INTERNATIONAL YEAR OF THE POTATO 2008

New light on a hidden treasure

AN END-OF-YEAR REVIEW

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Foreword

The International Year of the Potato (IYP) in 2008 was a celebration of one of humanity's most important and universally loved staple foods. This end-of-year review records IYP's achievements and underscores its essential message: that the potato is a vital part of the global food system, and will play an ever greater role in strengthening world food security and alleviating poverty.

The review describes the rationale for the International Year, its objectives and implementation. It introduces our guest-of-honour, *Solanum tuberosum*, the "humble tuber" that spread from the Andes across six continents and changed the course of world history. Specialists from FAO and the International Potato Center deepen our knowledge of the potato in 10 factsheets on key issues in potato development. The review also provides the most recent FAO statistics on world potato production and consumption, and profiles of 52 major potato producing countries.

The International Year was observed around the globe in scientific conferences, growers' congresses, festivals, cooking contests, art exhibitions and school projects. We present highlights of those events, as well as the winning entries in the IYP Global Photography Contest. The review concludes with viewpoints gathered from some of the world's leading "potato people" – those whose daily work with the potato has become a passionate way of life – and an overview of prospects for potato development beyond 2008.

This book seeks to contribute to strengthening the potato industry everywhere. It will be of particular value to developing countries that recognize the potential of the potato to drive economic development and sustain rural livelihoods. We sincerely trust that, for everyone, it will throw new light on the hidden treasure that is the potato.

Shivaji Pandey
Director, Plant Production
and Protection Division
Food and Agriculture Organization
of the United Nations

Acknowledgements

This end-of-year review of the International Year of the Potato offers an opportunity to convey our appreciation to those who contributed to the remarkable success of IYP.

Thanks are extended to the former Assistant Directors-General of FAO's Agriculture and Consumer Protection Department, Alexander Muller and Jose Maria Sumpsi Viñas, and their successor, Modibo Traoré, and to the Director of the Plant Production and Protection Division (AGP), Shivaji Pandey, for their support and confidence in the IYP Secretariat.

The work of the Secretariat was led with great dedication by NeBambi Lutaladio, of AGP, and benefited from the collaboration of many IYP partners, particularly the International Potato Center and its Director General, Pamela Anderson. Ireland, Italy, Spain and Switzerland provided financial support, as did private partners such as McCain Foods Ltd and Scott Simplot.

The Secretariat benefited from the guidance of an Informal International Steering Committee and FAO's IYP Task Force, and from the enthusiasm of the "IYP team" of communication and potato specialists. All those organizations and individuals who helped make 2008 a memorable year are listed at the back of this book.

Eric A. Kueneman
IYP Task Manager
Food and Agriculture Organization
of the United Nation

"The potato is on the frontline in the fight against world hunger and poverty."

Jacques Diouf
Director-General, FAO

The International Year

The IYP mission: to raise awareness of the importance of the potato – and that of agriculture in general – in addressing issues of global concern, including hunger, poverty and threats to the environment

Why potato?

"A United Nations international year once actually meant something. But what to make of the International Year of the ***Potato***?" So began a scathing editorial in a Canadian online daily, which joked that IYP might result in a "Declaration of the rights of potatoes and other starchy edible tubulars". The editorialist revealed a lack of familiarity not only with botany – the potato is a *tuber*, not a "tubular" – but, above all, with the potato's place in agriculture, the economy and world food security.

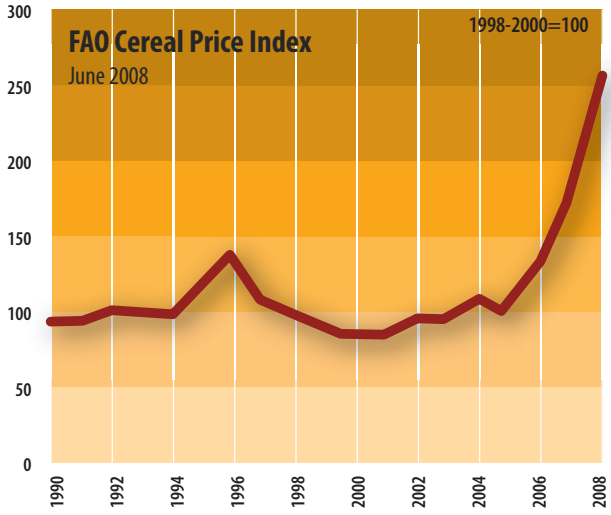
The potato is already an integral part of the global food system. It is the world's number one non-grain food commodity, with production reaching a record 325 million tonnes in 2007. Potato consumption is expanding strongly in developing countries, which now account for more than half of the global harvest and where the potato's ease of cultivation and high energy content have made it a valuable cash crop for millions of farmers.

At the same time, the potato – unlike major cereals – is not a globally traded commodity. Only a fraction of total production enters foreign trade, and potato prices are determined usually by local production costs, not by the vagaries of international markets. It is, therefore, a highly recommended food security crop that can help low-income farmers and vulnerable consumers ride out the turmoil in world food supply and demand.

In Peru, for example, the government has acted to reduce costly wheat imports by encouraging people to eat bread that includes potato flour. In China, the world's biggest potato producer, agriculture experts have proposed that potatoes become the major food crop on much of the country's arable land. India has plans to double its potato production.

Food of the future. The International Year of the Potato has raised awareness of the potato's fundamental importance as a staple food of humanity. But it also had a very practical aim: to promote development of sustainable potato-based systems that enhance the well-being of producers and consumers and help realize the potato's full potential as a "food of the future".

Cereal prices soared during 2008



Over the next two decades, the world's population is expected to grow on average by more than 100 million people a year. More

YANDER ZAMORA DE LOS REYES

than 95 percent of that increase will occur in the developing countries, where pressure on land and water is already intense. A key challenge facing the international community is, therefore, to ensure food security for present and future generations, while protecting the natural resource base on which we all depend. The potato will be an important part of the efforts to meet those challenges, for four reasons.

Potatoes are a truly global food

The potato has been consumed in the Andes for about 8 000 years. Brought to Europe by the Spanish in the 16th century, it quickly spread across the globe: today potatoes are grown on an estimated 193 000 sq km of farmland, from China's Yunnan plateau and the subtropical lowlands of India, to Java's equatorial highlands and the steppes of the Ukraine.

STEFANO ROLETTO

Potatoes feed the hungry

The potato should be a major component in strategies aimed at providing nutritious food for the poor and hungry. It is ideally suited to places where land is limited and labour is abundant, conditions that characterize much of the developing world. The potato produces more nutritious food more quickly, on less land, and in harsher climates than any other major crop – up to 85 percent of the plant is edible human food, compared to around 50 percent in cereals.

Potatoes are good for you

Potatoes are rich in carbohydrates, making them a good source of energy. They have the highest protein content (around 2.1 percent on a fresh weight basis) in the family of root and tuber crops, and protein of a fairly high quality, with an amino-acid pattern that is well matched to human requirements. They are also very rich in vitamin C – a single, medium-sized potato contains about half the recommended daily intake – and contain a fifth of the recommended daily value of potassium.

Demand for potatoes is growing

World potato production has increased at an annual average rate of 4.5 percent over the last 10 years, and exceeded the growth in production of many other major food commodities in developing countries, particularly in Asia. While potato consumption has declined in Europe, it has increased in the developing world from less than 10 kg per capita in 1961-1963 to almost 22 kg in 2005. Consumption of potatoes in developing countries is still less than a quarter of that in Europe, but all evidence suggests it will increase strongly in the future.

Background

The potato (*Solanum tuberosum*) originated in the Andes of South America. It was appropriate, therefore, that the initial impetus for declaring 2008 as the International Year of the Potato came from the Government of Peru.

Flag of Peru

At the biennial Conference of the Food and Agriculture Organization of the United Nations (FAO) in November 2005, the Permanent Representative of Peru proposed – and the Conference adopted – a resolution that sought to focus world attention on the importance of the potato in providing food security and alleviating poverty. The resolution was transmitted to the Secretary-General of the United Nations, with the aim of having the UN General Assembly declare the year 2008 as the International Year of the Potato (IYP).

The Sixtieth Session of the General Assembly accepted the resolution in December 2005, and invited FAO to facilitate the implementation of IYP 2008. The resolution noted that the potato is a staple food in the diet of the world's population, and affirmed the role that the potato could play in achieving internationally agreed development objectives, including the United Nations Millennium Development Goals.

IYP concept

The International Year of the Potato aimed at raising the profile of this globally important food crop and commodity, giving emphasis to its biological and nutritional attributes, and thus promoting its production, processing, consumption, marketing and trade. Celebration of IYP 2008 presented a unique opportunity to make a valid and effective contribution towards meeting the Millennium Development Goals:

- **Food security – improving access to safe and nutritious food.**
  IYP focused global attention on the need to reach the vulnerable with solutions that reduce constraints, create opportunities, improve productivity and reduce risks in the farming systems on which they depend.

  Despite the great increase in global food production over the past half-century, many individuals and communities – mainly in rural areas – do not have physical or financial access to food year round. Undernourishment places vulnerable people in a downward spiral of bad health that frequently ends in death. Furthermore, HIV/AIDS and social and political conflicts have disrupted access to traditional sources of nutrition, thereby creating large groups of at-risk individuals. Many developing countries face a "double burden" of malnutrition: the persistence of undernutrition, along with a rapid rise in overweight due to unhealthy diets associated with urbanization. The

cultivation of nutrient-rich potatoes can contribute to improved diets thus reducing mortality rates caused by malnutrition. As well as improving food security, such action will inevitably improve the health of target populations, especially women and children.

✳ Poverty alleviation

IYP focused global attention on the need to alleviate poverty by increasing incomes and linking farmers to markets.

Many farming families are caught in a "poverty trap" in which limited livelihood options conspire to keep them poor. Those livelihoods often need either slight or radical reworking to provide consistent income that enables the family to move – and stay – out of poverty. Local markets, once safe from outside competition, now face increased penetration from a wide range of suppliers due to globalization and urbanization. Learning to innovate and engage with markets, and to become more competitive, are challenges for small scale farming families. In order to compete in regional and global markets, they need yield-improving and input-saving technologies to help close the persistent yield and cost gap.

✳ Sustainable intensification of potato-based farming systems

IYP focused global attention on solutions for sustainable intensification of farming systems that will stop or reverse the loss of natural resources.

Most of the world's farms are less than 2 ha in size. In sub-Saharan Africa and many parts of Asia, farms are still shrinking and may continue to do so for the next several generations. As farm size shrinks, many farming families are switching from grains and legumes to root and tuber crops to meet subsistence and income goals. Farms with declining area are being managed more and more intensively, leading to soil erosion and ecological imbalances that encourage pest and disease outbreaks.

✳ Sustainable use of biodiversity

IYP focused global attention on the range of actions needed to protect, conserve and utilize potato diversity.

To overcome the multiple challenges of plant pests and diseases, low yields, natural resources degradation, and drought and climate change, potato-based agricultural systems need a continual supply of new, improved varieties. That implies access to the genetic resources contained in the totality of potato biodiversity, which needs to be conserved, and at the same time, made available to researchers and breeders in a responsible and equitable way.

Millennium Development Goals to which IYP contributed

Goal 1: Eradicate extreme poverty and hunger

Goal 4: Reduce child mortality

Goal 5: Improve maternal health

Goal 7: Ensure environmental sustainability

Goal 8: Develop a global partnership for development

UN /PAULO FILGUEIRAS

Participants at the launch of the International Year of the Potato, at UN Headquarters in New York. From left: J. Godfrey, Chairman of CIP; R. N. Mayanja, Assistant Secretary-General; S. Kerim, President of the 62nd session of the General Assembly; J. Diouf, Director-General of FAO; I. Benavides, Minister for Agriculture of Peru and L. Mérorès, Vice-President of the Economic and Social Council.

Launching the International Year

The International Year of the Potato was officially launched at United Nations headquarters in New York on 18 October 2007. The day's celebrations included the official launching ceremony, held in the ECOSOC Chamber, a special supporting event for IYP partners, and an exhibit on potato and IYP for the general public.

The official launching ceremony was held in conjunction with observation of World Food Day 2007, with the theme "Right to food".

It was attended by high-ranking United Nations officials, representatives of country missions to the UN, members of the IYP Informal International Steering Committee, representatives of the US "potato community", and 300 schoolchildren from the Washington DC area.

Following the official launch, a special event was held in the ECOSOC Chamber for IYP partners, including governments and major international organizations, public and private sector organizations, NGOs and civil society.

The IYP exhibit was held from 16 to 19 October. It included IYP information materials, potato plants provided by Cornell University, plastic replicas of tuber biodiversity from CIP, information on nutritional aspects of potato, and a video and photographs on potato from Peru.

Spud we like

The United Nations hopes that greater awareness of the merits of potatoes will contribute to the achievement of its Millennium Development Goals. It is always the international year of this or month of that. But the potato's unusual history means it is well worth celebrating...

The Economist
28 February 2008

Tremendous opportunity

The declaration by the United Nations of 2008 as the International Year of the Potato will provide multiple opportunities to publicize the role of the potato as a staple food for everyone.

El Comercio
18 October 2007

Key Partners

As the lead organization for IYP, FAO drew on its expertise in potato development, its experience in facilitating other International Years (Rice 2004 and Mountains 2002), and its regional, liaison and representative offices across the world to coordinate a global awareness and action campaign. It also sought to involve the entire "potato community" in observation of the International Year.

International partners

- Food and Agriculture Organization of the United Nations
- Latin American and Caribbean Group (GRULAC)
- International Potato Center (CIP)
- Bioversity International
- International Food Policy Research Institute (IFPRI)
- Global Forum for Agricultural Research (GFAR)
- The European Union (EU)
- International Fund for Agricultural Development (IFAD)

Donors

Funding for IYP implementation was provided by:

Governments

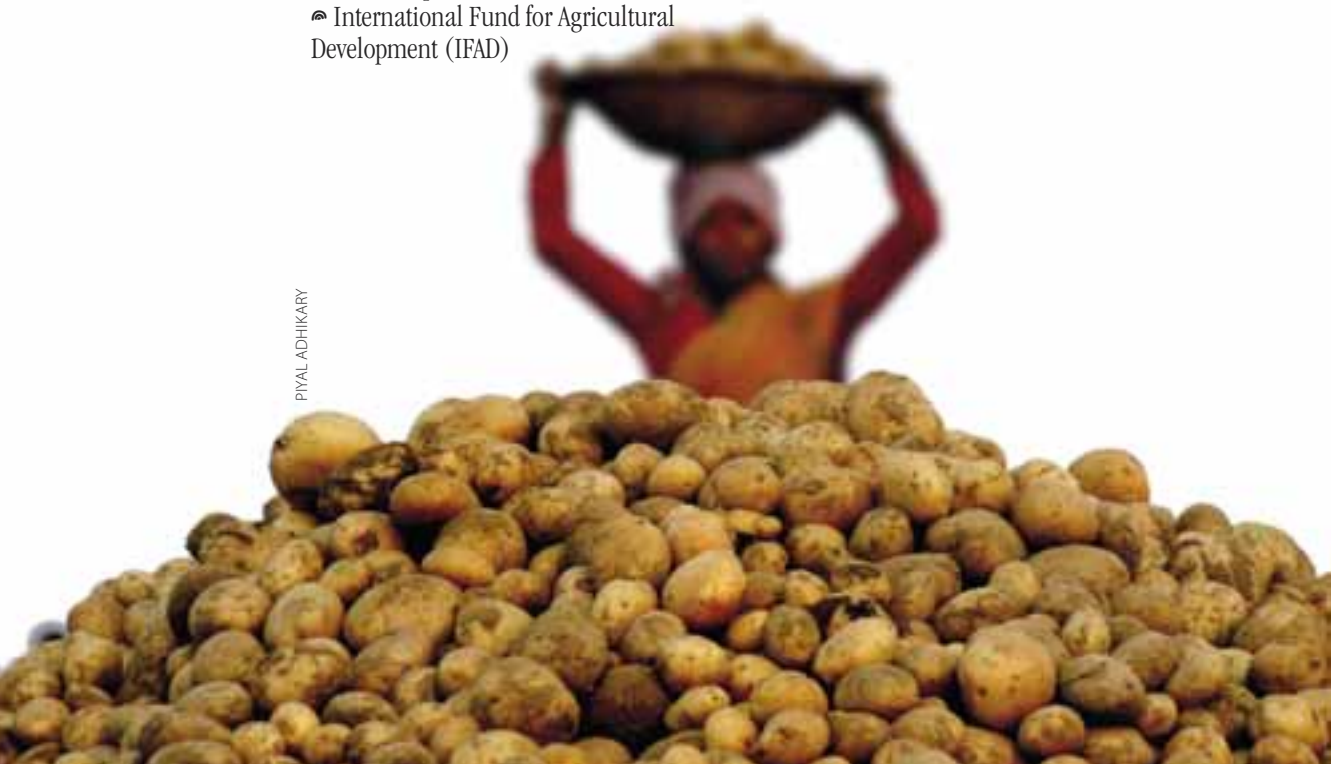
- Ireland
- Italy
- Spain
- Switzerland
- Friuli Venezia Giulia, Italy

Private sector

- HZPC Holland
- McCain Foods Ltd
- Nikon Europe
- J. R. Simplot
- United States Potato Board

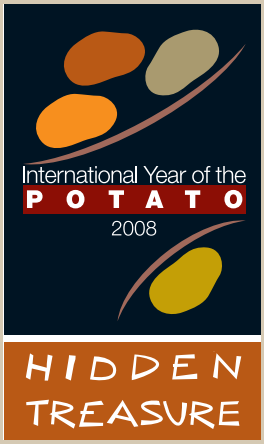
Informal International Steering Committee

Implementation of IYP 2008 was guided by an Informal International Steering Committee, made up of representatives of government, potato producers and the potato industry. For a full list of committee members, see page 136.



PIYAL ADHIKARY

IYP information products



The IYP logo was created by Italian graphic designer Giancarlo de Pol. During 2008, the IYP Secretariat approved more than 650 applications for use of the logo

www.potato2008.org Rated the most popular United Nations educational website

Video. Published in 8 languages – Arabic, Chinese, Dutch, English, French, Italian, Russian and Spanish

Factsheets. FAO specialists compiled 10 technical factsheets on key issues

Brochure. Some 6 000 copies were published in six languages

Poster. More than 5 000 copies were distributed worldwide

National Participation

A key objective of the International Year was the creation of national committees that would promote IYP observance and, in developing countries, lay the foundations for long-term potato development programmes. Some examples:

Belgium. IYP celebrations were organized by a task force with representatives of input suppliers, potato growers' associations, the processing industry, distributors and consumer groups, and delegates from regional governments.

Bolivia. The Ministry of Rural Development, Agriculture and Environment formed a national committee with representatives of FAO, government departments, the national seed potato enterprise, the potato producers' association, research and training institutes and NGOs.

China. IYP observation was coordinated by a committee representing FAO, the Ministry of Agriculture, the China Academy of Agricultural Sciences, the Chinese Cuisine Association, the Peruvian embassy and CIP's liaison office in Beijing.

Ireland. The committee included representatives of the Department of Agriculture, Fisheries and Food, the Irish

Food Agency, the Irish Potato Federation and Irish Farmers' Association, the Agriculture and Food Development Authority, the Agri-Awareness Trust and the Food Safety Authority.

Nepal. The Ministry of Agriculture and Cooperatives created a committee representing the Ministries of health, population and water resources, departments of agriculture and food technology, the National Agriculture Research Council and Potato Development Programme.

Peru. For IYP, the Peruvian Government established a National Multisectoral Commission with an executive team composed of delegates from the Ministry of Agriculture, the Ministry of Foreign Trade and Tourism, the Ministry of Foreign Affairs, FAO and CIP.

