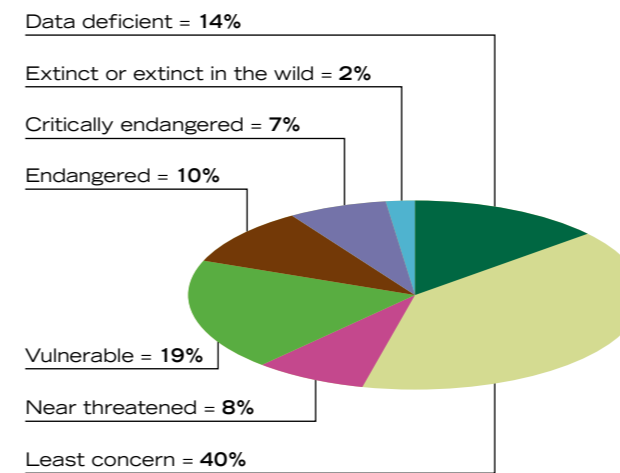
A considerable number of today's known animal and plant species are likely to be extinct, largely due to expanding infrastructure and agriculture, as well as climate change. Yet, our ability to mitigate climate change is dependent on the preservation of ecosystems. The quantity of carbon buried each year by vegetated coastal habitats such as mangroves, salt marshes and seagrass beds has been estimated at between 120 and 329 million tonnes. The higher estimate is almost equal to the annual greenhouse gas emissions of Japan.<sup>22</sup> Continued loss of biodiversity is likely to limit the Earth's capacity to provide the valuable ecosystem services that support economic growth and human well-being.<sup>23</sup>

The five principal pressures directly driving biodiversity loss (habitat change, overexploitation, pollution, invasive alien species and climate change) are either constant or increasing in intensity. Species in all groups with known trends are, on average, being driven closer to extinction, with amphibians facing the greatest risk and warm water reef-building corals showing the most rapid deterioration.<sup>24</sup>

Forests are estimated to contain more than half of terrestrial animal and plant species, the great majority of them in the tropics. Despite improvements in some countries, deforestation continues at an alarming pace. Just under 130,000 sq km of forest were converted to other uses or lost through natural causes each year from 2000 to 2010. Preliminary assessment suggests that 23% of plant species are threatened.<sup>25</sup>

Among animals, current rates of extinction are estimated to be 100 times higher than benchmark rates. General estimates indicate that at current rates, the conversion and deforestation of tropical forests and dry forests may wipe out 100,000-450,000 species within the next 40 years. Of the major vertebrate groups that have been comprehensively assessed, over 30% of amphibians, 23% of mammals and 12% of birds are threatened with extinction.

## PROPORTION OF SPECIES IN DIFFERENT THREAT CATEGORIES (CBD, 2010, GBO-3)



# challenges

## Biodiversity Losses

- **Bird populations in North American grasslands declined** by nearly 40% between 1968 and 2003, showing a slight recovery over the past five years; those in North American drylands have declined by nearly 30% since the late 1960s.
- Of the **1,200 waterbird populations** with known trends, **44% are in decline.**<sup>26</sup>
- Shellfish reefs play an important role in filtering seawater and providing food and habitat for fish, crabs and seabirds but they are highly threatened. It is estimated that **85% of oyster reefs have been lost globally.**<sup>27</sup>

Genetic diversity is being lost in natural ecosystems and in systems of crop and livestock production. However, important progress is being made to conserve plant genetic diversity, especially using ex situ seed banks. For some 200 to 300 crops, it is estimated that over 70% of genetic diversity is already conserved in gene banks.



