



• **P R E S S R E L E A S E** •  
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*CGIAR experts are available for interviews.*

**WHEAT IS CENTURY'S 'MIRACLE CROP'**

A massive agricultural transformation will make wheat the number one grain in developing countries as well as industrialized nations within the next decade, says the Consultative Group on International Agricultural Research (CGIAR).

"Wheat is a real miracle crop of this century," says Ismail Serageldin, chairman of CGIAR and World Bank Vice President for Environmentally Sustainable Development. "Increased wheat productivity has prevented widespread food shortages and stabilized the food security of Asia, Latin America and, to some extent, Africa."

Researchers have been able to modify wheat, once mostly restricted to temperate and subtropical zones, to make it productive even in hot climates. CGIAR notes five main reasons for the growing popularity of wheat in developing countries:

- **Increased demand** -- People in developing countries are now consuming half the world's wheat -- in the form of bread, burghul (cracked wheat), pasta, couscous and bakery products -- and within 10 years will be eating three-fifths of the world's entire wheat production. Since the 1960s, wheat consumption has risen almost 5 percent a year in developing countries, faster than any other basic food crop.

- **Lower Prices and Greater Convenience** -- Since 1965, world wheat prices have fallen 50 percent. Wheat in the form of bread reduces the cost of food preparation and frees up time for

women, an important advantage as women move into the workforce throughout the developing world.

- **Easy to grow** -- Wheat requires less water than rice, another major staple food crop, and is not as labor intensive as other food grains. It is a cash crop that has relatively few natural insect enemies. Thanks to years of intensive plant breeding work, modern wheats now have strong built-in resistance to major diseases. That means poor farmers in developing countries are assured of stable yields and can more easily adapt pest management procedures that make maximum use of biological control measures, minimizing chemical use.

- **New wheats** -- About 75 percent of all spring bread wheat varieties now grown in developing countries (not counting China) are either crosses developed by the International Maize and Wheat Improvement Center (CIMMYT), or crosses developed by national agricultural research programs in developing countries, using genetic material from CIMMYT and ICARDA. CIMMYT, based in Mexico, and ICARDA—the International Center for Agricultural Research in the Dry Areas, based in Syria—are two of the 16 international research centers of the CGIAR.

- **Higher yields** -- Since the early 1970s, average wheat yields in developing countries have doubled from 0.5 ton per acre (1.2 tons per hectare) to 1 ton per acre (2.46 tons per hectare), the fastest productivity growth of any basic food crop. In the last two decades, four-fifths of the additional wheat output of the developing world has come from yield increases; only one-fifth came from more land planted.

The five largest wheat producers in 1994 were: China, 101 million tons; the United States, 63 million tons; India, 59 million tons; Russia, 32 million tons; and France, 31 million tons.

In 1994, Asia harvested 217 million tons of wheat, outpacing Europe's 119 million tons, and North America's 90 million tons, the combined production of the United States, Canada and Mexico.

Despite the huge gains in wheat production in developing countries, these countries also account for about two-thirds the world's total wheat imports, indicating that demand in the developing world has risen even faster than domestic output.

Wheat exports from traditional growers in the industrialized world are likely to grow for the foreseeable future because demand is increasing faster than for most other grains. Exporters will ship some 75 million tons of wheat to the developing world in 1995/96, according to current forecasts.

"Increased wheat productivity has greatly reduced the pressure to open new and increasingly more fragile lands for agriculture," says Mr. Serageldin. "If wheat yields per acre had not improved since 1970, developing world farmers would have needed the equivalent of some 222 million acres (90 million hectares) of additional land, or almost double the amount of land they had under wheat in 1970/75."

During the 1980s and 1990s, wheats developed by national programs in collaboration with CIMMYT and ICARDA, for example, have spread to some 40 million acres (16 million hectares) of agricultural land never before planted to modern varieties, nearly all of that rainfed and some of it considered marginal for wheat production. This equals the area brought under CIMMYT-developed high-yielding wheat varieties during the "Green Revolution" of the 1960s and '70s, but most of that occurred on more costly irrigated land.

Wheat has experienced a 96 percent yield increase in the developing world from 1970-1994. This yield increase was achieved with new wheats, called semi-dwarf varieties, which grow to just half the height of older wheats, but are far more productive. Rather than using up valuable energy producing the long stems of the older varieties, semi-dwarf wheats send more energy to the plant's spikes, resulting in more grain per plant and increased output per unit of cultivated land area.