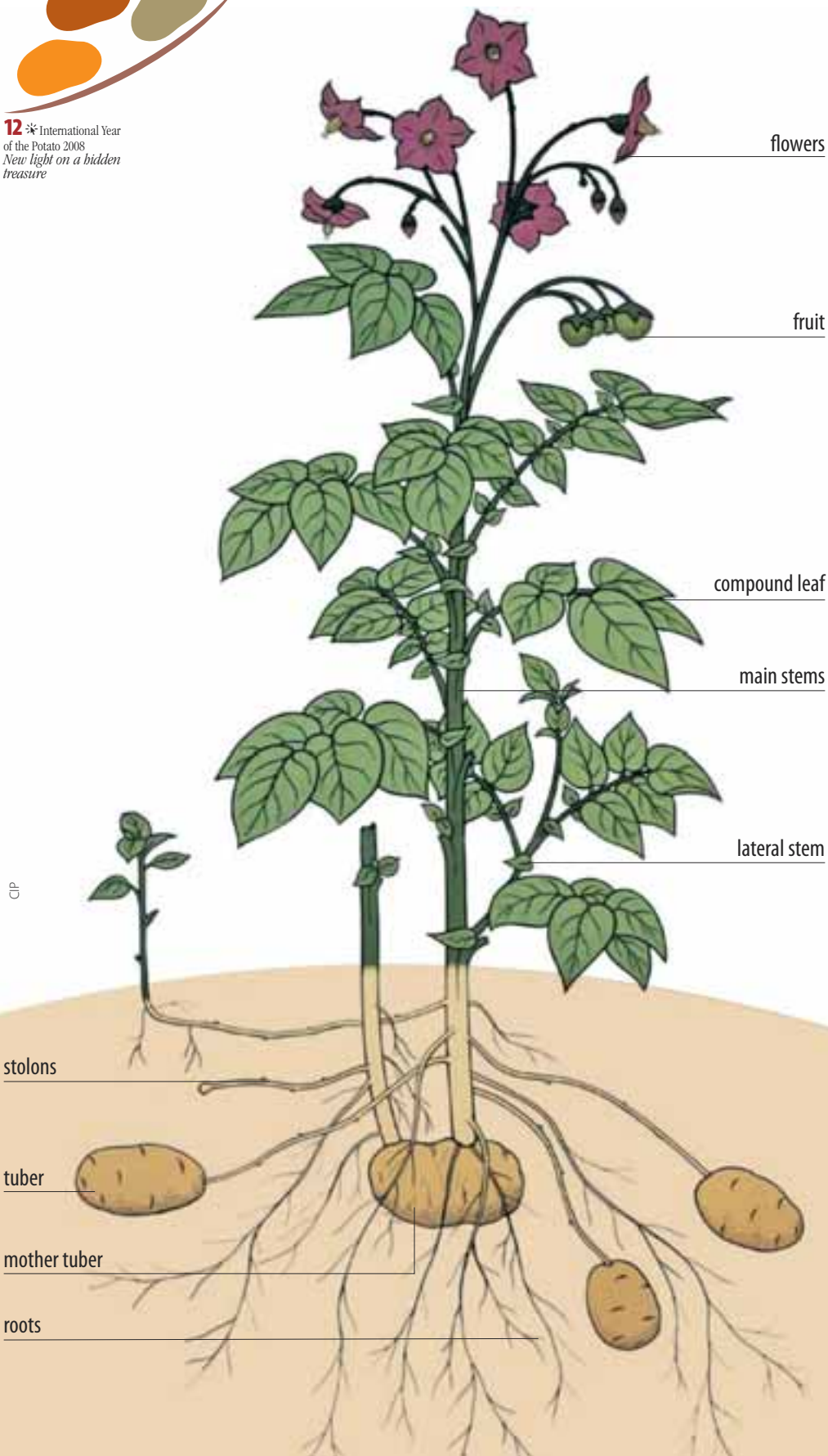
Pakistan. Coordinated by the National Potato Programme, the IYP committee consisted of representatives from the Agricultural Research Council, potato seed companies, processing industries, NGOs, farmer associations and provincial research organizations.

South Africa. The IYP steering committee included delegates from Potatoes South Africa (the national growers and processors' association), the National Department of Agriculture, FAO, the United Nations Information Centre, the Embassy of Peru and the University of Pretoria.

Syrian Arab Republic. The national committee represented the General Commission for Scientific Agricultural Research, the General Organization for Seeds Multiplication, and directorates of plant production and agricultural extension.

The potato

Introducing our special guest,
Solanum tuberosum, *the "humble tuber"*
that spread from its Andean birthplace
across six continents, staving off hunger,
fuelling economic development
and changing the course of world history


flowers
fruit
compound leaf
main stems
lateral stem
stolons
tuber
mother tuber
roots

CIP

The plant

The potato (*Solanum tuberosum*) is a herbaceous annual that grows up to 100 cm tall and produces a tuber – also called potato – so rich in starch that it ranks as the world's fourth most important food crop, after maize, wheat and rice. The potato belongs to the Solanaceae – or "nightshade"– family of flowering plants, and shares the genus *Solanum* with at least 1000 other species, including tomato and eggplant. Recent research indicates that *S. tuberosum* is divided into two, only slightly different, cultivar groups: Andigenum, which is adapted to short day conditions and is mainly grown in the Andes, and Chilotanum, the potato now cultivated around the world. Also known as the "European" potato, the Chilotanum group is believed to have developed from Andean cultivars introduced first into Chile and from there, during the 19th century, into Europe.

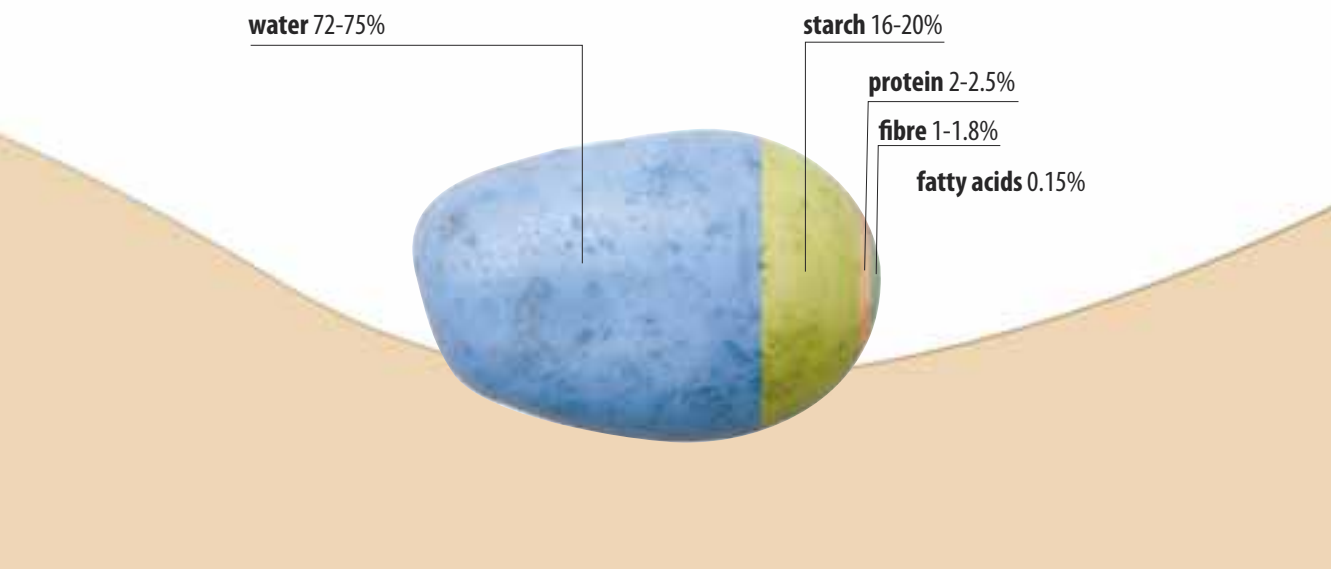
The tuber

As the potato plant grows, its compound leaves manufacture starch that is transferred to the ends of its underground stems (or stolons). The stems thicken to form a few or as many as 20 tubers close to the soil surface. The number of tubers that actually reach maturity depends on available moisture and soil nutrients. Tubers may vary in shape and size, and normally weigh up to 300 g each.

At the end of the growing season, the plant's leaves and stems die down to the soil level and its new tubers detach from their stolons. The tubers then serve as a nutrient store that allows the plant to survive the cold, and later regrow and reproduce. Each tuber has from two to as many as 10 buds (or "eyes"), arranged in a spiral pattern around its surface. The buds generate shoots which grow into new plants when conditions become favourable once more.

A raw potato tuber is rich in micro-nutrients – the vitamins and minerals that

Chemical composition of the potato tuber



are essential to health. A medium-size potato contains high levels of potassium and nearly half the daily adult requirement of vitamin C. It is also a good source of B vitamins, and minerals such as phosphorus and magnesium.

Micronutrients

(one raw potato, including skin, 213 g)

Minerals		
	potassium	897 mg
	phosphorus	121 mg
	magnesium	49 mg
	iron	1.66 mg
Vitamins		
	vitamin C	42 mg
	niacin	2.2 mg
	vitamin B6	0.62 mg
	thiamine	0.17 mg

Source: United States National Nutrient Database

Andean heritage

The story of the potato begins about 8 000 years ago near Lake Titicaca, which sits at 3 800 m above sea level in the Andes mountain range of South America, on the border between Bolivia and Peru. There, research indicates, communities of hunters and gatherers who had first entered the South American continent at least 7 000 years before, began domesticating wild potato plants that grew around the lake in abundance.

Some 200 species of wild potatoes are found in the Americas. But it was in the Central Andes that farmers succeeded in selecting and improving the first of what was to become, over the following millennia, a staggering range of tuber crops. In fact, what we know as "the potato" (*Solanum* species *tuberosum*) contains just a fragment of the genetic diversity found in the four recognized potato species and 5 000 potato varieties still grown in the Andes.

Although Andean farmers cultivated many food crops – including tomatoes, beans and maize – their potato varieties proved particularly suited to the *quechua* or "valley" zone, which extends at altitudes of from 3 100 to 3 500 m along the slopes of the Central Andes (among Andean peoples, the *quechua* was known as the zone of "civilization"). But farmers also developed a frost-resistant potato species that survives on the alpine tundra of the puna zone at 4 300 m.

The food security provided by maize and potato – consolidated by the development of

P.WHITEHOUSE

Lake Titicaca, a centre of Andean civilization

irrigation and terracing – allowed for the emergence around 500 AD of the Huari civilization in the highland Ayacucho basin. Around the same time, the city state of Tiahuanacu rose near Lake Titicaca, thanks largely to its sophisticated "raised field" technology – elevated soil beds lined with water canals – which produced potato yields estimated at 10 tonnes per hectare . At its height, around 800 AD, Tiahuanacu and neighbouring valleys are believed to have sustained a population of 500 000 or more.

Meteoric rise. The collapse of Huari and Tiahuanacu between 1000 and 1200 led to a period of turmoil that ended with the meteoric rise of the Incas in the Cusco valley around 1400. In less than 100 years, they created the largest state in pre-Columbian America, extending from present-day Argentina to Colombia.

The Incas adopted and improved the agricultural advances of previous highland cultures, and gave special importance to maize production. But the potato was fundamental to the food security of their empire: in the Incas' vast network of state storehouses, potato – especially a freeze-dried potato product called *chuño* – was one of the main food items, used to feed officials, soldiers and corvée labourers, and as an emergency stock after crop failures.

The Spanish invasion, in 1532, brought an end to the Incas – but not to the cultivation of potatoes. For, throughout Andean history, the potato – in all its forms – was profoundly a "people's food", playing a central role the Andean vision of the world (time, for example, was measured by how long it took to cook a pot of potatoes).

Farmers in some parts of the high Andes still measure land in *topo*, the area a family needs to grow their potato supply – a *topo* is larger at higher altitudes, where plots need to lie fallow for longer. They classify potatoes not only by species and variety, but by the ecological niche where the tubers grow best, and it is not unusual to find four species cultivated on a single, small plot of land.

Planting tubers remains the most important activity of the farming year near Lake Titicaca, where the potato is known as *Mama Jatha*, or mother of growth. The potato remains the seed of Andean society.

The dawn of agriculture

Incan myths relate that the Creator, Viracocha, caused the sun, moon and stars to emerge from Lake Titicaca. He also created agriculture when he sent his two sons to the human realm to study and classify the plants that grew there. They taught the people to sow crops and how to use them so that they would never lack food.

"The potato eaters" (1885) by Vincent Van Gogh

Diffusion

The diffusion of the potato from the Andes to the rest of the globe reads like an adventure story, but it began with a tragedy. The Spanish conquest of Peru between 1532 and 1572 destroyed the Inca civilization and caused the deaths – from war, disease and despair – of at least half the population.

The conquistadores came in search of gold, but the real treasure they took back to Europe was *Solanum tuberosum*. The first evidence of potato growing in Europe dates from 1565, on Spain's Canary Islands. By 1573, the potato was known to be cultivated on the Spanish mainland. Soon after, tubers were being sent around Europe as exotic gifts – from the Spanish court to the Pope in Rome; from Rome to the papal ambassador in Mons; and from there to a botanist in Vienna. Potatoes were grown in London in 1597 and reached France and the Netherlands soon after.

But once the plant had been added to botanical gardens and herbalists' encyclopaedias, interest waned. European aristocracy admired its flowers, but the tubers were considered fit only for pigs and the destitute. Superstitious peasants believed the potato was poisonous. At the same time, however, Europe's "Age of Discovery" had begun, and among the first to appreciate potatoes as food were sailors who took tubers to consume on ocean voyages. That is how the potato reached India, China and Japan early in the 17th century.

The potato also received an unusually warm welcome in Ireland, where it proved suited to the cool air and moist soils. Irish immigrants took the tuber – and the name, "Irish potato" – to North America in the early 1700s.

Long summer days. The widespread adoption of the potato as a food crop in the northern hemisphere was delayed not only by entrenched eating habits, but by the challenge of adapting a plant grown for millennia in the Andes to the temperate climate of the north. Only a drop of the rich potato gene pool had left South America, and it took 150 years before varieties suited to long summer days began to appear.

Those varieties arrived at a crucial time. In the 1770s, much of continental Europe was devastated by famines, and the potato's value as a food security crop was suddenly recognized. Frederick the Great of Prussia ordered his subjects to grow potatoes as

insurance against cereal crop failure, while the French scientist Parmentier succeeded in having the potato declared "edible" (around the same time, on the other side of the Atlantic, the President of the United States, Thomas Jefferson, served French fries to White House guests).

After initial hesitation, European farmers – even those in Russia, where the potato was called the "devil's apple" – began growing potatoes on a large scale. The potato became Europe's food reserve during the Napoleonic wars, and by 1815 it had become a staple crop across northern Europe. By then, the Industrial Revolution was transforming agrarian society in the United Kingdom, displacing millions of rural people into crowded cities. In the new urban environment, the potato became the first modern "convenience food" – energy-rich, nutritious, easy to grow on small plots, cheap to purchase, and ready to cook without expensive processing.

Increased potato consumption during the 19th century is credited with helping to reduce the scourge of diseases such as scurvy and measles, contributing to higher birth rates and the population explosion in Europe, the United States and the British Empire.

Papa, patata, potato...

While the Incas called it *papa* (as do modern-day Latin Americans), the Spaniards called the potato *patata*, apparently confusing it with another New World crop, the sweet potato (known as *batata*). In 1797, the English herbalist Gerard referred to the sweet potato as "common potatoes", and for many years *S. tuberosum* was known as the "Virginia potato" or "Irish potato" before finally displacing *batata* as *the* potato.

"Potato famine". But the potato's success proved a double-edged sword. For the tubers that were being cloned and cultivated across North America and Europe belonged to a few, genetically similar varieties. That meant they were highly vulnerable: a pest or disease that struck one plant could spread quickly to the rest.

The first sign of impending disaster came in 1844-1845, when a mould disease, late blight, ravaged potato fields across continental Europe, from Belgium to Russia. But the worst came to Ireland, where potato supplied 80 percent of calorie intake. Between 1845 and 1848, late blight destroyed three potato crops, leading to famines that caused the deaths of one million people.

The Irish catastrophe led to concerted efforts to develop more productive and disease-resistant varieties. Breeders in Europe and North America, drawing on new potato germplasm from Chile, produced many of the modern varieties that laid the foundation for massive potato production in both regions for most of the 20th century.

Meanwhile, European colonialism and emigration were taking the potato to all corners of the globe. Colonial governors, missionaries and settlers introduced potato growing to the floodplains of Bengal and Egypt's Nile delta, the Atlas Mountains of Morocco, and the Jos plateau in Nigeria. Emigrant farmers took the potato to Australia and even to South America, establishing the potato in Argentina and Brazil.

In the Asian heartland, the tuber moved along more ancient routes, finding its way from the Caucasus to Turkey's Anatolian

plateau, from Russia to western China, and from China to the Korean Peninsula. In the mountain valleys of Tajikistan, some potato types have been grown long enough to be considered "old local varieties".

The 20th century saw the potato finally emerge as a truly global food. The Soviet Union's annual potato harvest reached 100 million tonnes. In the years following the Second World War, huge areas of arable land in Germany and Britain were dedicated the potato, and countries like Belarus and Poland produced – and still do – more potatoes than cereals.

The potato came into its own as a snack food. The invention in the 1920s of the mechanical potato peeler helped make potato crisps America's top-selling snack. A restaurant chain founded by the McDonald brothers in the United States in 1957 spent millions of dollars to "perfect the French fry". A Canadian firm, McCain, that began making frozen French fries in 1957, expanded to open 57 production facilities on six continents and now supplies one third of all French fried potatoes produced internationally.

Exploding demand. From the 1960s, cultivation of the potato began to expand in the developing world. In India and China alone, total production rose from 16 million tonnes in 1960 to almost 100 million in 2007. In Bangladesh, potato has become a valuable winter cash crop, while potato farmers in Southeast Asia have tapped into exploding demand from food industries. In sub-Saharan Africa, potato is a preferred food in many urban areas, and an important crop in the highlands of Cameroon, Kenya, Malawi and Rwanda.

The potato has an extraordinarily rich past, and a bright future. While production in Europe – the potato's "second home" for four centuries – is declining, the potato has ample room for expansion in the developing world, where its consumption is less than a quarter that of developed countries.

Today in mountainous Lesotho, many farmers are shifting from maize to potato, assisted by an FAO project for production of virus-free seed tubers. In China, agriculture experts claim that a staggering 30 percent increase in potato yields is within reach.

And in the Andes, where it all began, the Government of Peru created in July 2008 a national register of Peruvian native potato varieties, to help conserve the country's rich potato heritage. That genetic diversity, the building blocks of new varieties adapted to the world's evolving needs, will help write future chapters in the story of *Solanum tuberosum*.

HARJONO DJOYOBISONO

Potato fields in central Java, Indonesia

Cultivation

Potato is grown in more than 100 countries, under temperate, subtropical and tropical conditions. It is essentially a "cool weather crop", with temperature being the main limiting factor to production: tuber growth is sharply inhibited in temperatures below 10°C and above 30°C , while optimum yields are obtained where mean daily temperatures are in the 18 to 20°C range.

For that reason, potato is planted in early spring in temperate zones and late winter in warmer regions, and grown during the coolest months of the year in hot tropical climates. In some sub-tropical highlands, mild temperatures and high solar radiation allow farmers to grow potatoes throughout the year, and to harvest tubers within 90 days of planting (in temperate climates, such as in northern Europe, that can take up to 150 days).

The potato is a very accommodating and adaptable plant, and will produce well even without ideal soil and growing conditions. However, it is also vulnerable to a number of pests and diseases. To prevent the build-up of pathogens in the soil, farmers avoid growing potatoes on the same land from year to year. Instead, they grow potatoes in rotations of three or more years, alternating with other, dissimilar crops, such as maize, beans and alfalfa. Crops susceptible to the same pathogens as the potato (e.g. tomato) are avoided, in order to break the development cycle of potato pests.

With good agricultural practices, including irrigation when necessary, a hectare of potato in the temperate climates of northern Europe and North America can yield more than 40 tonnes of fresh tubers within four months of planting. In most developing countries, however, average yields are much lower – ranging from as little as 5 to 25 tonnes – owing to lack of high quality seed and improved cultivars, lower rates of fertilizer use and irrigation, and pest and disease problems.

Selecting seed potato

Seed potato is usually the most expensive input to potato cultivation, accounting for from 30 to 50 percent of production costs. In areas of developing countries where no formal seed supply system exists, farmers have devised their own *ad hoc* method for selecting seed tubers: they sell the largest potatoes for cash, eat the medium-sized ones at home, and keep the smallest as future planting material.