# preserve



## The challenges of climate change

The strains from the food crisis come at a time when climate change is already expected to worsen poverty, by as many as 40 to 170 million people worldwide.<sup>28</sup> Climate change is also expected to increase water scarcity. In Africa, between 75 and 200 million people could be affected by additional water scarcity by 2020.<sup>29</sup>

Cereal yields are expected to decline in more than 40 developing countries with average losses of 15% and projections show that land suitable for wheat production may almost disappear in Africa.<sup>30</sup>

Climate change will also have an impact on pest prevalence and hence on human health. Every year, around 250 million people get sick with malaria and more than one million people die because of it every year.<sup>31</sup>



### climate change

A child dies of malaria every 30 seconds in the world. Through climate change, **an additional 220 to 400 million people could be exposed to malaria.**

#### DESERTIFICATION AND EROSION

About 1 billion people, or about 15% of the global population, have become affected by land degradation since 1981. The UN (UNCCD) estimates that by the year 2050, half of the current arable land will become unusable.<sup>32</sup> Globally, between 20,000-50,000 sq km of arable land is estimated to be lost annually through degradation, in particular, soil erosion. The rate of degradation is two to six times higher in Asia, Africa and Latin America than in Europe and North America.

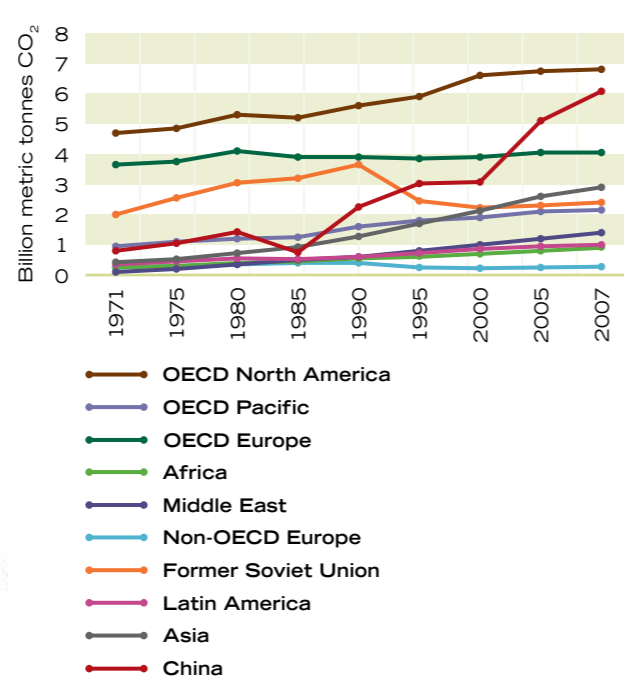
#### SALINITY

Salinity is increasing due to excess irrigation and from the intrusion of sea water into land. Worldwide, some 20% of irrigated land (450,000 sq km) is salt-affected, with 2,500-5,000 sq km lost from production every year as a result of salinity.<sup>33</sup>

#### CARBON EMISSIONS AND AIR POLLUTION

A rise in carbon emissions has resulted in a current level of 390 parts per million globally, much higher than the pre-industrial 18th century level of 280 ppm.<sup>34</sup> Losses in crop yield caused by air pollutants such as tropospheric ozone have been estimated to cause economic losses for 23 arable crops in Europe, totalling US\$5.72-12 billion/year.<sup>35</sup>

#### CO<sub>2</sub> EMISSIONS FROM FUEL COMBUSTION, 1971-2007



#### SOME PROGRESS

A study in the U.S. indicates the sustainability of U.S. agriculture is increasing in some areas including safeguarding soil, energy and land required per acre of production, as well as water use efficiency.<sup>36</sup>

- The land needed to grow a bushel of corn has **dropped by 37%** in just 20 years.
- A bushel of soybeans can be produced today using **26% less land** than was used 20 years ago.
- Soil loss through corn cultivation has **plummeted 69%** per bushel in the past 20 years.
- Cotton production is **66% more energy efficient** per pound today than it was 20 years ago.
- Greenhouse gas emissions from soybean farming have **fallen 38%** per bushel in 20 years.