The higher productivity of the modern wheats made it worthwhile for farmers to invest in irrigation and fertilizer use. It was the combination of genetic improvement, more water and fertilizer, and better crop management, that helped developing country farmers double their wheat yields. Those among them who use, for instance, new varieties of spring bread wheat developed between 1977 and 1990 now harvest an extra 15.5 million tons of grain each year, worth about \$3 billion.

CIMMYT is working with national programs and with its sister center, ICARDA, to develop wheat varieties that perform well in hot areas during the cooler winter periods of the year when, up to now, the land has usually been left uncultivated. These new heat-resistant varieties let farmers produce a second crop each year and earn extra income. Wheat stands virtually alone as a robust, water-efficient, winter-season crop that farmers can grow efficiently in rotation with such summer crops as rice, maize, sorghum, cotton and soybeans.

With less time needed to mature, modern wheats frequently enable farmers to move from rainfed to irrigated production, because the increased productivity of these varieties makes irrigation investments more profitable. Despite widespread poverty that restricts the purchasing power of their consumers, and hence the investment potential and income of many small farmers, wheat

yields in developing countries -- 2.4 tons per hectare (t/ha) -- nearly equaled those in the rest of the world -- 2.6 t/ha. Developing world yields exceeded those in Eastern Europe and the former Soviet Union, just 2.0 t/ha. In 1994, the wheat yield in low-income developing countries -- more than 2.6 t/ha -- was higher than that of North America, 2.5 t/ha.

With no major breakthroughs in wheat yields in the past decade, CGIAR researchers say they are coming up against a "yield barrier," but feel it can be broken with sufficient study and research.

"There's still a large gap to close between what technology has given us and what farmers are using," says Tony Fischer, director of CIMMYT's Wheat Program. "While wheat farmers in industrialized countries largely match what technology offers, poor farmers in many developing countries are 30 to 50 percent behind the technology curve. Thus, large production increases are still possible without scientific breakthroughs. However -- and this is very important -- such technology catch-up will give us only a part of the 3 percent yearly increase in yields that developing countries need to keep up with demand. Only further research can give us the rest."

While uniform in their appearance, modern wheat varieties contain a wealth of genetic diversity. For example, plant breeders drew on 49 landraces (varieties) from 21 different countries to develop *Kauz*, a high-yielding, disease-resistant wheat variety now grown in many developing countries. ICARDA, with its national partners, is developing modern varieties for harsher environments in the Middle East and North Africa, using landraces of wheat common in the region.

Modern wheat varieties, instead of reducing on-farm diversity in the developing world, promote sustainability and food security for the poor by incorporating multiple disease resistance and tolerance of such environmental stresses as drought, excessive moisture, heat, poor soil fertility and soil acidity. Modern varieties make critical-- and often overlooked--contributions to sustaining natural resources and ensuring food security for the poor.

"All of our efforts are geared toward making resource-poor farmers more productive *and* protecting the environment," says Mr. Serageldin. "Modern, genetically improved wheats, along with other grains such as maize, are the key ingredients to any formula for sustainable food security for the poor and for sustainable cropping systems."

**Africa** -- Wheat is becoming increasingly popular in Africa, with output up by two-thirds in the past 20 years, thanks mainly to yields rising 60 percent. Africa is also a heavy wheat importer, especially in urban areas as bread becomes more important. The hot and dry climate over much of sub-Saharan Africa limited local wheat production until recently.

Sudan, one of the world's hottest countries, introduced new heat-tolerant varieties and saw the area planted in wheat expand from 343,000 to 911,000 acres (144,000 to 383,000 hectares) between 1988 and 1992, with production rising from 181,000 to 895,000 metric tons.

Until 1960, scientists did not believe that wheat would grow south of the capital of Khartoum, where average winter temperatures peak around 86 degrees F. (30 degrees C.). Two earlier attempts in 1918 and 1940 had failed to extend wheat to this region during the relatively cool winter season.

ICARDA, in collaboration with Sudan's Agricultural Research Corporation, CIMMYT and Global 2000, has promoted wheat varieties and packages of agronomic practices for conditions in Sudan. By 1992, 80 percent of Sudan's wheat area was planted with Debiera, a high-yielding, heat-tolerant variety. If wheat is planted early, between the end of October and mid-November, the crop reaches maturity before the spring heat shrivels the seed.

"We have obtained wheat self-sufficiency," said Professor Ahmed Ali Geneif, Sudan's Minister of Agriculture and Livestock. "We even have a surplus to help solve food problems in the countries around us."

**Asia** -- Wheat is Asia's second most important staple, and demand has been growing much faster than for rice. Wheat now makes up 19.2 percent of total calorie supply. Asia is the wheat leader in all three growth parameters: area, output, and yield. Wheat output is now close to half the region's rice harvests. As with rice, practically all wheat is used for domestic consumption.