Soil and land preparation

The potato can be grown on almost any type of soil, except saline and alkaline. Naturally loose soils, which offer the least resistance to enlargement of the tubers, are preferred, and loamy and sandy loam soils that are rich in organic matter, with good drainage and aeration, are the most suitable. Soil with a pH range of 5.2 – 6.4 is considered ideal.

Growing potatoes involves extensive ground preparation. The soil needs to be harrowed until completely free of weed roots. In most cases, three ploughings, along with frequent harrowing and rolling, are needed before the soil reaches a suitable condition: soft, well-drained and well-aerated.

Planting

The potato crop is usually grown not from seed but from "seed potatoes" – small tubers or pieces of tuber sown to a depth of 5 to 10 cm. Purity of the cultivars and healthy seed tubers are essential for a successful crop. Tuber seed should be disease-free, well-sprouted and from 30 to 40 g in weight. Use of good quality commercial seed can increase yields by 30 to 50 percent, compared to farmers' own seed, but expected profits must offset the higher cost.

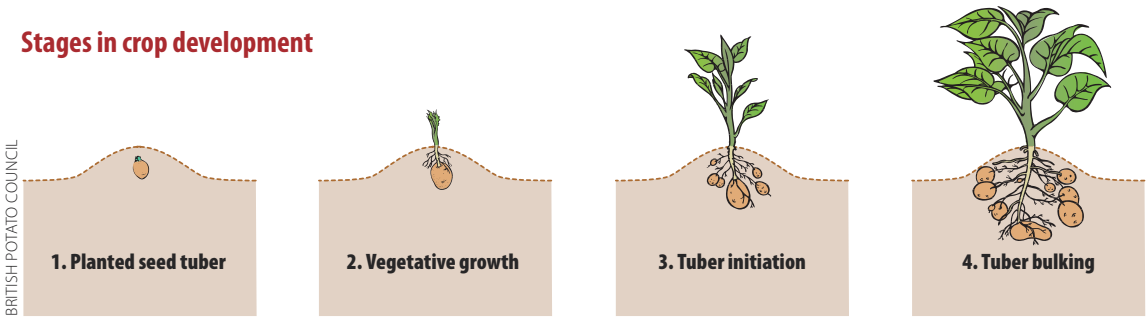
The planting density of a row of potatoes depends on the size of the tubers chosen, while the inter-row spacing must allow for ridging of the crop (*see below*). Usually, about two tonnes of seed potatoes are sown per hectare. For rainfed production in dry areas, planting on flat soil gives higher yields (thanks to better soil water conservation), while irrigated crops are mainly grown on ridges.

Crop care

During the development of the potato canopy, which takes about four weeks, weeds must be controlled in order to give the crop a "competitive advantage". If the weeds are large, they must be removed before ridging operations begin. Ridging (or "earthing up") consists of mounding the soil from between the rows around the main stem of the potato plant. Ridging keeps the plants upright and the soil loose, prevents insect pests such as the tuber moth from reaching the tubers, and helps prevent the growth of weeds.

After earthing up, weeds between the

Stages in crop development



BRITISH POTATO COUNCIL

Potato varieties

Although the potato cultivated worldwide belongs to just one botanical species, Solanum tuberosum, *the tubers come in thousands of varieties with great differences in size, shape, colour, texture, cooking characteristics and taste. Here is a small sample of potato diversity:*

1. Atahualpa
Bred in Peru, a high yielding variety good for both baking and frying

2. Nicola
Widely grown Dutch variety, one of the best for boiling, also good in salads

3. Russet Burbank
The classic American potato, excellent for baking and French fries

4. Lapin puikula
Grown in Finland for centuries, in fields bathed in the light of the midnight sun

5. Yukon Gold
A Canadian potato with buttery yellow flesh suitable for frying, boiling, mashing

6. Tubira
CIP-bred variety grown in West Africa. White flesh, pink skin

7. Vitelotte
A gourmet French variety prized for its deep blue skin and violet flesh

8. Royal Jersey
From the Isle of Jersey: the only British vegetable with an EU designation-of-origin

9. Kipfler
Hails from Germany. Elongated with cream flesh, popular in salads

10. Papa colorada
Brought to the Canary Islands by passing Spanish ships in 1567

11. Maris Bard
Bred in the United Kingdom, a white variety with a soft waxy texture good for boiling

12. Désirée
Red-skinned, with yellow flesh and a distinctive flavour

13. Spunta
Another popular commercial tuber, good for boiling and roasting

14. Mondial
A Dutch potato with smooth good looks. Boils and mashes well

15. Unknown
One of more than 5 000 native varieties still grown in the Andes

CIP [1,6], NIVAP HOLLAND [2,12,13,14], CANADIAN FOOD INSPECTION AGENCY [3,5,11], LAPIN KEITTIÖMESTARIT [4], ABSTRACT GOURMET [9], WIKIMEDIA [7,8,10], J-L GONTERRE [15]

growing plants and at the top of the ridge are removed mechanically or by using herbicides. Ridging should be done two or three times at an interval of 15 to 20 days. The first should be done when the plants are about 15-25 cm high; the second is often done to cover the growing tubers.

Manuring and fertilization

The use of chemical fertilizer depends on the level of available soil nutrients – volcanic soils, for example, are typically deficient in phosphorus – and in irrigated commercial production, fertilizer requirements are relatively high. However, the potato can benefit from application of organic manure at

the start of a new rotation: it provides a good nutrient balance and protects the structure of the soil. Crop fertilization requirements need to be correctly estimated according to the expected yield, the potential of the variety and the intended use of the harvested crop.

Water supply

The soil moisture content must be maintained at a relatively high level. For best yields, a 120 to 150 day crop requires from 500 to 700 mm of water. In general, water deficits in the middle to late part of the growing period tend to reduce yield more than those in the early part. Where supply is limited, water should be directed towards maximizing yield per hectare rather than being applied over a larger area.

Because the potato has a shallow root system, yield response to frequent irrigation is considerable, and very high yields are obtained with mechanized sprinkler systems that replenish evapotranspiration losses every one or two days. Under irrigation in temperate and subtropical climates, a crop of about 120 days can produce yields of 25 to 35 tonnes/ha , falling to 15 to 25 tonnes/ha in tropical areas.

Pests and diseases

A few basic precautions against diseases – crop rotation, using tolerant varieties and healthy, certified seed tubers – can help avoid great losses. There is no chemical control for bacterial and viral diseases but they can be controlled by regular monitoring (and when necessary, spraying) of their aphid vectors. The severity of fungal diseases such as late blight depends, after the first infection, mainly on the weather – persistence of favourable conditions, without chemical spraying, can quickly spread the disease.

Insect pests can wreak havoc in a potato patch. Recommended control measures include regular monitoring and steps to protect the pests' natural enemies. Even damage caused by the Colorado potato beetle, a major pest, can be reduced by destroying beetles, eggs and larvae that appear early in the season, while sanitation, crop rotations and use of resistant potato varieties help prevent the spread of nematodes.

Harvesting

Yellowing of the potato plant's leaves and easy separation of the tubers from their stolons indicate that the crop has reached maturity. If the potatoes are to be stored rather than consumed immediately, they are left in the soil to allow their skins to thicken – thick skins prevent storage diseases and shrinkage due to water loss. However, leaving tubers for too long in the ground increases their exposure to a fungal incrustation called black scurf.

To facilitate harvesting, the potato vines should be removed two weeks before the

potatoes are dug up. Depending on the scale of production, potatoes are harvested using a spading fork, a plough or commercial potato harvesters that unearth the plant and shake or blow the soil from the tubers. During harvesting, it is important to avoid bruising or other injury, which provide entry points for storage diseases.

Storage

Since the newly harvested tubers are living tissue – and therefore subject to deterioration – proper storage is essential, both to prevent post-harvest losses of potatoes destined for fresh consumption or processing, and to guarantee an adequate supply of seed tubers for the next cropping season.

For ware and processing potatoes, storage aims at preventing "greening" (the build up of chlorophyll beneath the peel, which is associated with solanine, a potentially toxic alkaloid) and losses in weight and quality. The tubers should be kept at a temperature of 6 to 8°C degrees, in a dark, well-ventilated environment with high relative humidity (85 to 90 percent). Seed tubers are stored, instead, under diffused light in order to maintain their germination capacity and encourage development of vigorous sprouts. In regions, such as northern Europe, with only one cropping season and where storage of tubers from one season to the next is difficult without the use of costly refrigeration, off-season planting may offer a solution.

NICOLAS MARTELLA

Potatoes awaiting sale in La Plata, Argentina

Uses of potato

Once harvested, potatoes are used for a variety of purposes, and not only as a vegetable for cooking at home. In fact, it is likely that less than 50 percent of potatoes grown worldwide are consumed fresh. The rest are processed into potato food products and food ingredients, fed to cattle, pigs and chickens, processed into starch for industry, and re-used as seed tubers for growing the next season's potato crop.

Food uses: fresh, "frozen", dehydrated

FAO estimates that just over two-thirds of the 320 million tonnes of potatoes produced in 2005 were consumed by people as food, in one form or another. Home-grown or purchased in markets, **fresh potatoes** are baked, boiled or fried and used in an astonishing range of recipes: mashed potatoes, potato pancakes, potato dumplings, twice-baked potatoes, potato soup, potato salad and potatoes *au gratin*, to name a few.

However, the global consumption of potato as food is shifting from fresh potatoes to added-value, **processed food products**.

ALESSANDRA BENEDETTI/FAO


UMAMI


M. ALVES


JIANGSU CORP.


JIANGSU CORP.

One of the main items in that category goes by the unappetizing name of *frozen potatoes*, but includes most of the *French fries* ("chips" in the United Kingdom) served in restaurants and fast food chains worldwide. The production process is fairly simple: peeled potatoes are shot through cutting blades, parboiled, air dried, par fried, frozen and packaged. The world's appetite for factory-made French fries is estimated at more than 11 million tonnes a year.

Another processed product, the *potato crisp* ("chips" in the United States), is the long-standing king of snack foods in many developed countries. Made from thin slices of deep-fried or baked potato, they come in a variety of flavours – from simple salted to "gourmet" varieties tasting of roast beef and Thai chili. Some crisps are produced using a dough made from dehydrated potato flakes.

Dehydrated potato flakes and granules are made by drying a mash of cooked potatoes to a moisture level of 5 to 8 percent. Flakes are used in retail mashed potato products, as ingredients in snacks, and even as food aid: as part of its international food assistance, the United States has distributed potato flakes to more than 600 000 people. Another dehydrated product, *potato flour*, is ground from cooked, whole potatoes and retains a distinct potato taste. Gluten-free and rich in starch, potato flour is used by the food industry to bind meat mixtures and thicken gravies and soups.

Modern starch processing can retrieve as much as 96 per cent of the starch found in raw potatoes. A fine, tasteless powder with "excellent mouth-feel", *potato starch* provides higher viscosity than wheat and maize starches, and delivers a more tasty product. It is used as a thickener for sauces and stews, and as a binding agent in cake mixes, dough, biscuits and ice-cream.

Finally, in eastern Europe and Scandinavia, crushed potatoes are heated to convert their starch to fermentable sugars that are used in the distillation of *alcoholic beverages* such as vodka and *akvavit*.

Non-food uses: Glue, animal feed and fuel-grade ethanol

Potato starch is also widely used by the pharmaceutical, textile, wood and paper industries as an adhesive, binder, texture agent and filler, and by oil drilling firms to wash boreholes. Potato starch is a 100% biodegradable substitute for polystyrene and other plastics and used, for example, in disposable plates, dishes and knives.


C. FROGGENHALL

Potato peel and other "zero value" wastes from potato processing are rich in starch that can be liquefied and fermented to produce **fuel-grade ethanol**. A study in Canada's potato-growing province of New Brunswick estimated that 440 000 tonnes of processing waste could produce 4 to 5 million litres of ethanol.

One of the first widespread uses of the potato in Europe was as **farm animal feed**. In the Russian Federation and other East European countries, as much as half of the potato harvest is still used for that purpose. Cattle can be fed up to 20 kg of raw potatoes

a day, while pigs fatten quickly on a daily diet of 6 kg of boiled potatoes. Chopped up and added to silage, the tubers cook in the heat of fermentation.

Seed potatoes: renewing the cycle...

Unlike other major field crops, potatoes are reproduced vegetatively, from other potatoes. Therefore, a part of each year's crop – ranging from 5 to 15 percent, depending on the quality of the harvested tubers – is set aside for re-use in the next planting season. Most farmers in developing countries select and store their own seed tubers. In developed countries, farmers are more likely to purchase disease-free "certified seed" from dedicated suppliers. More than 13 percent of France's potato growing area is used to produce seed potatoes, and the Netherlands exports some 700 000 tonnes of certified seed a year.

D. MARIJNE

OSCAR MARÍN REPOLLER

Traditional dish of the Canary Islands

Potatoes in the kitchen

What has made the "humble tuber" the world's No. 4 food crop is not only its nutritional value but its amazing versatility in the kitchen. Potatoes are the world's most popular vegetable, and have been welcomed into the cuisines of countries around the globe. Potatoes are used in curries in India and in pasta in Italy, stewed with bananas in Costa Rica, baked with rice in Iran, stuffed with liver in Belarus, stir-fried with green beans in Ethiopia, and simmered with smoked haddock in winter soups in Finland.

The secret of the potato's success is its great diversity: in Peru, a potato salad may include three or four different types. While the choice of tubers is more limited elsewhere, modern varieties of *Solanum tuberosum* offer a wide range of cooking characteristics suitable for hundreds of different dishes. Some give soups a creamy density, providing a delicate taste that highlights other ingredients. Other potatoes are great when baked, served as a simple snack or with a filling as a complete meal. Roast potatoes – crisp and golden outside and fluffy inside – are the perfect

accompaniment to roast meat. Smooth, creamy, mashed potato is said to be the "ultimate comfort food", while "new" potatoes, steamed or boiled, are considered a special delicacy.

Most potato recipes are easy to prepare. But choosing the right potato variety is essential for a successful potato dish – in the kitchen, potatoes are classified according to their starch content, which determines how they react to cooking. Basically, the more starch they contain, the more easily the tuber's starch cells burst when heated.

Choosing the "right potato"

High-starch potatoes, also called "floury" potatoes, generally have coarse, corky skin and a dry texture (due to lower levels of moisture). Boiled, they tend to fall apart. But they are unbeatable for baking, making French fries, and yielding light, fluffy mashed potato. Common high-starch varieties are Russets, Bintje, King Edward and Maris Piper.


S. GILBERT


J. JULIAN

Medium-starch (or "all purpose") potatoes include long white, round white and yellow potatoes, such as Yukon Gold, German Butterball and Nicola, as well as purple-fleshed tubers. They are more moist than baking potatoes, but – some say – have a blander taste. Ideal for steaming, they go well in stews and in baked, roasted, pan-fried and *au gratin* dishes.

Low-starch potatoes are called "waxy" for their glossy skins. These moist tubers keep their shape during cooking, making them the best choice for boiling, sautés, stews and salads (in France, waxy varieties are preferred for making thick mashed potato). Use fingerling and round reds, or "new" (immature, of any variety) potatoes.


K. PUGH

Factsheets. To deepen understanding of the potato's role in world agriculture, the economy and global food security, FAO specialists compiled a series of factsheets on key issues in potato development.

International Year of the Potato 2008

Potatoes, nutrition and diet

Potatoes can be important staple foods, but balanced diets need to include other vegetables and whole grain foods

Key Points

- The potato is a good source of dietary energy and some micronutrients, and its protein content is very high in comparison with other roots and tubers.
- Potato is low in fat – but preparing and serving potatoes with high fat ingredients raises the caloric value of the dish.
- Boiling potatoes in their skins prevents loss of nutrients.
- Potatoes are important in many diets, but need to be balanced with other vegetables and whole grain foods.
- Further research is needed to determine the link between potato consumption and Type 2 diabetes.

Potato is a versatile, carbohydrate-rich food highly popular worldwide and prepared and served in a variety of ways. Freshly harvested, it contains about 80 percent water and 20 percent dry matter. About 60 to 80 percent of the dry matter is starch. On a dry weight basis, the protein content of potato is similar to that of cereals and is very high in comparison with other roots and tubers. In addition, the potato is low in fat.

Potatoes are rich in several micronutrients, especially vitamin C – eaten with its skin, a single medium-sized potato of 150 g provides nearly half the daily adult requirement (100 mg). The potato is a moderate source of iron, and its high vitamin C content promotes iron absorption. It is a good source of vitamins B1, B3 and B6 and minerals such as potassium, phosphorus and magnesium, and contains folate, pantothenic acid and riboflavin. Potatoes also contain dietary antioxidants, which may play a part in preventing diseases related to ageing, and dietary fibre, which benefits health.

Effects of potato preparation methods

The nutritive value of a meal containing potato depends on other components served with them and on the method of preparation. By itself, potato is not fattening (and the feeling of satiety that comes from eating potato can actually help people to control their weight). However, preparing and serving potatoes with high-fat ingredients raises the caloric value of the dish.

Since the starch in raw potato cannot be digested by humans, they are prepared for consumption by boiling (with or without the skin), baking or frying. Each preparation method affects potato composition in a different way, but all reduce fibre and protein content, due to leaching into cooking water and oil, destruction by heat treatment or chemical changes such as oxidation.

Boiling – the most common method of potato preparation worldwide – causes a significant loss of vitamin C, especially in peeled potatoes. For french fries and chips, frying for a short time in hot oil (140 °C to 180 °C) results in high absorption of fat and significantly reduces mineral and ascorbic acid content. In general, baking causes slightly higher losses of vitamin C than boiling, due to the higher oven temperatures, but losses of other vitamins and minerals during baking are lower.

Potato's role in the developing world's "nutrition transition"

In many developing countries, and especially in urban areas, rising levels of income are driving a "nutrition transition" toward more energy-dense foods and prepared food products. As part of that transition, demand for potato is increasing. In South Africa, potato consumption has been growing in urban areas, while in rural areas maize is still the staple. In China, higher income and increased urbanization have led

Nutrient content of potatoes

(Per 100 g, after boiling in skin and peeling before consumption)
Source: United States Department of Agriculture, National Nutrient Database

to increased demand for processed potatoes. Thus, the potato already plays a role in diet diversification in many countries. However, where other staple crops are available to meet energy requirements, potato should not replace them but rather supplement the diet with its vitamins and mineral content and high quality protein. Potatoes can be important staple foods, but balanced diets need to include other vegetables and whole grain foods.

As part of the trend toward greater consumption of "convenience foods", demand for fried potatoes is increasing. Over-consumption of these high-energy products, along with reduced physical activity, can lead to overweight. Therefore the role of fried potato products in the diet must be taken into consideration in efforts to prevent overweight and diet related non-communicable diseases, including heart disease and diabetes. Type 2 diabetes is caused by many factors, and further research is needed to determine whether potato consumption and Type 2 diabetes may be linked.

Toxic components of potato

As part of the potato plant's natural defences against fungi and insects, its leaves, stems and sprouts contain high levels of toxic compounds called glycoalkaloids (usually solanine and chaconine). Glycoalkaloids are normally found at low levels in the tubes, and occur in the greatest concentrations just beneath the skin.

Potatoes should be stored in a dark, cool place in order to keep glycoalkaloid content low. Under exposure to light, potatoes turn green in colour due to increased levels of chlorophyll, which can also indicate higher levels of solanine and chaconine. Since glycoalkaloids are not destroyed by cooking, cutting away green areas and peeling potatoes before cooking ensures healthy eating.

About IYP 2008

The **International Year of the Potato**, to be celebrated throughout 2008, aims at raising global awareness of the potato's key role in agriculture, the economy and world food security.

www.potato2008.org

Credits:
Information provided by the Nutrition and Consumer Protection Division of FAO
Photo: © FAO/Giulio Napolitano

International Year of the POTATO 2008

HIDDEN TREASURE

www.potato2008.org

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International Year of the Potato 2008

Potato and biodiversity

By conserving – and utilizing – the potato genetic diversity developed by their ancestors, small farmers in the Andes are helping ensure world food security

Key points

- Potato farming systems need a continuous supply of new varieties drawn from the entire potato gene pool.
- Potato biodiversity is under threat – ancient varieties cultivated for millennia have been lost and wild species are threatened by climate changes.
- Smallholder farming systems in the Andes encourage cross-pollination of potato flowers, vital to sustaining the diversity of local, farmer-developed varieties.
- With CIP support, Andean communities have created a "potato park" holding some 1 200 traditional varieties of potato.