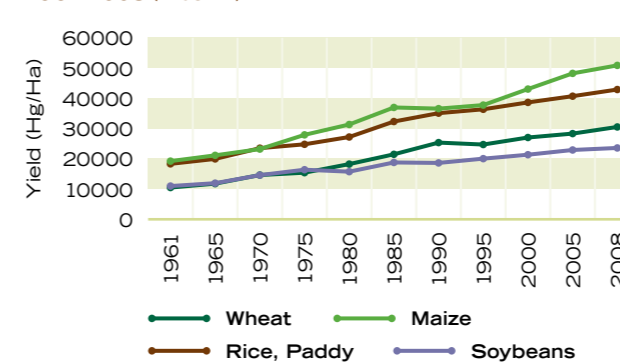
## Plant science and the future of food production

The plant science industry has a long history of seeking to improve agriculture, not only in terms of output but also in terms of quality and safety. New technologies and production techniques account for dramatic increases in yield in many crops and many countries.

#### YIELD INCREASE

Globally, production of major crops has more than tripled since 1960. Yields for rice have more than doubled and yields for wheat have gone up about 160%.<sup>37</sup>

#### INCREASE IN YIELD FOR KEY CROPS, 1961-2008



In the 1980s, one farmer produced one tonne of food, and one hectare of arable land produced 1.8 tonnes, annually on average. Today, one farmer produces 1.4 tonnes, and one hectare of land produces 2.5 tonnes.<sup>38</sup> This has come about as a result of both an increase in yields and a reduction in post-harvest losses. In some regions, losses can be as low as 20%. Conversely, losses can amount to 100% of a harvest if no crop protection is available or unaffordable.



#### RESEARCH AND DEVELOPMENT

Plant science is one of the most research-intensive industries in existence. During 2008, research and development expenditure for the 15 leading companies in plant science reached an estimated \$5 billion – equivalent to over 8.5% of sales. \$2.4 billion was spent on seed and traits R&D, and \$2.7 billion was spent on agrochemicals.<sup>39</sup>

Overall, **bringing a new crop protection product to market costs over \$250 million** and takes about 10 years, although these costs continue to rise steadily.

#### LOOKING TO THE FUTURE

Innovations are needed to meet the challenges of climate and human demand, such as biotech crops, innovative farming and management techniques, and improved crop protection products.

- Conservation agriculture can help improve soil quality and reduce erosion. It is estimated that conservation tillage can reduce soil erosion by 50 to 98%. This is important for the environment as well as farm business, as erosion reduces yields by 10 to 30%.
- In addition, conservation agriculture has a great impact on carbon emissions. In 2008, global fuel savings associated with the switch to conservation tillage systems, and less frequent pesticide applications made possible by biotech crops, reduced carbon dioxide emissions by about 1,205 million kg – equivalent to removing over 0.5 million cars from the road. Combined with additional soil carbon sequestration gains, this is equal to removing nearly 7 million cars.<sup>40</sup>
- Fruits and vegetables can be fortified with extra vitamin C and E to protect against risks of cancer and heart disease.
- Improved varieties can make crop yields more stable. The annual benefits from better yield stability in maize and wheat alone are estimated at about \$300 million.<sup>41</sup>

The development of **drought resistant crops and the better management of water resources** could greatly help in addressing the issue of water shortages.

### management

## Growing with a responsible partner

The plant science industry has strong commitment to human and environmental safety. One example is an extensive network of stewardship programmes that reach farmers, their families and other industry participants.

- Our stewardship programmes reach over 40 countries and train more than 300,000 individuals each year.
- Training farmers in Integrated Pest Management and responsible use of crop protection products is a key focus of our stewardship programmes – managing pests and reducing unnecessary pesticide use across the world.
- A recent study in China found that stewardship training cut improper disposal of used pesticide containers by more than half.

**CropLife member companies support the Global Crop Diversity Trust** for the conservation of valuable plant genetic resources.

Globally, the plant science industry is also an active participant in the efforts to stop climate change. We are committed to being part of the solution.

- Technological innovation allows more renewable resources to be used in everyday objects, reducing our carbon footprint. For instance, using corn sugar instead of petroleum-based feedstocks to create polymers consumes 40% less energy and reduces greenhouse gas emissions by 20%.