New, more productive rotations have been made possible by the advent of earlier maturing varieties. South Asia's rice/wheat rotation is a good example, in which wheat is grown in the winter and rice in the summer, with both crops receiving either supplemental or full irrigation. This cropping system barely existed 30 years ago but now stretches across 32 million acres (13 million hectares) of the best agricultural land in the region, providing food for 150 million people.

In China, wheat has increased from 23 percent of total grain consumption in 1960 to 32 percent in 1990; in India, the wheat share increased from 19 to 31 percent over the same period, and in Indonesia from 1.2 to 5.2 percent.

**Latin America and the Caribbean** -- Wheat showed considerable growth in terms of yield and total production between 1970 and 1989 in this region. Since then, the area harvested has decreased

noticeably, but overall production did not decrease at the same rate, mainly because yields rose somewhat. Wheat production in the region, combined with sizable imports, accounts for almost 14 percent of food supply.

Much of Brazil's wheat crop is produced on acid soil, up to 95 percent in one state—Rio Grande do Sul—especially on the country's savannas. Such conditions also prevail in other countries on the continent. Wheat helps develop savanna farming, thus reducing population pressure on more fertile habitats such as Latin America's remaining rain forests.

In the 1970s, the Brazilian government and CIMMYT initiated a shuttle breeding program to incorporate the older Brazilian varieties' tolerance of acidic soils into Mexican semi-dwarf wheats, along with improved disease resistance. The new varieties were released in the early 1980s and have increased yields by more than 25 percent.

**Middle East and North Africa (MENA)** -- Wheat is MENA's main staple crop. The region is the leading per capita producer of wheat. Wheat production grew 115 percent between 1970—74 and 1990, almost as quickly as in Asia.

Due to the improved cultivars and production practices, developed by national programs in collaboration with the international research centers, the region experienced fast-rising yields, while the area harvested expanded only 10 percent. MENA countries consume all the wheat they produce, or about 50 million tons annually, and import one-third more, indicating the continuing need for production growth. Wheat provides an exceptionally high 44 percent of the region's total food supply.

### **Future Demand**

While per capita wheat production in developing countries has risen more than 50 percent since the early 1970s, the per capita output of many other basic food crops declined or stagnated. Hundreds of millions of people are still malnourished, mostly in South Asia and sub-Saharan Africa.

A doubling of food production will be required by 2025 to satisfy demand increases from population growth and rising incomes. Some 90 million people, most of them in developing countries, are being added to the global population every year, equal to another Mexico.

CGIAR research on crops critical to the food needs of developing countries also brought some spin-off benefits for developed countries as a consequence of the intensified global exchange of plant germplasm. Certain improvements for wheat cultivated in more temperate zones constitute by-products of the highly successful CGIAR wheat research in the warmer regions. Improved heat tolerance for example, would mainly benefit tropical countries but also has had pay-offs for late sowings in sub-tropical countries.

**Industrialized Countries** -- Over 60 million acres (more than 25 million hectares) in industrial countries are planted in wheat varieties -- especially spring bread wheat and durum wheat -- that have some CIMMYT ancestry.

**Australia** -- Semi-dwarf varieties based on CIMMYT germplasm were released in the 1970s. Currently, more than 80 percent of the country's entire wheat area (some 10 million hectares) is sown in the new varieties. Increased wheat yields bring an additional \$110 million per year to Australian farmers. About half of this gain can be attributed to CIMMYT's research.

**United States** -- Most of the durum wheat in the Southwest come from varieties imported directly from northwestern Mexico, where CIMMYT does most of its wheat research. In 1994, varieties grown on about 21 percent of the total U.S. wheat area had some CIMMYT ancestry.

**Mediterranean Europe** -- Durum wheat, from which pasta is made, is a major crop in Mediterranean Europe. In 1974, Italy released its first semi-dwarf durum variety based on a CIMMYT cross. Since then varieties related to the Center's work have been sown on some 60 percent of the country's durum wheat area. Spain, Portugal and Greece have released durum cultivars for commercial production, originating from the international centers.

**Canada** -- The main wheat-growing provinces of the prairies--Manitoba, Saskatchewan and Alberta--have released spring wheat varieties that contain CIMMYT lines. By 1992, several of these varieties, including Robin, Laura, Hy320 and Genesis, were sown on 8.6 million acres (3.5 million hectares), or 28 percent of the wheat area in the three provinces.

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Modern semidwarf variety



Traditional tall variety