The history of the potato provides a grim warning of the need to maintain genetic diversity in our staple food crops. In the 19th century, Ireland was heavily reliant on only a few varieties of potato, and those types contained no resistance to the devastating disease known as late blight. When late blight destroyed the 1845-1846 potato crop, widespread famine followed. An estimated one million people starved to death and more than a million were forced to migrate abroad.

To combat pests and diseases, increase yields, and sustain production on marginal lands, today's potato-based agricultural systems need a continuous supply of new varieties. That requires access to the entire potato gene pool. But potato biodiversity is under threat: ancient varieties cultivated by Andean peoples for millennia have been lost to diseases, climate change and social upheaval.

Species and crop-associated diversity

While most varieties of potatoes belong to a single species, *Solanum tuberosum*, about 10 other *Solanum* species have been cultivated, and 200 wild species have been recorded. Climate change may threaten the survival of those wild relatives: it is forecast that as many as 12 percent will become extinct as their growing conditions deteriorate. If climate changes drastically, the area where wild potatoes grow naturally could be reduced by as much as 70 percent.

Since potatoes mostly propagate vegetatively, most commercial varieties of potato have a reduced ability to flower and breeders do not select for traits that make the flower attractive to pollinators. However, natural potato pollination remains important to sustaining the diversity of land races (farmer-developed varieties that are adapted to local environmental conditions). Fortunately, the diverse smallholder farming systems in the Andes harbour a variety of flowering plants that do attract pollinators, such as honeybees and bumblebees, which promote cross-pollination of potato flowers, thus increasing seed production and sustaining diversity.

Farmers sort varieties at Peru's "potato park". Photo: © CIP

Centre of origin

In the Andean region, generations of farmers have domesticated thousands of potato varieties. Even today, farmers cultivate up to 50 varieties on their farms. In the biodiversity reserve of the Chiloé archipelago in Chile, local people cultivate about 200 varieties of native potato. They use farming practices transmitted orally by generations of mainly women farmers.

International Treaty

The potato is included in the multilateral system established under FAO's International Treaty on Plant Genetic Resources for Food and Agriculture.

The Treaty, which entered into force in 2004, aims at the conservation and sustainable use of crop plant diversity and the fair and equitable sharing of benefits derived from their use.

Conserving potato biodiversity in the Andes

Having lost many of their traditional potato varieties, Peruvian farmers in the Andes are now taking measures to conserve and sustainably use those that remain. A pact has been signed by six Quechua communities with the International Potato Center that recognizes the rights of the communities over potato strains they have developed.

Under the agreement, the Center's genebank returns potato genetic resources – and knowledge associated with them – to the communities, which have established a "potato park" (*Parque de la papa*) in a conservation area where they grow and manage the plants. This repatriation of biological diversity effectively keeps control of genetic resources local. The 15 000 ha park is a "living library" of potato genetic diversity, holding some 1 200 varieties of potato cultivated in the highlands. A long-term goal is to re-establish all the world's 4 000 known potato varieties in the valley, allowing the park to function as a second centre of origin for this vital staple crop.

Inside CIP's gene bank. Photo: © CIP

Diversity conserved in trust

The International Potato Centre in Peru maintains the world's largest bank of potato germplasm, including some 1 500 samples of about 100 wild species collected in eight Latin American countries, and 3 600 traditional Andean cultivated potatoes. The collection is maintained and managed under the terms of an agreement with the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture and, like all collections eligible for funding from the Global Crop Diversity Trust, is available to plant breeders worldwide upon request.

Credits:
Information provided by the Global Crop Diversity Trust and the Plant Production and Protection Division, FAO.

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Potato and gender

Around the world, rural women are essential to conservation, seed selection, planting, harvesting, storing and marketing of potatoes

Key points

Women in developing countries play a central role in guaranteeing family food security and provide most of the labour for potato production.

Andean women possess a unique reservoir of knowledge and skills in domesticating wild potatoes and adapting new varieties.

New strategies are helping to empower small-scale farmers and ensure that gender issues are incorporated in potato development policies and programmes.

Since the beginning of Andean agriculture, seeds have been associated with reproduction and femininity. The Incas believed the moon conferred fertility on women and moved *Pachamama* (Mother Earth) to germinate and offer up her potatoes (known as *Mama Acxo*) at harvest time. Men deposited the seeds and women received them, to harbour and nurse. In the Andes today, and in many other parts of the developing world, potato growing is still highly labour-intensive. Rural women provide most of the labour in both small- and large-scale potato production – from conservation and seed selection to planting, harvesting, storing and marketing.

China: Increasing gender awareness
In China, most potatoes are grown in mountain areas of Inner Mongolia and Shaanxi provinces, both as a staple food and as a cash crop. Research in Wuchuan County, Inner Mongolia, shows how the labour-intensive nature of potato production, coupled with strong gender inequalities, can pose a threat to the sustainability of local livelihoods.

Says Zhang Ailian, a woman farmer: "Potato growing is very tiring, especially at harvest time, and the burden of household tasks is already very heavy. The Agriculture and Animal Husbandry Bureau provides technical training in potato production, but heads of the village usually tell men to attend. Women make up fewer than 10 percent of total participants."

A project in Wuchuan is working to ease the burden of potato production on women by supplementing agricultural training with gender-sensitive materials. The project uses participatory approaches such as "farmer field schools", and brings gender issues into potato development policies. It advocates a more equitable division of labour and financial decision making powers for women, and facilitates their access to extension services and training.

A group of farmers harvests potatoes near Cajamarca. Photo: © CIP

Peru: Women as conservationists
In the high-altitude Peruvian Andes, the genetic diversity found in hundreds of native potato varieties guarantees rural communities' food security. Over centuries, Andean farmers and the descendants of *ayllu* family groups, primarily women, have selected countless varieties of potato to preserve and enhance plant diversity, allowing them to cultivate in different agro-ecological zones and cope with pests, diseases and climatic changes. The "bitter potato", for example, is the result of crossing with frost-resistant varieties adapted to the freezing temperatures of the *Puna* agro-ecological zone.

Male migration to urban centres has left women farmers responsible for almost 70 percent of family farm work. In the Chetilla community in Cajamarca, the

Andean women also handle marketing. Photo: © FAO

tasks of seed selection and storage are exclusively women's. Their participation in seed fairs is invaluable in preserving Andean potato biodiversity. Surveys have found that women attending fairs are able to identify up to 56 different varieties. However, the heavy burden placed on women in potato production highlights the need for a more equitable division of labour to ensure the conservation of agro-biodiversity.

Uganda: Enabling rural innovation

Potatoes have become an important staple and cash crop in sub-Saharan Africa's highland zones, and Uganda is a major potato producer in the region. Virtually all households in southwestern Uganda grow potatoes, harvesting over 60 percent of the national crop. Most tubers are grown in highland areas of Kabale and Kisoro as a staple food and as the main source of income.

"Enabling rural innovation" is a gender-sensitive strategy being used in various development programmes. The idea is to empower both men and women farmers and rural communities to develop market opportunities. In Kabale, for example, farmer field school training covered integrated potato pest and disease management. It also helped the Nyabyumba United Farmers group to establish an enterprise that now supplies potatoes for french fries at fast-food restaurants in Kampala.

Potato cultivation is expanding in Africa. Photo: © FAO

Gender roles in agriculture

FAO's Gender Plan of Action underscores the need for rural and agricultural development policies that acknowledge the roles of both men and women in achieving food security. The Plan aims at promoting gender equality in access to food, in the control over and management of natural resources and agricultural support services, in policy- and decision-making processes at all levels in the agricultural and rural sector, and in opportunities for on- and off-farm rural employment.

About IYP 2008

The **International Year of the Potato**, to be celebrated throughout 2008, aims at raising global awareness of the potato's key role in agriculture, the economy and world food security.

www.potato2008.org

Credits:

Information provided by the Gender, Equity and Rural Employment Division, FAO

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The global potato economy

Developing countries are now the world's biggest potato producers – and importers – and consumer demand is shifting from fresh tubers to processed products

Key points

- In 2005, for the first time, the developing world's potato production exceeded that of the developed world
- Subsistence potato growing in developing countries is declining as producers reorient toward domestic and international markets
- Global consumption is shifting from fresh potatoes to added-value processed products
- In international trade, both the value and volume of traded processed products far outweigh trade in fresh tubers
- Developing countries are net importers in international potato trade, which in 2005 was estimated to be worth US$6 billion.
- Despite its importance as a staple food and in combating hunger and poverty, potato has been neglected in agricultural development policies for food crops

In 2005, the world produced some 315 million tonnes of potatoes. Photo: © FAO

Potato production in developed countries, especially in Europe and the Commonwealth of Independent States, has declined on average by one percent per annum over the past 20 years. However, output in developing countries has expanded at an average rate of five percent per year. Asian countries, particularly China and India, fuelled this growth.

In 2005, the developing countries' share of global potato output stood at 52 percent, surpassing that of the developed world. This is a remarkable achievement, considering that just 20 years ago the developing countries' share in global production was little more than 20 percent. Even so, world potato production and consumption are currently expanding more slowly than the global population.

Fresh potato consumption, once the mainstay of world potato utilization, is decreasing in many countries, especially in developed regions. Currently, more potatoes are processed to meet rising demand from the fast food, snack and convenience food industries. The major drivers behind this development include growing urban populations, rising incomes, the diversification of diets and lifestyles that leave less time for preparing the fresh product for consumption.

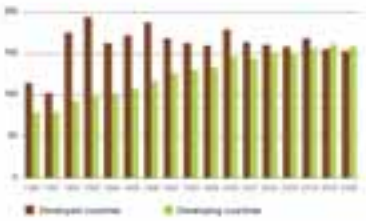
Potatoes are commonly regarded as a bulky, perishable commodity with high transport costs and limited export potential, confined mostly to cross-border transactions. These constraints have not hampered the international potato trade, which has doubled in volume and risen almost fourfold in value since the mid-1980s. This growth is due to unprecedented international demand for processed products, particularly frozen and dehydrated potato products. To date, developing countries have not been beneficiaries of this trade expansion. As a group, they have emerged as leading net importers of the commodity.

International trade in potatoes and potato products still remains thin relative to production, as only around 6 percent of output is traded. High transport costs, including the cost of refrigeration, are major obstacles to a wider international marketplace.

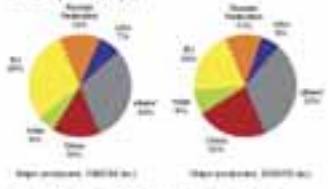
Trade policies

Ad valorem import tariffs are used to protect domestic potato markets. Other

World potato production 1960-2006



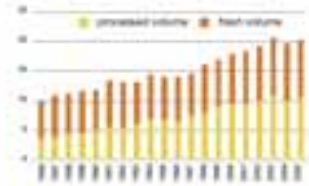
China and India now account for 30 percent of world potato output



Imports and exports of processed products now dominate world potato trade

Global potato trade volume (tuber equivalent), 1986-2005

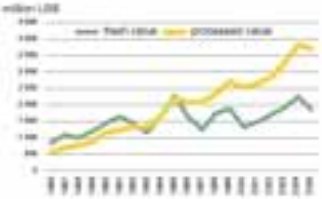
million tonnes



Global transactions worth close to US$4 billion, driven by processed potatoes

Global potato trade value, 1986-2005

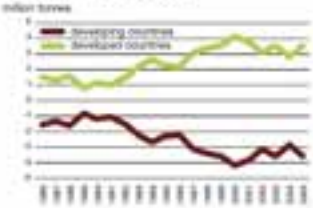
million US$



Net trade position of developing countries continues to deteriorate

Potato net trade (exports-imports) in tuber equivalent, 1986-2005

million tonnes



policies that restrict access to markets include sanitary and phytosanitary measures and technical barriers to trade.

Import tariffs on potatoes and potato products are applied by most countries. The binding rates agreed under the aegis of the World Trade Organization vary considerably. Potato provides a classic example of "tariff escalation", where importing countries protect processing industries by levying higher duties on processed products than on raw material. By preventing countries from diversifying their export base into higher-value processed products, tariff escalation can therefore keep them "trapped" as providers of raw material.

Countries wishing to supply potato commodities to the international market – especially to the more lucrative developed country markets – also face considerable hurdles in the form of food health standards and technical regulations. The Doha Development Round of trade negotiations recognizes the negative impacts of tariff escalation and contains important provisions aimed at ensuring that standards and regulations do not become de facto barriers to trade or hidden protectionist policies, while at the same time putting public health concerns foremost. Unfortunately, negotiations pertaining to the Doha agenda have suffered a series of setbacks, and agreement on a final solution has yet to materialize.

Potato potential

Potato's positive attributes, particularly its high nutritional value and potential to boost incomes, have not received the attention they deserve from governments. The lack of established marketing channels, inadequate institutional support and infrastructure, and restrictive trade policies are impediments to commercialization of the sector. National and international stakeholders need to place potato higher on the development agenda.

	WTO Bound Tariff (%)	
Product	Trade Weighted Average	Maximum
Fresh potatoes (inc. seed)	29	376
Frozen potatoes	16	414
Potato flour*	38	446
Potato starch	109	550

* includes flour, meal, flakes, granules and pellets

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International Year of the Potato 2008

Potato and food price inflation

The potato is a highly recommended food security crop that can help shield low-income countries from the risks posed by rising international food prices

Key Points

Prices of cereals are rising faster than those of potato and other root crops.

Countries with low levels of dietary diversity and high dependency on cereal imports could benefit greatly from expanded potato cultivation.

Potato flour can be blended easily with wheat flour, providing countries with a means of reducing costly wheat imports.

Potato is increasingly a valuable source of cash income for low-income farm households

Intense competition for reduced international supplies of cereals and other agricultural commodities is driving worldwide food price inflation, which brings with it the risk of food shortages and social unrest in low-income countries. One strategy that could help reduce the risk is diversification of food production to nutritious and versatile staple crops that are less susceptible to the vagaries of international markets. One such crop is potato.

Unlike rice, wheat and maize, the potato is not a globally traded commodity and its prices are determined usually by local supply and demand. A recent FAO survey in more than 70 of the world's most vulnerable countries found that inflation in potato prices is much lower than that for cereals. The potato is, therefore, a highly recommended food security crop that can help low-income countries ride out turmoil created by food price increases.

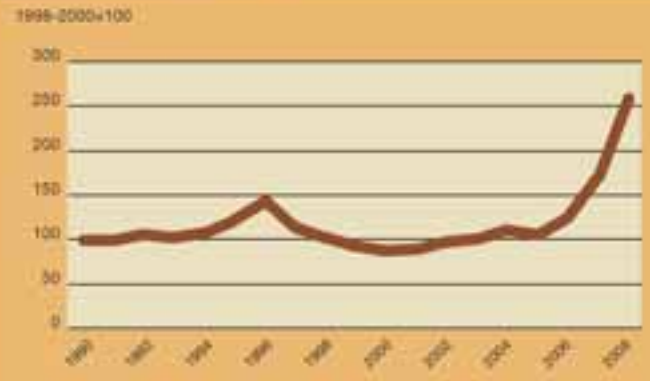
Potato for nutrition – and income

In many developing countries, the poorest and most undernourished farm households depend on potatoes as a primary or secondary source of food and nutrition. These households value potato because it produces large quantities of dietary energy and has relatively stable yields under conditions in which other crops might fail.

The potato is highly adaptable to a wide variety of farming systems. With its short vegetative cycle – high yields within 100 days – it fits well into double cropping systems with rice, and is also suitable for intercropping with maize and soybeans. Potatoes can be grown at altitudes of up to 4 300 m and in a variety of climates, from the barren highlands of the Andes to the tropical lowlands of Africa and Asia.

Potato is also rapidly becoming a valuable source of cash income – a primary requisite of food security – for many small scale producers. In many developing countries, growth in urban populations and incomes and the diversification of diets have led to rising demand for potatoes from the fast food, snack and convenience food industries. The structural transformation of agriculture-based economies into more urbanized societies opens up new market opportunities for potato growers.

FAO Cereal Price Index



Rising prices of maize, wheat and rice pose a threat to low-income countries

and to their trading and processing partners in the value chain.

Investing in potato production

With its adaptability to a wide range of uses, the potato has a potentially important role to play in the food systems of developing countries. However, policy makers have traditionally focused on cash crops for export and on cereals, leaving potato and other root crops at the periphery of agricultural development efforts. Redressing this imbalance is important if potato sectors are to thrive.

Investment in potato production should be considered as insurance against international market turbulence and as a food security safeguard. In the current climate of high food prices, it is often forgotten that until recently international prices for cereals had reached historic lows when adjusted for inflation. A boom followed by bust in cereal prices could easily undermine investments in the potato sector if consumers revert back to purchasing cheap, subsidized imported cereals.

Strengthening the potato 'value chain'

In developing countries, potatoes are often sold through fragmented marketing chains with little co-ordination and a lack of market information, giving rise to supply disruptions and high transactions costs. Many small scale farmers are excluded from markets owing their low yields, and inadequate storage and transport. Inefficient and unfair pricing discourages them from making on-farm investments in production.

Enhancing the value chain requires substantial public and private investment, especially in breeding programmes and in infrastructure to support and co-ordinate activities along the chain.

Production initiatives can be strengthened by research focused on specific end uses, rapid multiplication of good quality planting material, and varieties with pest and disease resistance. Producers of potato seed tubers need to offer yield-improving and input-saving technologies that boost yields and

reduce costs. The formation of producer groups would help farmers share expertise and strengthen their bargaining power. Production would also benefit from improvements in the supply of irrigation water and chemical fertilizers, and in cold storage and transport infrastructure.

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International Year of the Potato 2008

Potato and biotechnology

In vitro conservation, molecular markers and recombinant DNA technologies are creating new opportunities in potato production and transformation

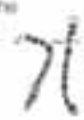
Key points

- The potato industry has benefited from major recent discoveries about the plant's genetics, physiology and pathology.
- Micropropagation is helping developing countries produce low-cost, disease-free tuber "seed" and increase potato yields.
- Use of molecular markers helps identify desirable traits in potato collections, thus simplifying the development of improved varieties.
- Sequencing of the complete potato genome, now under way, will significantly increase knowledge and understanding of genetic interactions and functional traits.
- Genetically modified varieties have the potential to produce more stable yields, improve nutritional quality and facilitate non-food industrial uses, but must be carefully assessed before release.

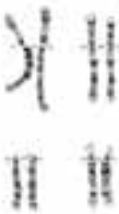
New molecular biology and plant cell culture tools have enabled scientists to understand better how potato plants reproduce, grow and yield their tubers, how they interact with pests and diseases, and how they cope with environmental stresses. Those advances have unlocked new opportunities for the potato industry by boosting potato yields, improving the tuber's nutritional value, and opening the way to a variety of non-food uses of potato starch, such as the production of plastic polymers.

Producing high-quality propagation material

Unlike other major field crops, potatoes are vegetatively reproduced as clones, ensuring stable, "true-to-type" propagation. However, tubers taken from diseased plants also transmit the disease to their progenies. To avoid that, potato tuber "seed" needs to be produced under strict disease control conditions, which adds to the cost of propagation material and therefore limits its availability to farmers in developing countries.



Micropropagation or propagation *in vitro* offers a low-cost solution to the problem of pathogens in seed potato. Plantlets can be multiplied an unlimited number of times, by cutting them into single-node pieces and cultivating the cuttings. The plantlets can either be induced to produce small tubers directly within containers or transplanted to the field, where they grow and yield low-cost, disease-free tuber "seed". This technique is very popular and routinely used commercially in a number of developing and transition countries.* For example, in Viet Nam micropropagation directly managed by farmers contributed to the doubling of potato yields in a few years.



Protecting and exploring potato diversity

The potato has the richest genetic diversity of any cultivated plant. Potato genetic resources in the South American Andes include wild relatives, native cultivated species, local farmer-developed varieties, and hybrids of cultivated and wild plants. They contain a wealth of valuable traits, such as resistance to pests and diseases, nutrition value, taste and adaptation to extreme climatic conditions. Continuous efforts are being made to collect, characterize and conserve them in gene banks, and some of their traits have been transferred to commercial potato lines through cross-breeding.