- Improvement in crops also means more sustainable production of biofuels. This comes about by increasing yields, high starch and oil content, and limiting the need to expand the land under cultivation.
- Creating plants that use nitrogen more efficiently can reduce the need for added fertilizer, reducing greenhouse gas emissions from agriculture.
- We are part of several initiatives, including UNEP's Global Programme of Action for the Protection of the Marine Environment. We also take part in the Sustainable Agriculture and Rural Development (SARD) Initiative as part of Commission on Sustainable Development Partnerships.
- In addition, we take part in public-private partnerships for development such as with the International Fund for Agricultural Development.
- Our industry is also involved in preserving biodiversity. Member companies support the Global Crop Diversity Trust to help financially support an endowment of US\$260 million for gene banks around the world.

Plant sugars may soon be used to create everything from plastic films and fibres to adhesives and thermoplastic materials.

**Bioplastics are biodegradable and offer a renewable and environmentally friendly alternative** to petroleum-based plastics.



## Global market performance

### CROP PROTECTION

Although the value of the global crop protection market grew strongly in the previous year, 2009 proved to be a disappointing year as a number of negative factors came together that led to a significant reduction in the value of the market. The economic crises in late 2008 in the Americas and Europe reduced credit availability for a number of companies and resulted in crop prices declining from the peak level that they had attained in 2008. As a result, grower confidence was not particularly strong in these markets. Another key factor was a major reduction in the average global price of glyphosate due to the resumption of supply and increased manufacturing capacity for the product.

In Latin America, crop protection market growth was impacted by the prevailing crop prices and economic situation, and although the planted area of soybeans



### Major Factors Affecting Crop Protection Market Performance in 2009:

- Reduced crop commodity prices
- Economic crisis
- Decline in glyphosate prices
- Global area of soybean and wheat increased while maize, rice and cotton areas were reduced

increased, the herbicide sector was reduced as a result of the lower glyphosate prices. The Asian market benefited from some modest growth in the Japanese market, as well as growth in local currency terms in the Chinese and Indian markets, however currency factors reduced this impact in U.S. dollar terms. In Europe, a combination of weaker crop prices, the economic crisis and a move by growers from cereals towards oilseed crops, resulted in the agrochemical market declining. Currency factors exacerbated the overall level of decline in U.S. dollar value. In the NAFTA region, declining crop prices and lower glyphosate prices combined to reduce the overall market value in 2009.

### GLOBAL CROP PROTECTION MARKET GROWTH BY PRODUCT SECTOR 2009

	2009(\$m)	2008(\$m)	Growth '09/'08(%)
Herbicides	17,527	19,100	-8.2
Insecticides	9,411	9,676	-2.7
Fungicides	9,726	10,405	-6.5
Others	1,196	1,294	-7.6
<b>TOTAL</b>	<b>37,860</b>	<b>40,475</b>	<b>-6.5</b>

During 2009 the global market value for conventional crop protection products declined by 6.5% in nominal U.S. dollar value to reach \$37,860 million.

### GLOBAL CROP PROTECTION MARKET GROWTH BY REGION 2009

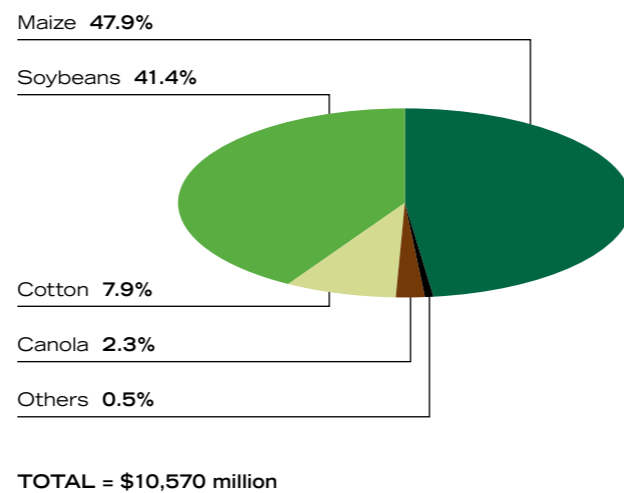
	2009(\$m)	2008(\$m)	Growth '09/'08(%)
NAFTA	7,930	8,325	-4.7
Latin America	7,700	8,405	-8.4
Europe	11,480	12,850	-10.7
Asia	9,245	9,360	-1.2
Rest	1,505	1,535	-2.0
<b>TOTAL</b>	<b>37,860</b>	<b>40,475</b>	<b>-6.5</b>