To protect collections of potato varieties and wild and cultivated relatives from possible diseases and pest outbreaks, scientists use a variation of micropropagation techniques to maintain potato samples *in vitro*, under sterile conditions. Accessions are intensively studied using molecular markers, the identifiable DNA sequences found at specific chromosomal locations on the genome and transmitted by the standard laws of inheritance.

Obtaining improved varieties

Potato genetics and inheritance are complex, and developing improved

* Source: FAO-BioDeC database on biotechnologies in developing countries www.fao.org/biotech/inventory_admin/dep/default.asp

varieties through conventional cross breeding is difficult and time consuming. Molecular marker based screening and other molecular techniques are now widely used to enhance and expand the traditional approaches to potato in food production. Molecular markers for characteristics of interest help identify desired traits and simplify the selection of improved varieties. Such techniques are currently applied in a number of developing and transition countries, and commercial varieties are expected to be released within the next few years.

Through the Potato Genome Sequencing Consortium, significant progress is being made in mapping the complete DNA sequence of the potato genome, which will enhance our knowledge of the plant's genes and proteins, and of their functional traits. Technical advances in the fields of structural and functional potato genomics – and the ability to integrate genes of interest into the potato genome – have expanded the possibility of genetic transformation of the potato using recombinant DNA technologies. Transgenic varieties with resistance to Colorado Potato Beetle and viral diseases were released for commercial production in the early 1990s in Canada and the USA, and more commercial releases can be expected in the future.

Transgenic potato varieties offer the possibility of increasing potato productivity and production, as well as creating new opportunities for non-food industrial use. However, all biosafety and food safety aspects must be carefully assessed and addressed before their release.

Glossary

cell culture – *in vitro* growth of cells isolated from multi-cellular organisms;

functional genomics – research aimed at determining patterns of gene expression and interaction in the genome;

genome – the entire complement of genetic material present in each cell of an organism;

genome sequencing – process of determining the exact order of chemical building blocks that make up the DNA of an organism;

genetically modified – transformed by the insertion of one or more transgenes;

in vitro – in an artificial environment (e.g. cells, tissues or organs cultured in glass or plastic containers);

micropropagation – miniaturized *in vitro* multiplication or regeneration of plant material under aseptic and controlled environmental conditions;

molecular biology – study of living processes at molecular level;

molecular marker – a genetic marker that is assayed at the DNA level;

trait – one of the many characteristics that define an organism;

transgene – an isolated gene sequence – often derived from a different species – used to transform an organism.

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International Year of the Potato 2008

Production of disease-free seed tubers

A simple, low-cost technology can help developing countries produce the healthy seed tubers farmers need for sustainable potato production

Key Points

- Potato diseases can dramatically reduce both tuber yields and quality.
- Tissue culture of plantlets *in vitro* for production of disease-free seed tuber requires expensive technology and highly trained staff.
- A low cost alternative is the use of cuttings - a single-node, leaf-bud or other type of very small plant cutting - for propagation of plantlets under non-sterile conditions.
- The cuttings root easily and produce plantlets as efficiently as *in vitro* propagation – each cutting can yield up to 100,000 progeny within six months.

Tissue culture and micropropagation

Elementary methods of tissue culture were developed in the 1950s, and micropropagation has been used commercially for multiplying stock plant material since the late 1960s.

The annual volume of plants micropropagated from tissue culture is estimated at hundreds of millions of plants, representing tens of thousands of varieties.

Commonly micropropagated plants include flowers, strawberry, ornamental shrubs and forestry trees.

Potatoes are susceptible to a variety of diseases that lower yields and tuber quality. What's more, pathogens accumulate in successive clonings of tubers and in the soil used to grow them. That is why sustainable potato production depends on a constantly renewed supply of disease-free planting material.

A major innovation for the potato industry in developed countries was the widespread adoption in the 1970s of tissue culture – or micropropagation - as a means of multiplying disease-free plants that can then be used to produce healthy seed tubers for farmers. First, viruses and other pathogens are eliminated by growing potato plants in a controlled environment at high temperature. The disease-free shoot tips of the plants are then placed on a standard nutrient medium in glass containers (*in vitro*) in a completely sterile laboratory environment. The tips develop into plantlets that are then transferred to either a greenhouse or a field protected from insect pests, where they grow at the same rate as normal potato plants but produce smaller tubers (called "mini-tubers").

After harvesting, mini-tubers need to be stored at low temperature. After about 45 days – and for a period of up to seven months thereafter – they can be moved to a warmer environment to induce sprouting. Once planted, they go on to produce normal-size, disease-free seed tubers ready for delivery to farmers. (While growing, the plants need to be protected from insect pests to avoid new disease infections.)

Multiplication *in vivo* (at right) produces disease-free potato plantlets at the same rate as *in vitro* propagation (at left), at a fraction of the cost. Photo: T. Hiekata

A low-cost alternative: small cuttings

While the above process does deliver healthy seed tubers, micropropagation of plantlets is costly, requiring sophisticated technology and well-trained staff. In many developing countries, simpler and less expensive ways of propagation are needed. FAO is promoting a promising, low-cost alternative: the use of very small cuttings, i.e. a single-node, leaf-bud or other type *of* plant cutting of about 1.5 cm, which can be grown to produce plantlets on a commercial scale.

The starter plant material remains a small number of disease-free micropropagated plantlets, which, in regions such as sub-Saharan Africa, are often imported from developed countries. However, they are multiplied not *in vitro* but *in vivo* (i.e. in non-sterile, natural conditions). Cuttings are propagated in a growing room or a shaded greenhouse in a mixture of peat and sand (or other rooting media) in plastic trays placed on metal stands.

The cutting technique takes advantage of etiolation – i.e. growing the plantlets under low light intensity. Etiolated plants retain their juvenile characteristics, producing new shoots for further cuttings that root easily. In addition, the plants remain small, so many can be grown in a limited space.

- each tray can hold up to 500 cuttings per square metre. The cuttings grow into new plantlets within three weeks, providing a source for further cuttings. Within six months, a single cutting can yield up to 100 000 progeny.

Once the plant material is multiplied to the quantity needed, plantlets can be transferred to an environment free of insect pests (in a greenhouse or an open field under shade). Planted in deep soil, the plantlets root easily within a week, grow into perfectly normal potato plants and produce mini-tubers.

The technique produces plantlets at the same rate as *in vitro* propagation at a fraction of the cost. However, it is essential that the disease-free starting plant material is kept *in vitro* and all standard phytosanitary measures are followed throughout the propagation process.

The importance of timing

Potato plantlets in a greenhouse, soon to be planted outdoors. Photo: CIP

The cutting technique is suited to developing countries that need simpler and less expensive ways of propagating seed tubers. However, producing good quality starter planting material is only one element in the process of potato seed tuber production. Seed supply schemes can fail because propagation from cuttings and storage of mini-tubers is not coordinated with farmers' cropping calendars. Unless the field and storage phases are well planned and implemented, the benefits of micropropagation may be lost.

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International Year of the Potato 2008

Potato and water resources

Agriculture faces a double challenge: to grow enough food for the world's expanding population while reducing its share of the Earth's freshwater resources. The potato can help...

Key Points

- Agriculture must significantly improve its volume of production per unit of water used.
- The potato produces more food per unit of water than any other major crop.
- From the same amount of water, the potato produces more dietary energy than rice, wheat and maize.
- Tailoring the timing and depth of water applications to specific stages of the potato's growth cycle can help reduce water usage.

To reduce potato's water needs, scientists are developing varieties that are drought resistant with longer root systems. Drawing: CIP

Over the past century, human appropriation of fresh water has expanded at more than twice the rate of population increase. An estimated 3 830 cubic km (or 3 830 trillion litres) of water are now withdrawn for human use each year, with the lion's share – some 70 percent – being taken by the agricultural sector.

An irrigated potato field in Cape Verde. Photo: ©FAO/Marco Marcel

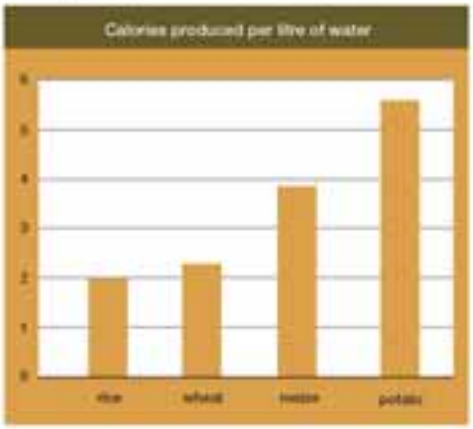
But agriculture's thirst is not sustainable in the long term. Facing intense competition from urban and industrial users, and mounting evidence that human use of water is jeopardizing the efficiency of the Earth's ecosystems, the sector must significantly improve the volume of production per unit of water used.

Nutritional productivity

The potato stands out for its productive water use, yielding more food per unit of water than any other major crop. Along with groundnut, onion and carrots, its "nutritional productivity" is especially high: for every cubic metre of water applied in cultivation, the potato produces 5 000 calories of dietary energy, compared to 3 860 in maize, 2 300 in wheat and just 2 000 in rice. For the same cubic metre, the potato yields 150 g of protein, double that of wheat and maize, and 540 mg of calcium, double that of wheat and four times that of rice.

An increase in the proportion of potato in the diet would alleviate pressure on water resources. Currently, producing the foods – especially animal products – consumed in the average diet in the developed world requires water withdrawals estimated at 4 000 litres per capita per day (it takes, for example, around 13 000 to 15 000 litres of water to produce 1 kg of grain-fed beef). But one recent study estimated that a balanced diet based on potato, groundnut, onion and carrot would require per capita water consumption of just 1 000 litres per day.

While a potato-based diet is impractical – 4 kg would be needed to cover per capita daily energy and protein requirements – increased consumption of processed potato products and extraction of potato's nutrients offer a water-efficient means of meeting nutritional needs.



Potato's water requirements

Modern potato varieties are sensitive to soil water deficits and need frequent, shallow irrigation. A 120 to 150 day potato crop consumes from 500 to 700 mm of water, and depletion of more than 50 percent of the total available soil water during the growing period results in lower yields.

To reduce potato's water needs, scientists are developing varieties that are drought-resistant with longer root systems. But significant water savings can be made in cultivation of today's commercial varieties by tailoring the timing and depth of water applications to specific stages of the plant's growth cycle.

In general, water deficits in the middle to late part of the growing period – during stolonization and tuber initiation and bulking – tend to reduce yield, while the crop is less sensitive during early vegetative growth. Water savings can also be achieved by allowing higher depletion toward the ripening period so that the crop uses all available water stored in the root zone, a practice that may also hasten maturity and increase dry matter content.

Some varieties respond better to irrigation in the earlier part of tuber bulking, while others show a better response in the latter part. Varieties with few tubers are usually less sensitive to water deficit than those with many tubers.

While soil should be maintained at a relatively high moisture content to maximize yield, frequent irrigation with relatively cold water may reduce the soil temperature below the optimum value for tuber formation (15 to 19°C), thus affecting yields. Also, wet and heavy soils can create soil aeration problems.

The most common irrigation methods for potato use furrow or sprinkler systems. Furrow irrigation has relatively low water use efficiency and is suitable when water supply is ample. In areas with water scarcity, sprinkler or drip irrigation is preferred, especially on soils with low water retention capacity.

For every unit of water, the potato produces twice as much protein as wheat and maize. Photo: IPAC/Giulio Napolitano

Tuber quality and yield

Water supply and scheduling have important impacts on tuber quality – frequent irrigation reduces the occurrence of tuber malformation. Water deficit in the early phase of yield formation increases the occurrence of spindled tubers (more noticeable in oval than in round tuber varieties) and, when followed by irrigation, may result in tuber cracking or tubers with "black hearts".

Using good agricultural practices, including irrigation when necessary, a crop of about 120 days in temperate and subtropical climates can yield 25 to 40 tonnes of fresh tubers per hectare.

About IYP 2008

The **International Year of the Potato**, to be celebrated throughout 2008, aims at raising global awareness of the potato's key role in agriculture, the economy and world food security.

www.potato2008.org

Credits:
Information provided by FAO's Land and Water Division.

International Year of the POTATO 2008

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International Year of the Potato 2008

Potato pest and disease management

Combating pests and diseases with intensive use of insecticides and fungicides often does more harm than good. An array of alternatives is available...

Key points

- Intensive potato cultivation tends to increase pest and disease pressure, which often leads to intensive use of harmful pesticides.
- Resistant potato varieties and improved cultural practices can reduce or eliminate many common pests and diseases.
- Integrated pest management has helped farmers drastically reduce the need for chemical controls while increasing production.

The use of chemical pesticides on potato is increasing in developing countries, as farmers intensify production and expand cultivation into areas and planting seasons beyond the crop's traditional range. The chemicals used are frequently highly toxic and applied with little or no protective equipment.

The result is alarming levels of pesticide poisoning in farming communities. Insecticide absorbed by soil often penetrates subsequent crops and runs off to contaminate water supplies. Overuse of pesticides even compounds pest and disease problems: in Colombia, outbreaks of a viral disease have been linked to insecticides that wiped out natural predators of the disease's vector.

Increasing potato production while protecting producers, consumers and the environment requires a holistic crop protection approach encompassing a range of strategies – encouraging natural pest predators, breeding varieties with pest/disease resistance, planting certified seed potatoes, growing tubers in rotation with other crops, and organic composting to improve soil quality.

Photo: © FAO

Ecuador: training reduces pesticide poisoning

In Ecuador's Carchi province, a programme supported by CIP and FAO used Farmer Field Schools to drastically reduce high rates of pesticide poisoning. Continuous cropping of potato had produced not only high yields, but highly favourable conditions for insects and fungal diseases, leading to massive applications of insecticides and fungicides. As a result of pesticide exposure, CIP scientists say, 60 percent of people in the area showed reduced neuro-behavioural functions. IPM training enabled farmers to reduce agrochemical application costs – including fertilizer, pesticide and labour costs – by an average of 75 percent with no effect on productivity. Follow-up studies show that the reduced exposure to pesticides was associated with recovery of previously suppressed nervous system functions.

There is no effective chemical control, for example, against bacterial wilt. But planting healthy seed in clean soil, using

Some of potato's main enemies

Diseases	Pests
Late blight: the most serious potato disease worldwide, is caused by a water mould, *Phytophthora infestans*, that destroys leaves, stems and tubers.	***Colorado potato beetle*** (*Leptinotarsa decemlineata*): a serious pest with strong resistance to insecticides.
Bacterial wilt: caused by the bacterial pathogen, leads to severe losses in tropical, subtropical and temperate regions.	***Potato tuber moth:*** most commonly *Phthorimaea operculella*, is the most damaging pest of planted and stored potatoes in warm, dry areas.
Potato blackleg: a bacteria infection, causes tubers to rot in the ground and in storage.	***Leafminer fly*** (*Liriomyza huidobrensis*): A South American native common in areas where insecticides are used intensively.
Viruses: disseminated in tubers, can cut yields by 50 percent.	***Cyst nematodes*** (*Globodera pallida* and *G. rostochiensis*): serious soil pests in temperate regions, the Andes and other highland areas.

tolerant varieties in rotation with non-susceptible crops, and other sanitation and cultivation practices can lead to significant reduction of the disease. Incidence of potato tuber moth can also be reduced by preventing soil cracking that allows moths to reach the tubers.

Both the International Potato Center (CIP) and FAO advocate Integrated Pest Management (IPM) as the preferred pest control strategy during production. IPM aims at maintaining pest populations at acceptable levels and keeping pesticides and other interventions to levels that are economically justified and safe for human health and the environment.

FAO has promoted IPM in many developing countries using Farmer Field Schools, which centre around a "living laboratory" where farmers are trained to identify insects and diseases and compare results on two subplots – one using conventional chemical pest control and the other using IPM. On the improved management plot, participants strive to improve ecosystem health by cutting pesticide use while increasing productivity through management intensification. Farmers experiment with a variety of techniques, such as weevil traps,

Virus control

Because virus-infected potato plants cannot be cured, CIP is working to incorporate into new varieties resistance to the three most common potato viruses. Some virus resistance is now available in about a quarter of CIP-bred genotypes.

Beating late blight

The mould responsible for late blight has consistently overcome resistant cultivars and mutated into strains that survive spraying with powerful fungicides. The Global Initiative on Late Blight, a network of scientists, technologists and agricultural knowledge agents in 72 countries, is exploring new control strategies, including "organic management" using improved sanitation in storage, risk forecasting and genetic resistance.

different strains of potatoes and targeted applications of lower toxicity pesticides.

In Peru's Cañete River valley, CIP entomologists designed an IPM package to help growers protect their crops against the leafminer fly, which had become a major problem after massive use of insecticides exterminated its natural enemies. The IPM programme included traps to lure and kill adult flies and reintroduction to the valley of parasitic wasps. Participating growers were able to reduce spraying from 12 times per season to only one or two carefully timed applications of insect growth regulators.

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Potato and soil conservation

Mulch planting and the "no-till" potato can help reduce the soil degradation, erosion and nitrate pollution often associated with potato production

Key Points

- Land preparation, weeding and harvesting of potato often involve intensive soil disturbance.
- Cover crops sown before planting and as the crop matures protect the soil and facilitate harvesting.
- Cultivation of potato without tillage helps restore soil, produces good yields and reduces the need for fertilizer and fuel.

Potato cultivation usually involves intensive soil tillage throughout the cropping period, which often leads to soil degradation, erosion and leaching of nitrates. During soil preparation, the entire topsoil is loosened and - particularly on sticky soils - pulverized into small aggregates to avoid the formation of clods in the potato beds. Mechanical weeding and mechanized harvesting also involve intensive soil movement. Conservation agriculture – a resource-saving crop production system – offers several useful techniques for soil conservation in potato production.

Mulch planting for potatoes

In conventional, tillage-based potato cropping systems, the risk of soil erosion and nitrate leaching can be reduced using the mulch planting technique. The potato beds are prepared well in advance of planting - if potato is to be planted in spring, the beds would be prepared before winter – and seeded with a green manure cover crop. The potato is later planted into the beds which, by then, are covered by the dead mulch of the manure crop.

For mechanical planting, planters are equipped with special discs that cut through the mulch and split the potato beds. The mulch protects the soil from erosion during the first weeks of the crop. As the potato plants grow, the reshaping of the beds incorporates the mulch. A second green manure crop can be seeded towards the end of the potato crop, as the potato plants are drying off. The cover crop helps to dry out the potato beds, contributing to healthier tubers with reduced risk of damage during harvest. The green manure is separated from the potato by a mechanical potato harvester and is left as a mulch cover after harvest, protecting the soil from erosion.

Mulch planting is being used for potatoes in parts of Germany and Switzerland, particularly in watersheds where drinking water sources might be prone to nitrate pollution from conventional cultivation methods. Nevertheless, while mulch planting of potatoes reduces the risk of erosion and nitrate leaching, it still involves major soil movement.

The 'no-till potato'

Soil conservation can be enhanced further using a basic CA technique, "no-till" cultivation. The "no-till" potato is pressed into the soil surface, then covered with a thick layer of mulch - preferably straw, which is fairly stable and does not rot quickly. (Potatoes need to be kept in the dark to avoid the formation of chlorophyll, which renders the tubers green, bitter and toxic.)

The advantages of conservation agriculture

Conservation agriculture (CA) aims at enhancing natural biological processes both above and below ground. It is based on three principles: minimum mechanical soil disturbance, permanent organic soil cover, and diversified crop rotations for annual crops and plant associations for perennial crops. By minimizing soil disturbance, CA creates a vertical macro-pore structure in the soil, which facilitates the infiltration of excess rainwater into the subsoil, improves the aeration of deeper soil layers, and facilitates root penetration.

In some cases - for example in dry areas under drip irrigation - black plastic sheets can also be used as mulch. Holes are punched in the plastic to allow the potato plant to grow through it. The young potato tubers form under the mulch but above the soil surface. During harvesting, the sheets are removed and the potatoes are simply "collected". Currently, the "no-till" potato is only grown in small fields using manual labour - for example, in Peru under plastic covers and in the Democratic People's Republic of Korea under rice straw.

No-till potato in the Democratic People's Republic of Korea

Farmers in the Democratic People's Republic of Korea are using conservation agriculture in rice and potato production in order to restore degraded soils and achieve good potato yields with reduced need for fertilizer and fuel. The potato-rice crop rotation system produces two crops in a relatively short growing season, resulting in higher overall food production when compared to output from a single main crop. The seed potato is inserted into the soil under a mulch cover formed by the residues of the preceding rice crop. The potatoes grow through the rice straw and are harvested within three months. Immediately afterward, "no-till" rice is transplanted as the main summer crop. Per hectare, the system can produce 25 tonnes of potatoes and 7.5 tonnes of rice, and in cold storage and transport infrastructure.

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Photos: © FAO/T. Friedrich

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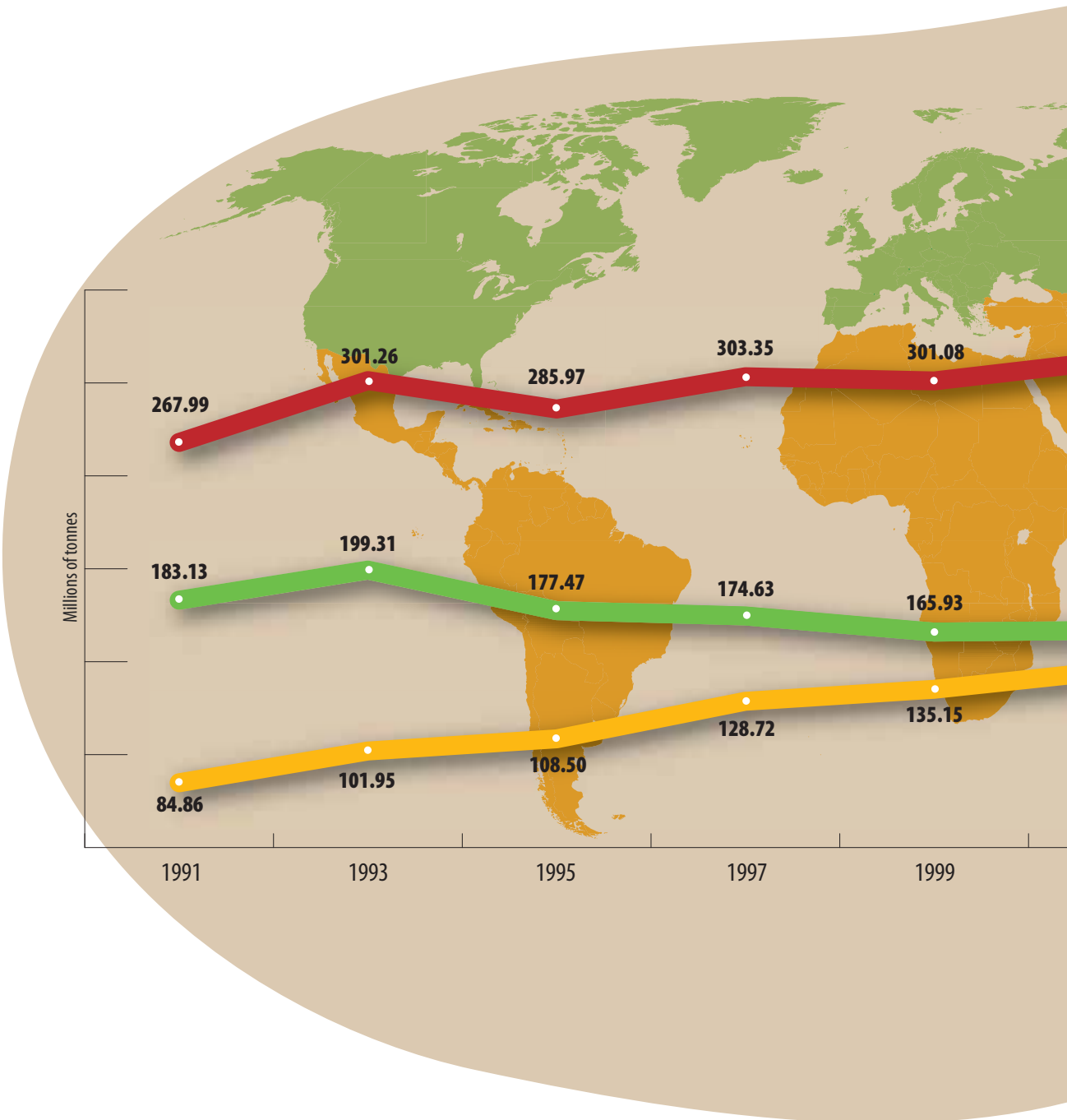
Potato world

The potato is grown in more than 100 countries from the Arctic Circle to the southern extremity of South America, and at all latitudes in between. Profiles of the world's top producers reveal the potato's extraordinarily rich past – and point to a bright future

48 International Year of the Potato 2008
New light on a hidden treasure

World potato production



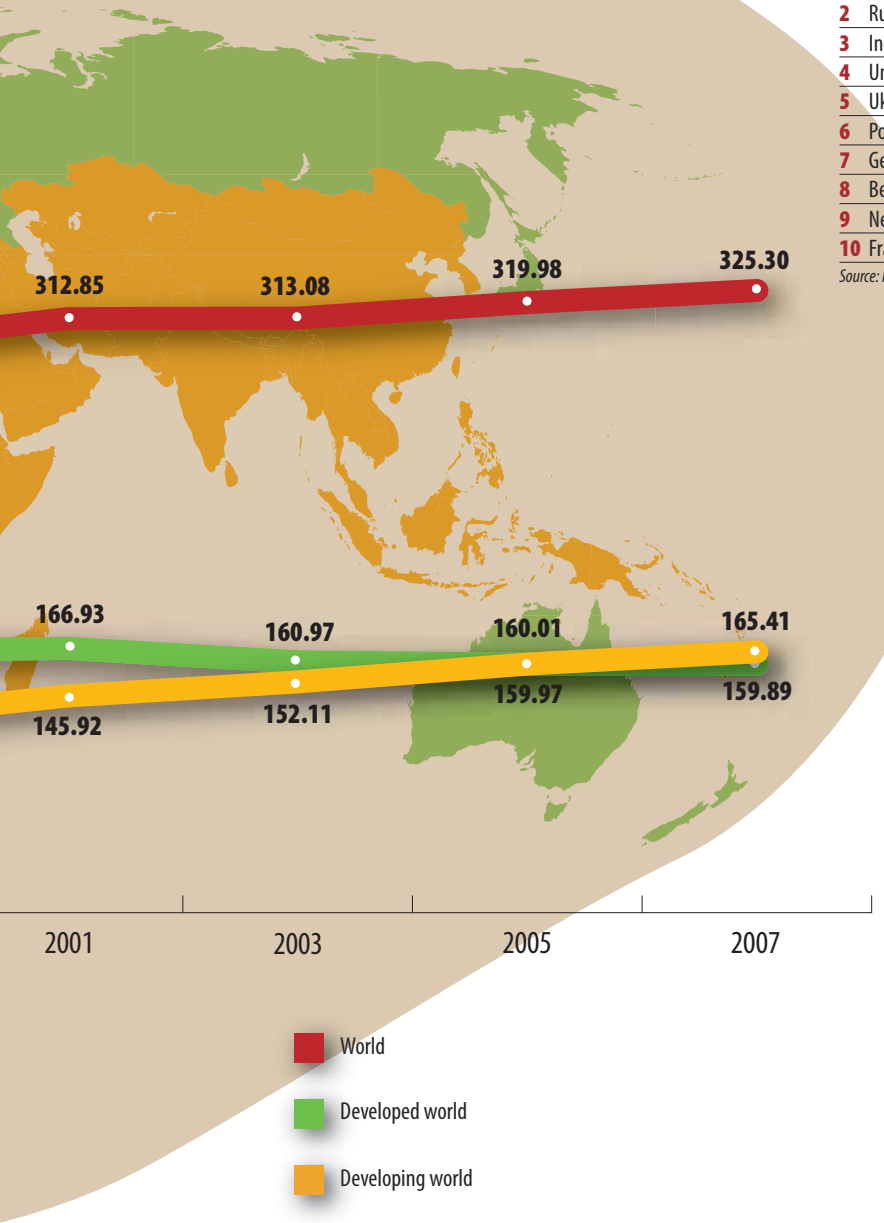
The world potato sector *is undergoing major changes. Until the early 1990s, most potatoes were grown and consumed in Europe, North America and countries of the former Soviet Union. Since then, there has been a dramatic increase in potato production and demand in Asia, Africa and Latin America, where output rose from less than 30 million tonnes in the early 1960s to more than 165 million tonnes in 2007. FAO data show that in 2005, for the first time, the developing world's potato production exceeded that of the developed world. China is now the world's biggest potato producer, and almost a third of all potatoes is harvested in China and India.*

Top potato producers, 2007

tonnes

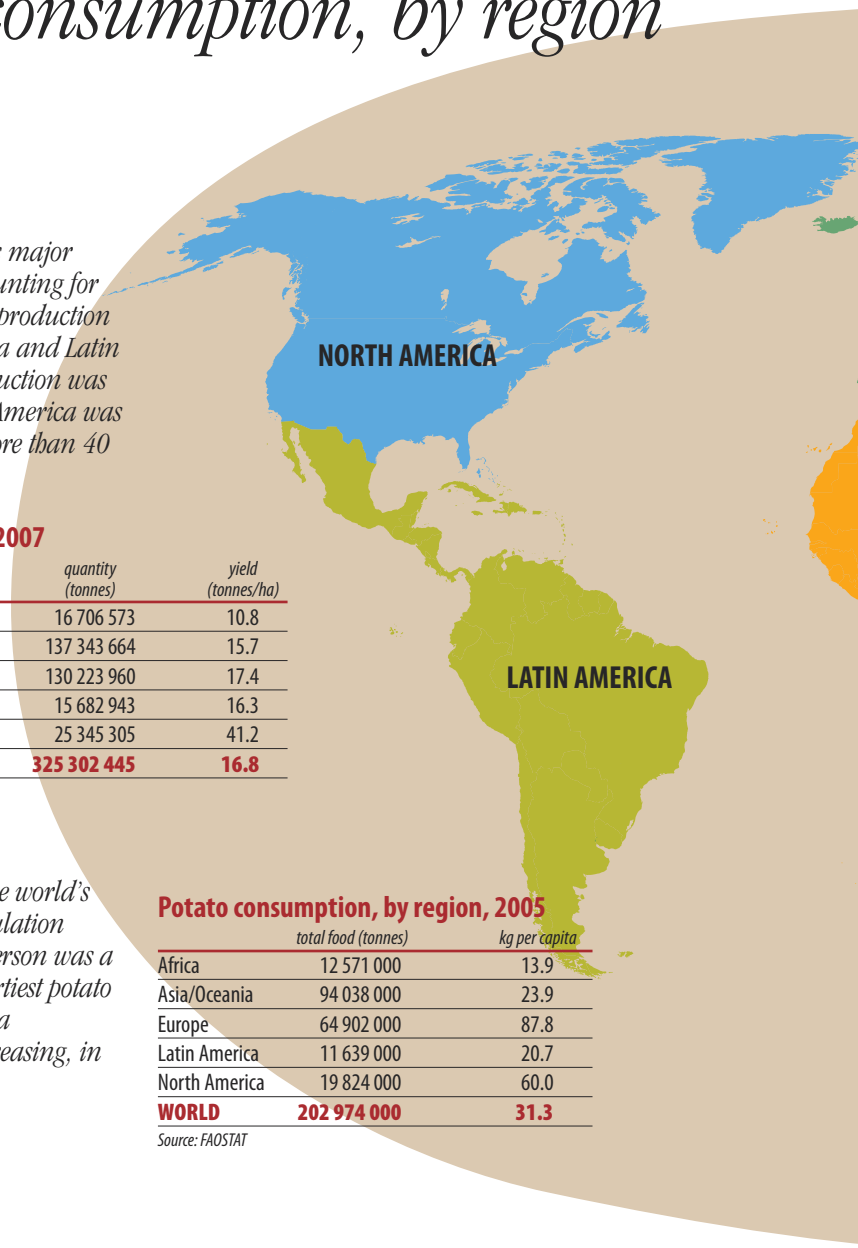
1	China	72 040 000
2	Russian Federation	36 784 200
3	India	26 280 000
4	United States of America	20 373 267
5	Ukraine	19 102 000
6	Poland	11 791 072
7	Germany	11 643 769
8	Belarus	8 743 976
9	Netherlands	7 200 000
10	France	6 271 000

Source: FAOSTAT



Potato production and consumption, by region

Asia and Europe are the world's major potato producing regions, accounting for more than 80 percent of world production in 2007. While harvests in Africa and Latin America were far smaller, production was at or near record levels. North America was the clear leader in yields, at more than 40 tonnes per hectare.



Potato production, by region, 2007

	harvested area (hectares)	*quantity (tonnes)*	*yield (tonnes/ha)*
Africa	1 541 498	16 706 573	10.8
Asia/Oceania	8 732 961	137 343 664	15.7
Europe	7 473 628	130 223 960	17.4
Latin America	963 766	15 682 943	16.3
North America	615 878	25 345 305	41.2
WORLD	**19 327 731**	**325 302 445**	**16.8**

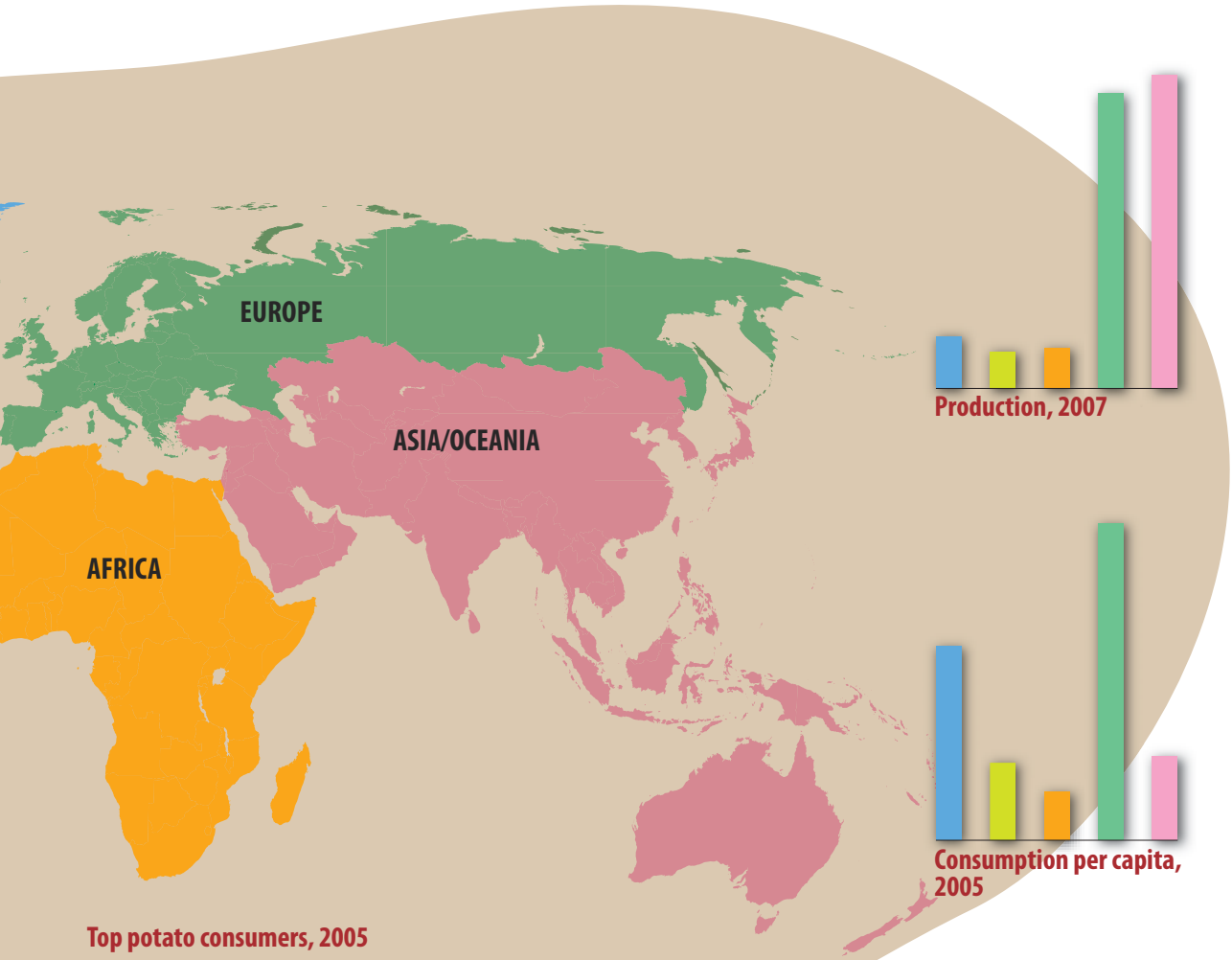
Source: FAOSTAT

Asia consumes almost half of the world's potato supply, but its huge population means that consumption per person was a modest 24 kg in 2005. The heartiest potato eaters are Europeans. Per capita consumption is lowest, but increasing, in Africa and Latin America.

Potato consumption, by region, 2005

	total food (tonnes)	*kg per capita*
Africa	12 571 000	13.9
Asia/Oceania	94 038 000	23.9
Europe	64 902 000	87.8
Latin America	11 639 000	20.7
North America	19 824 000	60.0
WORLD	**202 974 000**	**31.3**

Source: FAOSTAT



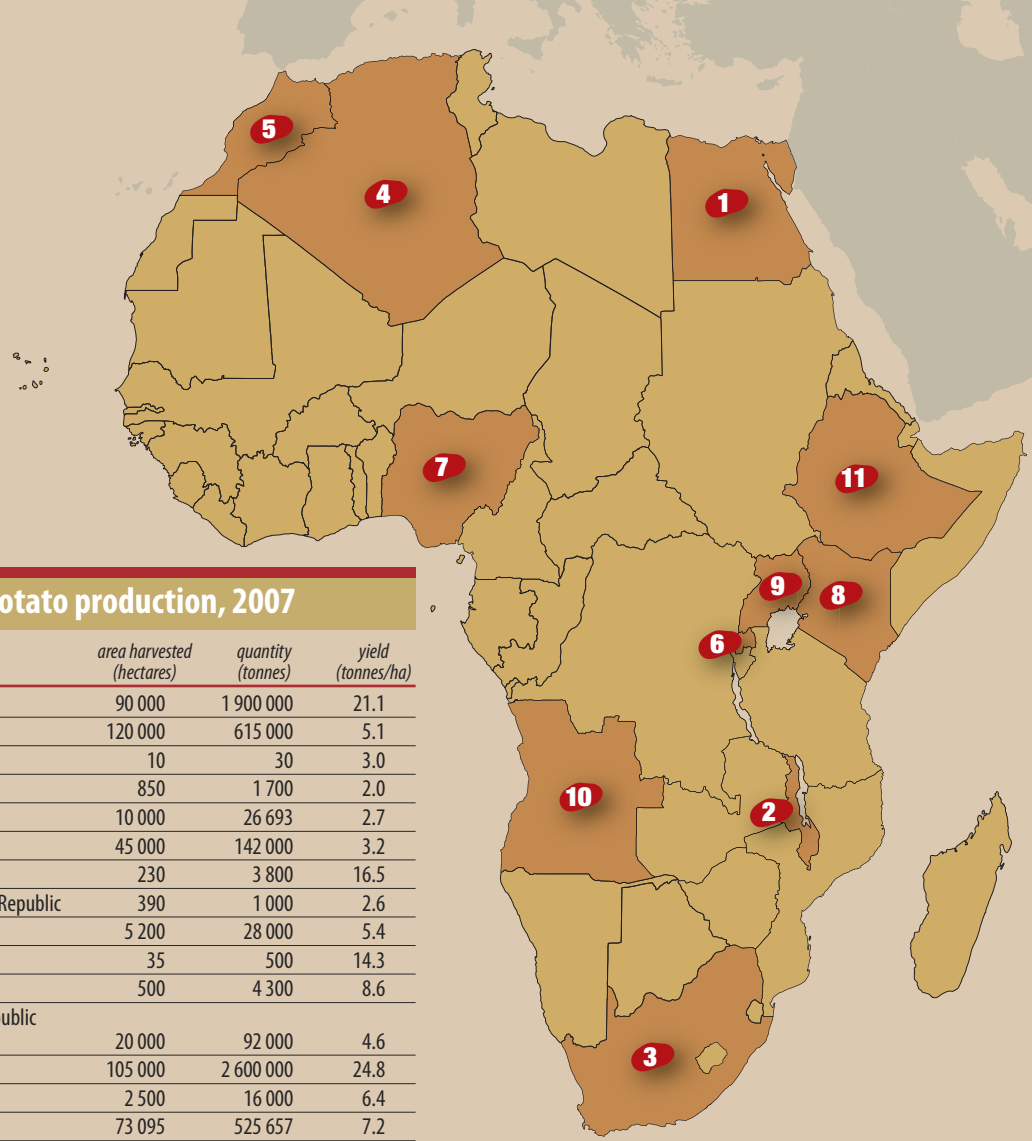
Production, 2007

Consumption per capita, 2005

Top potato consumers, 2005

		quantity (tonnes)			*kg per capita*
1	China	47 594 193	**1**	Belarus	181
2	Russian Federation	18 828 000	**2**	Kyrgyzstan	143
3	India	17 380 730	**3**	Ukraine	136
4	United States of America	17 105 000	**4**	Russian Federation	131
5	Ukraine	6 380 850	**5**	Poland	131
6	United Kingdom	6 169 000	**6**	Rwanda	125
7	Germany	5 572 000	**7**	Lithuania	116
8	Poland	5 000 000	**8**	Latvia	114
9	Bangladesh	4 041 463	**9**	Kazakhstan	103
10	Islamic Republic of Iran	3 991 142	**10**	United Kingdom	102