## PLANT BIOTECHNOLOGY

During 2009, the overall planted area of biotech crops rose by 5.1% to reach 311.6 million acres. This in turn was a major contributing factor to the rise in value of the sale of biotech seed, which rose by 15.5% to reach \$10,570 million. As well as the higher planted area, the other key factor influencing this increase in value was a rise in the proportion of maize and cotton area planted with stacked trait varieties of the crops.

In 2009, a record 14 million small and large farmers in 25 countries planted biotech crops. The countries were, in order of hectareage, U.S., Brazil, Argentina, India, Canada, China, Paraguay, South Africa, Uruguay, Bolivia, Philippines, Australia, Burkina Faso, Spain, Mexico, Chile, Columbia, Honduras, Czech Republic, Portugal, Romania, Poland, Costa Rica, Egypt and Slovakia. Almost half (46%) of the global hectareage was planted by developing countries, expected to take the lead from industrial countries before 2015.<sup>42</sup>

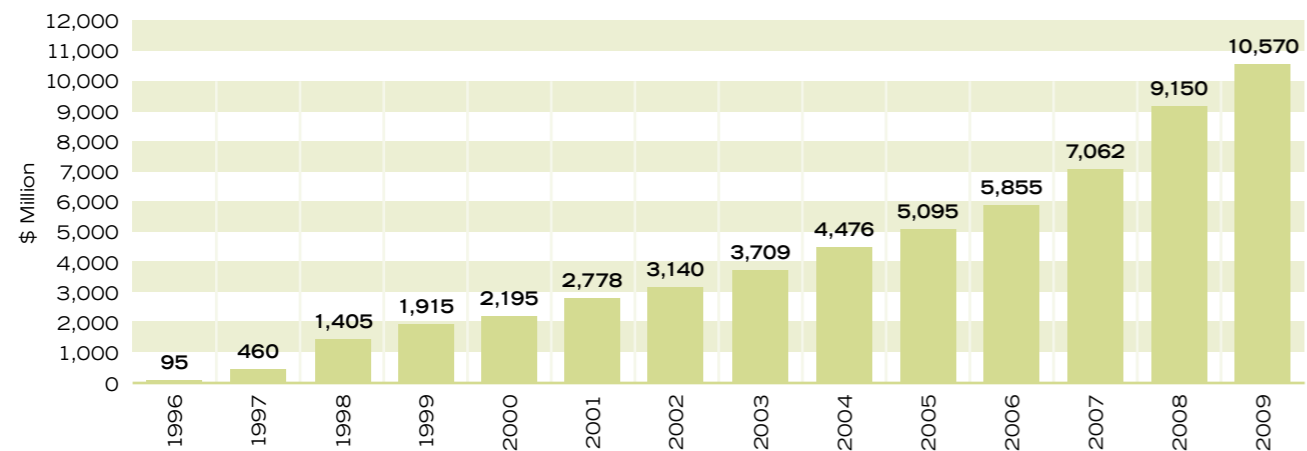
## BIOTECH SEED MARKET BY CROP



In 2009, the value of the market for plant biotechnology-based products rose by 15.5% to reach \$10,570 million.