Source: FAOSTAT



Africa: Potato production, 2007

country	*area harvested (hectares)*	*quantity (tonnes)*	*yield (tonnes/ha)*
Algeria	90 000	1 900 000	21.1
Angola	120 000	615 000	5.1
Benin	10	30	3.0
Burkina Faso	850	1 700	2.0
Burundi	10 000	26 693	2.7
Cameroon	45 000	142 000	3.2
Cape Verde	230	3 800	16.5
Central African Republic	390	1 000	2.6
Chad	5 200	28 000	5.4
Comoros	35	500	14.3
Congo	500	4 300	8.6
Democratic Republic of the Congo	20 000	92 000	4.6
Egypt	105 000	2 600 000	24.8
Eritrea	2 500	16 000	6.4
Ethiopia	73 095	525 657	7.2
Kenya	120 000	800 000	6.7
Lesotho	5 600	96 000	17.1
Libyan Arab Jamahiriya	10 000	196 000	19.6
Madagascar	38 000	225 000	5.9
Malawi	185 000	2 200 402	11.9
Mali	4 100	90 000	22.0
Mauritania	430	2 200	5.1
Mauritius	550	13 000	23.6
Morocco	60 000	1 450 000	24.2
Mozambique	6 200	80 000	12.9
Niger	420	4 200	10.0
Nigeria	270 000	843 000	3.1
Réunion	230	5 300	23.0
Rwanda	133 000	1 200 000	9.0
Senegal	600	12 000	20.0
South Africa	58 000	1 972 391	34.0
Sudan	15 708	263 900	16.8
Swaziland	3 000	6 000	2.0
Tunisia	24 550	350 000	14.3
Uganda	93 000	650 000	7.0
United Republic of Tanzania	37 000	240 000	6.5
Zambia	1 050	14 500	13.8
Zimbabwe	2 250	36 000	16.0
Africa	**1 541 498**	**16 706 573**	**10.8**

Source: FAOSTAT

Top producers, 2007

1 Egypt
2 Malawi
3 South Africa
4 Algeria
5 Morocco
6 Rwanda
7 Nigeria
8 Kenya
9 Uganda
10 Angola
11 Ethiopia

Africa

Potatoes arrived late in Africa, around the turn of the 20th century. In recent decades, production has been in continual expansion, rising from 2 million tonnes in 1960 to a record 16.7 million tonnes in 2007. Potatoes are grown under a wide range of conditions – from irrigated commercial farms in Egypt and South Africa to intensively cultivated tropical highland zones of Eastern and Central Africa, where it is mainly a small farmer's crop.

MOSTAFA MOFTAH

At a potato sorting factory in the Nile Delta, Egypt

1. Egypt

The potato was introduced to Egypt during the 1800s, and large scale cultivation began during the First World War, when British colonial officials encouraged its production to feed their troops. After the war, however, expansion of potato growing was hampered by the poor quality of imported seed and by farmers' inexperience with the crop.

All that has changed: since 1961, Egypt's irrigated potato production – concentrated in the Nile River delta in the north – has expanded at a rate of more than 5 percent a year. Between 1990 and 2007, annual output rose from 1.6 million tonnes to some 2.6 million tonnes, making Egypt Africa's No. 1 potato producer.

Egypt also ranks among the world's top potato exporters – in 2004, exports totalled more than 380 000 tonnes of fresh potatoes and 18 000 tonnes of frozen potato products, destined mainly for markets in Europe.

2. Malawi

Potatoes came to East Africa in the 19th century, brought by missionaries and European colonialists. But the crop did not become important to Malawians until the 1960s, when production reached around 60 000 tonnes a year.

Now Malawi is sub-Saharan Africa's biggest potato producer, with a 2007 harvest of 2.2 million tonnes. The potato is grown mainly in highland areas in the country's southern and central regions, the most suitable areas being at altitudes of between 1 000 and 2 000 m and with more than 750 mm of annual rainfall. In parts of the

ANNE LI

Potato market in Kasungu, Malawi

southern region, farmers can grow two crops each year. Potatoes are often planted with maize and beans during the main October-March season.

Only a tiny proportion of Malawi's potatoes is exported. Annual consumption has more than tripled over the past 15 years to a high 88 kg per capita.

3. South Africa

Dutch seafarers heading for East Asia probably brought the potato to South Africa in the 1600s (it is thought sailors encouraged potato growing at ports of call so they could re-supply with fresh tubers during ocean voyages).

South Africa's potato output has grown strongly over the past 15 years, from 1.2 million tonnes in 1990 to a record 1.97 million tonnes in 2007. In the same period, the potato farming area actually declined, from 63 000 ha to 58 000 ha. Most potatoes are grown on relatively large farms, increasingly under irrigation, with yields averaging around 34 tonnes per hectare.

South Africa boasts a sophisticated seed potato industry and – thanks largely to the country's rapid rate of urbanization – a vibrant potato processing sector, which utilizes some 250 000 tonnes of potatoes per year, mainly for frozen French fries and crisps. Annual potato consumption is around 30 kg per person.

4. Algeria

After the introduction of *Solanum tuberosum* to Algeria in the mid-1800s, potatoes were grown mainly for export to French markets. By the time of national independence from France, in 1962, farmers were harvesting on average 250 000 tonnes a year, with about one third marked for export.

Since then, the potato has become an increasingly important crop for domestic consumption, with production in 2006 reaching a record 2.18 million tonnes. Potato

is grown over an area of 90 000 ha, and can be planted and harvested somewhere in Algeria in virtually any month of the year.

The main fresh potato growing areas are along the Mediterranean coast, where a mild climate permits year-round production. Potatoes are also grown at elevations of 500 m in hills and valleys between the coast and the Atlas Mountains, and in high plateau areas. Annual potato consumption in Algeria has increased from 35 kg in 1990 to around 57 kg in 2005.

5. Morocco

The potato was probably well established in Morocco before the country became a French protectorate in 1910. Over the following century – and particularly since independence in 1956 – production has expanded strongly, rising from about 150 000 tonnes in 1961 to a record 1.56 million tonnes in 2006. In the same period, yields grew from 10 tonnes per hectare to more than 26 tonnes.

By sheer weight, the potato is now Morocco's third biggest crop, after sugar beets and wheat, and second only to tomatoes among exported vegetables, with more than 40 000 tonnes shipped to Europe in 2005.

Except for a brief period during the winter months, potatoes are grown year round. Production of fresh potatoes is concentrated along the Atlantic Coast north and south of Casablanca, where a modified Mediterranean climate provides very favourable growing conditions. Potatoes are also grown in high, rugged parts of the Atlas mountains, at elevations of more than 3 000 m. Moroccans consume an average of 42 kg per capita of potatoes a year.

6. Rwanda

The potato arrived with German soldiers and Belgian missionaries in Rwanda in the early 20th century. Today, *ibirayi* – derived from *uburayi* ("that which comes from Europe") – is the country's second most important crop after plantains and, in the sub-Saharan region, Rwanda is the third largest potato producer.

Since 1961, Rwanda's potato output has risen from less than 100 000 tonnes to 1.3 million tonnes in 2005. The harvest in 2007 was only slightly smaller. Potatoes grow well in several parts of the country – mainly above elevations of 1 800 m – and some areas grow two crops a year. Most of the potato sector consists of small family farms that intercrop potato with beans and maize, and yields average almost 10 tonnes per hectare.

The potato underpins Rwanda's food security. Annual consumption is a very high 125 kg per person, making potato the country's second most important source of calorie intake after cassava.

7. Nigeria

In the potato world, Africa's most populous country, Nigeria, stands out: it is the fourth biggest producer of potato in sub-Saharan Africa, and has almost as much land under potato as Germany. Potato output has grown sevenfold over the past decade, reaching 840 000 tonnes in 2007.

The main potato growing area is the Jos plateau, where altitudes ranging from 1 200 to 1 400 m and summer temperatures that rarely exceed 35°C make for a temperate climate well suited to potato production. However, productivity is constrained by a lack of suitable varieties, and high land and labour costs. In fact, Nigeria records one of the world's lowest average potato yields, little more than 3.1 tonnes per hectare.

Potato consumption is also very low, at around 3.2 kg per capita per year. However, Nigeria's taste for potatoes, especially in rapidly growing urban areas, is increasing: since 2000, imports of raw and processed potatoes have risen from less than 9 000 tonnes to 40 000 tonnes a year.

8. Kenya

Introduced to East Africa by British farmers in the 1880s, the potato has grown in importance – both as a staple food and as a source of farmer incomes – over the past 30 years. Measured by quantity harvested, it now ranks as the country's No. 2 food crop, after maize, with production in 2007 totalling around 800 000 tonnes.

The potato in Kenya is grown mainly by small scale farmers, many of them women, although some larger-scale growers specialize in commercial production. Cultivation is concentrated in highland areas of from 1 200 to 3 000 m above sea level.

Nearly all of Kenya's potatoes are consumed locally, at an average rate of almost 25 kg per capita a year. *Kiazi* is relished not only by the rural people who grow them, but by higher-income urban dwellers as well. While in some African countries potato is considered a "poor person's food", in Kenya it is considered a high quality and prestigious food item.

9. Uganda

Potato cultivation reached Uganda early in the 1900s, thanks probably to missionaries from the Congo. By mid-century, the tubers were widely grown in the country's cool highlands – in fact, the plant was so prolific in some areas that it was regarded as a weed.

In the 1960s, the Ugandan Department of Agriculture launched a potato development programme that helped boost average yields to 10 tonnes per hectare. Potato output topped 350 000 tonnes in the 1970s, but dropped sharply during the widespread civil strife of the following decade.

PETER KIBERA

Potatoes are popular in Nairobi

Since 1990, potato production has rebounded, rising from 224 000 tonnes to a record 650 000 tonnes in 2007. In the same period, the area under potato tripled to an estimated 90 000 ha. Almost half of the national harvest comes from the intensely farmed Kabale highlands, which lie at 2 000 m above sea level, some 400 km southwest of Kampala.

10. Angola

During the early 16th century, ships from Portugal took both potato and sweet potato to what was to become Portuguese West Africa. While sweet potato was widely adopted by local farmers, potato growing was confined to the Bié Plateau, where altitude and the Antarctic ocean current produce a moderate climate.

When Angola gained its independence in 1975, the country's annual potato production was about 32 000 tonnes, most of it grown in the highlands of Huambo province. Production stagnated during the ensuing 27 years of civil war but boomed once peace was restored. FAO data shows that between 2002 and 2007 the area under potato tripled and total output more than doubled, from 260 000 tonnes to a record of 615 000 tonnes.

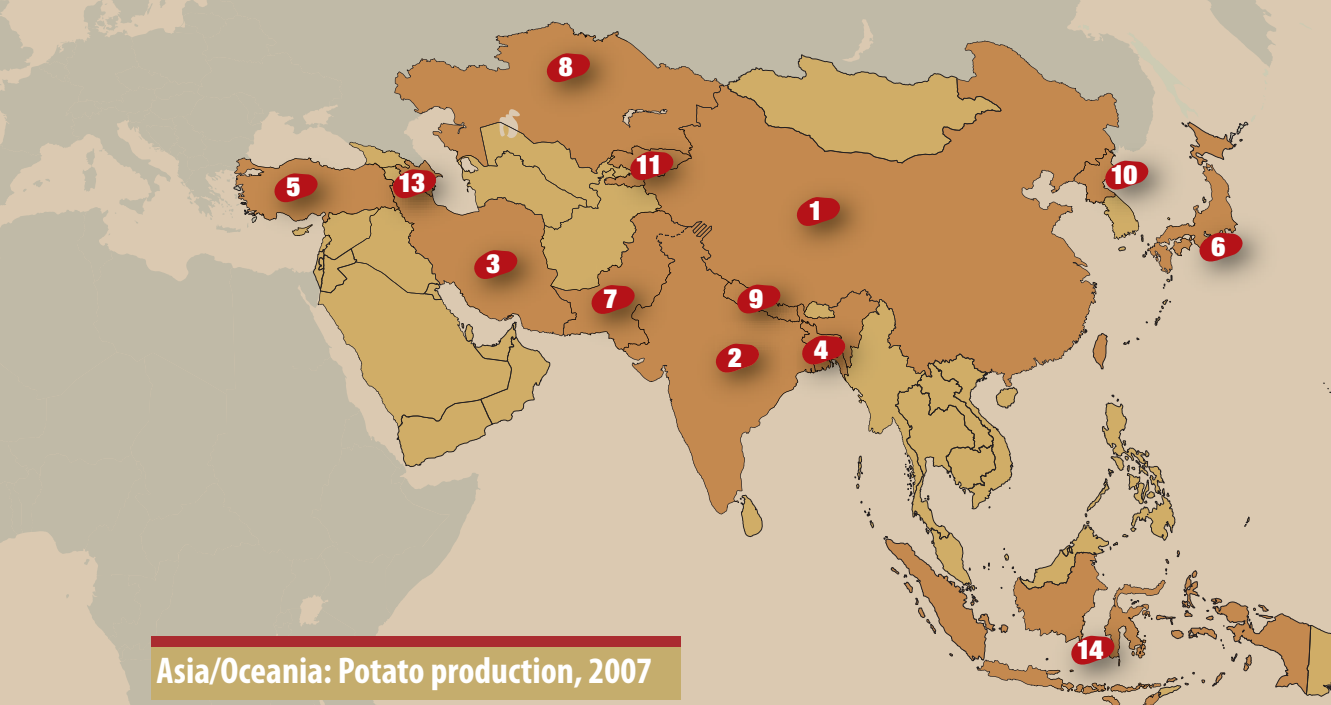
Annual potato consumption is estimated at 15 kg per capita and is expected to grow rapidly with urbanization. However, production is constrained by low average yields of 5 tonnes per hectare, high post-harvest losses and dependence on imported seed potato. To satisfy demand, Angola also imports potatoes from South Africa.

11. Ethiopia

A German immigrant is credited with introducing the potato to Ethiopia in 1858. Over the following decades, farmers in Ethiopia's highlands began cultivating the new tuber – known as *denech* – as an "insurance policy" against cereal crop failures.

Among African countries, Ethiopia has possibly the greatest potential for potato production: 70 percent of its arable land – mainly in highland areas above 1 500 m – is believed suitable for the potato. Since the highlands are also home to almost 90 percent of Ethiopia's population, the potato could play a key role in ensuring national food security.

At present, potatoes are still widely regarded as a secondary crop, and annual per capita consumption is estimated at just 5 kg. However, potato growing is expanding steadily: FAO estimates that production has increased from 280 000 tonnes in 1993 to around 525 000 tonnes in 2007.



Asia/Oceania: Potato production, 2007

country	area harvested (hectares)	quantity (tonnes)	yield (tonnes/ha)
Afghanistan	20 000	300 000	15.0
Armenia	31 612	579 571	18.3
Australia	32 000	1 150 000	35.9
Azerbaijan	67 110	1 037 317	15.5
Bahrain	2	40	20.0
Bangladesh	310 000	4 300 000	13.9
Bhutan	6 200	57000	9.2
China	5 000 000	72 040 000	14.4
Cyprus	5 500	135 000	24.5
Democratic People's Republic of Korea	190 000	1 900 000	10.0
Fiji	10	80	8.0
French Polynesia	100	900	9.0
Georgia	21 200	229 200	10.8
India	1 600 000	26 280 000	16.4
Indonesia	60 000	1 014 200	16.9
Iran (Islamic Republic of)	210 000	5 240 000	25.0
Iraq	45 000	740 000	16.4
Israel	17 000	658 803	38.8
Japan	83 000	2 650 000	31.9
Jordan	5 000	170 000	34.0
Kazakhstan	155 000	2 414 800	15.6
Kuwait	850	23 500	27.6
Kyrgyzstan	86 430	1 373 780	15.9
Lao People's Democratic Republic	5 500	36 000	6.5
Lebanon	19 000	490 000	25.8
Mongolia	11 462	114 490	10.0
Myanmar	36 000	510 000	14.2
Nepal	153 534	1 943 246	12.7
New Caledonia	180	2 400	13.3
New Zealand	10 050	505 000	50.2
Occupied Palestinian Territory	2 200	66 000	30.0
Oman	319	9 067	28.4
Pakistan	131 900	2 622 300	19.9
Papua New Guinea	200	900	4.5
Philippines	5 600	72 000	12.9
Qatar	5	45	9.0
Republic of Korea	22 500	625 000	27.8
Saudi Arabia	24 000	570 000	23.8
Sri Lanka	5 330	77 390	14.5
Syrian Arab Republic	30 000	640 000	21.3
Taiwan Province of China	1 600	40 000	25.0
Tajikistan	29 800	659 900	22.1
Thailand	7 981	125 703	15.8
Timor-Leste	400	1 000	2.5
Turkey	158 500	4 280 700	27.0
Turkmenistan	26 800	159 000	5.9
United Arab Emirates	310	7 900	25.5
Uzbekistan	50 500	890 000	17.6
Viet Nam	35 000	370 000	10.6
Yemen	18 276	231 432	12.7
Asia/Oceania	**8 732 961**	**137 343 664**	**15.7**

Source: FAOSTAT

Top producers, 2007

1 China
2 India
3 Islamic Republic of Iran
4 Bangladesh
5 Turkey
6 Japan
7 Pakistan
8 Kazakhstan
9 Nepal
10 Democratic People's Republic of Korea
11 Kyrgyzstan
12 Australia
13 Azerbaijan
14 Indonesia

Asia and Oceania

Asia and Oceania includes the world's potato giant, China, which accounts for more than 20 percent of both the global potato-growing area and the world potato harvest. Several other Asian countries – Bangladesh, India, the Islamic Republic of Iran, Japan and Turkey – also figure in the world's top 20 potato producing countries. Some of the world's best yields are recorded in New Zealand – on average, around 42 tonnes per hectare.

1. China

China is the world's biggest potato producer, with an output in 2007 of 72 million tonnes. It is also an increasingly important global supplier, with potato exports totalling some 250 000 tonnes (raw equivalent) in 2005.

The tuber probably reached coastal China aboard ships from Europe during the 17th century and was introduced to central China by Russian traders around the same time. Production has increased nearly fivefold since 1961. Although Chinese potato output ranks behind that of maize and sweet potato, more than 80 percent of the maize and 40 percent of the sweet potato are used as animal feed. Most of the potatoes go directly to human consumption, and each year, the Chinese consume 40 kg per head.

The potato is important to China not only as a staple food, but also as a source of income, especially for farmers in mountainous areas with poor soils. In northern China's Inner Mongolia and Shanxi provinces, sales of potato account for more than half of rural household earnings. To help cope with growing shortages of water and land for agriculture, Chinese scientists have proposed a major expansion of potato cultivation in dry areas, which account for 60 percent of China's arable land.