## GROWTH OF THE BIOTECH SEED MARKET

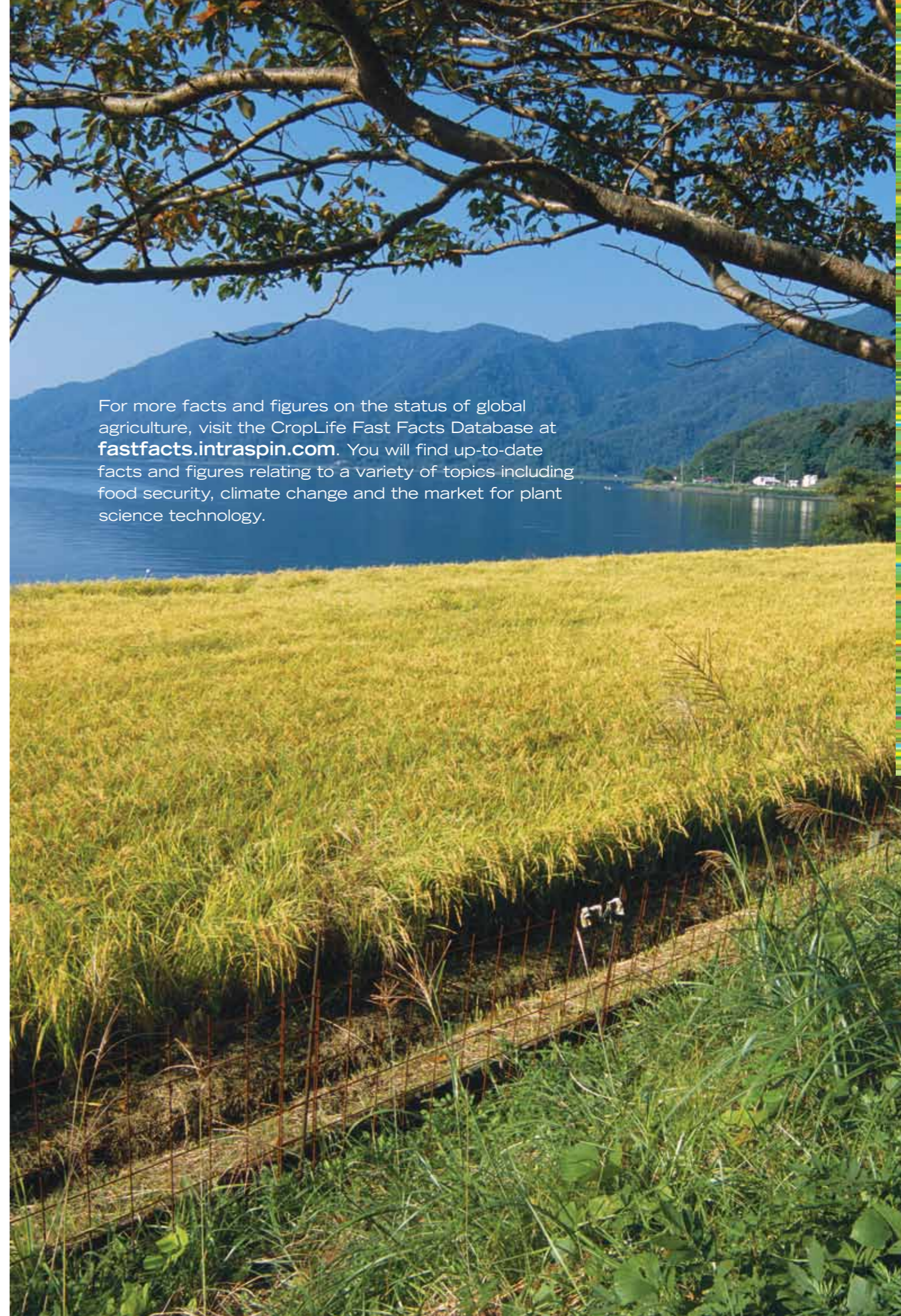
Source: Phillips McDougall, 2010



The largest share of the biotech crops sector is attributed to herbicide tolerant crop varieties, which represented 51.3% of the value of the sector in 2009. However, over the last few years the overall share attributable to stacked trait crop varieties of maize and cotton has increased at a rate ahead of the overall market, to reach a value equivalent to 37.7% of the overall biotech seed market.

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For more facts and figures on the status of global agriculture, visit the CropLife Fast Facts Database at [fastfacts.intraspin.com](http://fastfacts.intraspin.com). You will find up-to-date facts and figures relating to a variety of topics including food security, climate change and the market for plant science technology.



There are no easy ways to solve issues such as rapid population growth, climate change or increased human demand on the earth's resources. CropLife International is committed to looking beyond the traditional paths to help provide crop production solutions to meet the challenges of a growing world.

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