FENG TANG

Roasting potatoes in Zao Tong, China

JONATHAN KINGSTON

Potato harvest in Tamil Nadu, southern India

2. India

The potato reached India in the late 16th or early 17th centuries, most likely aboard ships from Portugal. Today, India ranks as the world's third largest potato producing nation, with production in 2007 of around 26 million tonnes.

Between 1960 and 2000, potato production increased by almost 850 percent, partly in response to growing demand from higher-income urban populations. Since 1990, per capita consumption has risen from around 12 kg to 17 kg a year.

In India, the *aloo* is not primarily a rural staple but a cash crop that provides significant income for farmers: the value of the 2005 harvest is estimated at $3.6 billion and exports totalled about 80 000 tonnes that year. Potato varieties suited to the country's climate – hot summers and short winters – are grown on the Indo-Gangetic plain during the shorter days from October to March, while some year-round production takes place in relatively high altitude areas in the south.

3. Islamic Republic of Iran

A British ambassador, Sir John Malcolm, is said to have introduced the potato to the royal court of Persia during the early 1800s. For a time, the tuber was known as "Malcolm's plum", but it is called the "earth apple" by today's Iranians.

Iran is the world's No. 12 potato producer and the third biggest in Asia, after China and India. Since 1961, production has increased more than 15 times over. In 2007, the country's farmers achieved an all-time record harvest of 5.24 million tonnes, with per hectare yields averaging 25 tonnes. The potato is one of Iran's leading agricultural exports, with shipments in 2005 totalling around 166 000 tonnes.

Potatoes are grown mostly under irrigation around the southern shore of the Caspian Sea, in the Zagros Mountains, and on the southern lowlands, alternated with wheat, vegetables, sugar beets and fallow in three or four year rotations. Traditional varieties prized for their culinary qualities continue to be grown in the mountainous north.

4. Bangladesh

A British governor promoted potato cultivation in Bengal in the 1770s, and within a century it was a well established garden vegetable. However, large scale production was held back by the lack of suitable varieties: European cultivars were not adapted to the hot Bengali plains.

Today, the potato has become a highly successful October-March winter crop in Bangladesh, with a production value – estimated at $560 million in 2005 – second only to that of paddy rice. In 2007, Bangladeshi farmers harvested 4.3 million tonnes of potatoes (12 times more than in 1961), which placed the country at No. 14 among the world's potato producers, and No. 4 in Asia.

The potato is usually grown for cash sale, and much of national production is concentrated near the capital, Dhaka, the country's largest urban market. Annual consumption has been growing briskly, from around 7 kg per capita in 1990 to more than 24 kg in 2005.

5. Turkey

In some areas of Anatolia, local potato varieties are still called *ruskartoe*, commemorating the tuber's introduction from the Russian Caucasus in the early 1800s. Potato cultivation has been officially encouraged in Turkey since 1872, and today the country is the Near East's biggest producer after Iran, with output in 2007 of almost 4.3 million tonnes.

Second only to tomatoes as a horticultural crop, the *patates* is grown on an estimated 158 000 ha of land across the country. The Anatolian central plateau, with its hot, dry summers and cold winters, is the most important producing region, accounting for nearly half of the national potato area, while intensive cultivation is conducted on the Aegean and Mediterranean coasts. Yields in 2007 were a high 27 tonnes per hectare.

Turkey's current production hovers at 1990 levels, and is well below the 2000 record harvest of 5.4 million tonnes. Annual per capita potato consumption is contracting, from 63 kg in 1990 to a less than 50 kg in 2006.

6. Japan

The potato was probably brought to Japan by Dutch traders who established an enclave in Nagasaki early in the 17th century. But widespread cultivation of the tuber did not begin until late in the 19th century, when it proved well suited to the cool summers of the northern island of Hokkaido.

Today, Hokkaido's potato farmers produce yields of more than 41 tonnes per hectare and account for about two-thirds of the national harvest, which totalled some 2.6 million tonnes in 2007. While that placed the country at No. 6 among Asia's potato producers, it was also one of the smallest harvests recorded since the 1960s, when Japan was producing up to 4 million tonnes a year.

Along with the steady decline in production over recent decades, there has been a shift from home preparation to consumption of

processed potato products such as chips and French fries. To meet domestic demand, Japan imports each year some 650 000 tonnes of potatoes, mainly from China.

7. Pakistan

Although potato was grown on the Indian subcontinent from the late 16th or early 17th centuries, at Pakistan's foundation in 1947, cultivation was restricted to a few thousand hectares and total annual output was less than 30 000 tonnes.

In the decades since independence, the *aalu* has become the country's fastest growing staple food crop. Thanks to strong gains in cultivated areas and average yields – both made possible mainly by irrigation – output rose between 1995 and 2007 from one million to a record of more than 2.6 million tonnes. The lion's share of potato production comes from the Punjab, where spring and autumn crops account for 85 percent of the national harvest.

Apart from some subsistence growers in the north, most Pakistani farmers produce for urban markets rather than household consumption, and the potato has become a significant source of rural income (worth some $300 million in 2005). At present, annual intake is around 11 kg per capita.

8. Kazakhstan

At the breakup of the Soviet Union in 1991, Kazakhstan was producing annually around 2.5 million tonnes of potatoes from an area of 240 000 ha. In the turmoil of the following decade, there was a steady decline in the size of the potato growing area and in potato output, which dropped to 1.2 million tonnes in 1998.

Since then, production has rebounded, thanks largely to rapid gains in average per hectare yields, which rose from 7.6 tonnes in 1998 to more than 15 tonnes in 2007. In that year, Kazakh potato farmers harvested some 2.4 million tonnes of tubers from 155 000 ha of land.

Today, the potato is Kazakhstan's most important food crop after wheat, with average per capita consumption of a high 100 kg a year. While most potatoes are consumed fresh or used as fodder, recent years have seen strong growth in exports of processed potato products, which rose from 1 000 tonnes in 2000 to more than 15 000 tonnes in 2005.

9. Nepal

The first record of potatoes in Nepal dates back to 1793. Although it remained a relatively minor crop for the next 180 years, some researchers say that its early introduction to the high altitude Himalayas helped fuel the rise of Buddhist civilization in northern Nepal.

In the 1970s, a national potato development programme, aiming at improving the quality of seed potato,

G.M. BAKASH

Potatoes carried to market in Panuty district, Nepal

stimulated a rapid expansion of both cultivated area and production, which increased from 300 000 tonnes in 1975 to a record 1.97 million tonnes in 2006. The potato is now Nepal's second staple food crop, after rice, and per capita consumption has almost doubled since 1990 to 51 kg a year.

Potatoes are widely grown in Nepal, at below 100 m altitude in the south to as high as 4 000 m in the northern mountains. The tuber is particularly favoured by farmers in high hills areas (roughly 1 800 to 3 000 m), where it is more productive than rice and maize and the cool climate is well suited to production of seed tubers for sale at lower altitudes.

10. Democratic People's Republic of Korea

The potato was introduced to the Korean peninsula – probably from China – during the early 1800s. It became a staple crop during the Japanese occupation from 1910 to 1945, replacing rice exported to Japan, and saved many farming families from starvation during the Second World War.

The potato remains an essential food security crop in the Democratic People's Republic of Korea. In 2007, it produced an estimated 1.9 million tonnes, placing the country among Asia's top 10 producers. The area under potato has grown from 36 000 ha to almost 200 000 ha since 1960, while potato output has increased fourfold over the past decade.

Farmers' average yields, however, have barely improved over 1960 levels, mainly owing to shortages of agricultural inputs and the lack of virus-free seed potato. To boost production, the government is promoting a "potato farming revolution". Innovations include a low-input potato-rice cropping system that produces, in a relatively short growing season, 32 tonnes of potatoes and rice per hectare.

11. Kyrgyzstan

Lying at the heart of Asia, along the ancient Silk Road, Kyrgyzstan was introduced to the potato – and its Russian name, *kartófil* – during the 1800s. Although the mountainous country is suitable mainly for grazing livestock, the new crop flourished in the temperate climate of the northern foothills, and today Kyrgyzstanis praise the potato as their country's "second bread".

Since 1992, potato production has increased almost fourfold, from 360 000

tonnes to a record 1.37 million tonnes in 2007. By head of population, Kyrgyzstan now ranks as the world's 10th largest potato producer, while its annual consumption of potato – more than 140 kg per capita – is second only to that of Belarus.

Potato growing in Kyrgyzstan is held back by shortages of virus-free seed tubers, improved varieties and agricultural inputs. But the country's rapidly expanding production has attracted investors – recently announced joint ventures with companies from India and the Republic of Korea are building potato processing plants that aim at producing 40 000 tonnes of starch and bio-ethanol a year.

12. Australia

Potatoes were aboard the ship of explorer James Cook when he claimed eastern Australia for Britain in 1770, and their cultivation began along with colonization 18 years later. Today, "spuds" are grown across the continent, from the temperate southern state of Tasmania to tropical North Queensland.

Australian potato production more than doubled between 1960 and 1990 – from 450 000 tonnes to 1.2 million – but since then output has stabilized at an annual average of about 1.3 million tonnes. Potatoes are the country's most important horticultural crop, accounting for more than 40 percent all vegetables grown. Some 60 percent is processed into frozen products and crisps, while about 37 percent is marketed fresh.

Competition from foods such as pasta and rice has made recent inroads into the fresh potato market, and FAO estimates that between 1995 and 2005 annual per capita consumption of potatoes slipped from 55 kg to 53 kg.

13. Azerbaijan

Azerbaijan became part of the Russian empire in 1828 and was a Soviet republic from 1920 to 1990. During that time, rice, which had been traditionally cultivated in the foothills of the Caucasus mountains, gave way to potato (known as ***kartoşka***) in both agriculture and Azerbaijani cuisine.

Today, Azerbaijan continues to expand its potato production. Since 1992, the area under potato has tripled, while yields have more than doubled. As a result, the national harvest grew from 156 000 tonnes at the beginning of the 1990s to a record 1.1 million tonnes in 2006, only slightly less than wheat production (rice output in 2006 was just 5 000 tonnes).

Potato yields average around 17.5 tonnes per hectare, but improved management techniques recently introduced by experts from Israel have boosted output to more than 50 tonnes in some areas. Azerbaijanis currently consume around 82 kg of potatoes per capita per year and, to meet demand, the country recently increased imports of potatoes from Russia.

NUR MUHAMMAD SYARIFUDDIN

In the highlands of Java, Indonesia

14. Indonesia

The Dutch East India Company brought potatoes to West Java around 1795, and within 15 years the *kentang holanda* (or "Dutch tuber") was being grown by Batak farmers in the highlands of northern Sumatra.

Today, Indonesia is the biggest potato producer in southeast Asia. Between 1960 and the mid-1990s, the country's potato output grew at a rate of almost nine percent per year, and since 2003 annual production has averaged more than one million tonnes. Potato is cultivated throughout the archipelago, in highland areas of between 800 and 1 800 m, mainly by small scale farmers.

Potato growers are largely dependent on seed tubers imported from Germany and the Netherlands. While some potatoes are grown for export, mainly in northern Sumatra, the bulk of Indonesia's potato harvest is destined for fresh consumption in large urban areas. Indonesia imported some 32 000 tons of potatoes in 2006 mainly for processing into food products.

Europe: Potato production, 2007

country	area harvested (hectares)	quantity (tonnes)	yield (tonnes/ha)
Albania	8 200	154 900	18.9
Austria	22 675	668 755	29.5
Belarus	412 553	8 743 976	21.2
Belgium	68 106	2 877 685	42.3
Bosnia and Herzegovina	41 291	387 239	9.4
Bulgaria	22 427	290 553	13.0
Croatia	17 355	296 302	17.1
Czech Republic	31 908	820 515	25.7
Denmark	41 200	1 625 600	39.5
Estonia	11 150	191 754	17.2
Faroe Islands	100	1 400	14.0
Finland	27 300	701 600	25.7
France	145 000	6 271 000	43.2
Germany	274 961	11 643 769	42.3
Greece	35 500	830 000	23.4
Hungary	25 400	531 300	20.9
Iceland	712	13 000	18.3
Ireland	12 300	454 800	37.0
Italy	71 968	1 837 844	25.5
Latvia	40 300	642 000	15.9
Lithuania	52 800	576 100	10.9
Luxembourg	600	20 200	33.7
Malta	700	14 146	20.2
Montenegro	10 000	130 000	13.0
Netherlands	161 000	7 200 000	44.7
Norway	14 421	318 357	22.1
Poland	569 600	11 791 072	20.7
Portugal	41 400	638 900	15.4
Republic of Moldova	353 500	199 000	0.6
Romania	267 035	3 705 694	13.9
Russian Federation	2 851 660	36 784 200	12.9
Serbia	81 379	743 282	9.1
Slovakia	17 769	287 667	16.2
Slovenia	5 736	131 050	22.8
Spain	89 000	2 502 300	28.1
Sweden	28 522	790 100	27.7
Switzerland	11 800	490 000	41.5
The Former Yugoslav Republic of Macedonia	14 000	180 900	12.9
Ukraine	1 453 300	19 102 000	13.1
United Kingdom	139 000	5 635 000	40.5
Europe	**7 473 628**	**130 223 960**	**17.4**

Source: FAOSTAT

Top producers, 2007

1 Russian Federation
2 Ukraine
3 Poland
4 Germany
5 Belarus
6 Netherlands
7 France
8 United Kingdom
9 Romania
10 Belgium
11 Spain
12 Italy
13 Denmark

Europe

For most of the 20th century, Europe was the undisputed world leader in potato production. While that honour has now passed to Asia, seven European countries are among the top 10 global producers. The continent also has the highest level of potato consumption in the world (almost 90 kg per capita per year). Many western European countries are shifting from potato growing to processing and production of seed tubers for export.

1. Russian Federation

Legend has it that Czar Peter the Great, on his voyage through western Europe in 1697, sent home Russia's first bag of potatoes. But for more than a century afterwards, the new tuber was widely considered poisonous and shunned as "the devil's apple".

When Russian farmers finally warmed to the potato, in the mid-1800s, there was no stopping them. By 1973, Russia was producing, along with the other then-Soviet republics of Belarus and Ukraine, more than 100 million tonnes of potatoes a year. Since then, the area dedicated to potato has fallen steadily, and Russia's annual production over the past 15 years has stabilized at around 35 million tonnes.

Nevertheless, the Russian Federation remains a "potato giant", with output second only to China in 2007, and the average Russian consumes a hearty 130 kg of potatoes a year. More than 90 percent of Russian potatoes are grown on household plots and private farms, with average yields of 13 tonnes per hectare. Pests and diseases are a major problem: as much as 4 million tonnes are lost annually to Colorado beetle, late blight and viruses.

MARIA KUSHCHEVA

The Russians call it kartófil

2. Ukraine

Although potatoes have been grown in Ukraine since the 18th century, the crop adapted slowly to the Ukrainian climate and was initially used mainly to produce starch and alcohol. It was only during the 20th century that the crop came to be widely cultivated for food, to the point that it now revered as the country's "second bread", and potato-filled *perogie* dumplings are a favourite national dish.

Ukraine is the world's No. 5 producer of potatoes, after China, the Russian Federation, India and the United States of America, and

consumes per capita a very high 136 kg a year. Around half of the country's 1.5 million hectares of potato farms are located on the black soils of the forest-steppe zone in central Ukraine, although the best yields are obtained in the Polesye wetlands of the north.

Production in 2004 reached a record 20.7 million tonnes, with average yields of around 13 tonnes per hectare. Despite its great production volumes, however, Ukraine is not a potato exporter: a large part of the crop is lost each year to pests – mainly the Colorado potato beetle – and inadequate storage.

The potato is Ukraine's "second bread"

ALEXEI MELNIK

3. Poland

The Polish King John III Sobieski is credited with having introduced potatoes – known initially as *amerykany* (from "America") – to his countrymen in the mid-1600s, after a visit to Vienna. Thus began a love affair that was to make Poland one of the 20th century's giants of potato production.

By 1970, the country was harvesting more than 50 million tonnes of potatoes a year, a quantity bettered at the time only by the Soviet Union. Today, Poland still ranks among the top 10 world producers. However, harvests have declined in recent years, slipping from 36 million tonnes in 1990 to 24.2 million tonnes in 2000, then plummeting to a record low of less than 9 million tonnes in 2006. The 2007 harvest of almost 11.8 million tonnes was a welcome "return to form" for Polish production.

Ziemniaki are at the heart of Polish agriculture, grown by an estimated 2.2 million farmers using 10 percent of the total area for field crops. By recent estimates, almost half of the potato crop is used as farm animal feed, while 25 percent goes to human consumption, which was around 130 kg per capita in 2005.

4. Germany

Taken to Germany at the end of the 1500s, the potato was grown almost exclusively as animal feed for the next 200 years. But, after a severe famine in the 1770s, German monarchs – notably Frederick the Great of Prussia – promoted the *kartoffel* as a staple food crop as well.

Today Germany is the world's seventh largest potato producer, and the biggest in western Europe, with output in 2007 of just over 11.6 million tonnes. Even so, German potato production has been falling since 1960 – at that time, the harvest was almost 33 million tonnes and potato growing occupied 10 percent of all arable land, compared to less than three percent today.

Germany is a major potato processor and exporter. In 2005 it processed 6.5 million

FROUKJE DE JONG-KRAP

The Netherlands has achieved world record yields

tonnes of potatoes, including 3.3 million tonnes transformed into potato starch, and exported 1.3 million tonnes of fresh potatoes and 2 million tonnes (primary equivalent) of processed products. It is also a leading importer of early potatoes (nearly 550 000 tonnes, mostly from France, Italy and Egypt, in 2005).

5. Belarus

Belarusians love their potatoes. They consume more per head than any other country – an estimated 180 kg, or almost half a kilogram a day. The potato is believed to have been introduced to Belarus from the Netherlands, and by the 1800s had already become a staple food crop and the heart of the country's cuisine.

Today, Belarus ranks eighth among world potato producing countries, and its annual output – 8.7 million tonnes in 2007 – is about twice that of wheat and barley combined. Over the past 15 years, the country's harvested area has shrunk, from 780 000 ha to 400 000 ha, but production has held steady at an average of 8.6 million tonnes annually, thanks to yield gains.

During the Soviet era, Belarus bred improved potato varieties that were grown on a third of all lands under potato in the USSR, and exported more than 500 000 tonnes of fresh potato and up to 300 000 tons of seed potato. Those days are now past: in 2005, potato exports amounted to less than 17 000 tonnes.

6. Netherlands

Within a century of its introduction to the Netherlands, in the 1600s, the potato had become one of the country's most important food crops. Today, the Netherlands ranks among the world's top 10 potato producers, with a harvest in 2007 of 7.2 million tonnes.

While potato production is declining in most of Europe, the Dutch still plant almost 25 percent of their arable land – some 160 000 ha – with *aardappel*, and have achieved world record average yields of more than 45 tonnes per hectare. The potato sector is highly mechanized and draws on a list of some 250 approved varieties.

Only half of the Netherlands' potato crop is grown directly for food – around 20 percent is seed potatoes, and the remaining 30 percent is processed into starch. About 70 percent of Dutch ware potatoes is exported in the form of fresh tubers and potato products, such as chips and flour. The

Netherlands is the world's major supplier of certified seed potatoes, with exports of some 700 000 tonnes a year.

7. France

The *pomme de terre* was introduced to France at the beginning of the 17th century, but its true value as food was not recognized until the late 18th century, when a renowned scientist, A.A. Parmentier, recommended it as the solution to endemic famines that were then devastating the country.

Potato cultivation took off, with output rising from 1.5 million tonnes in 1803 to 11.8 million in 1865. Production reached its zenith in 1960, with a harvest of around 14 million tonnes. Since then, there has been a steady decline, with the 2007 harvest totalling just under 6.3 million tonnes. Some two million tonnes of France's potatoes are destined for the domestic fresh market, and one million tonnes for the processing industry. France is Europe's No. 1 exporter of fresh potatoes, with nearly 1.5 million tonnes shipped in 2005/2006, and dedicates some 14 500 ha for production of potato seedlings.

Today, the potato still has an important place in the national diet: the French consume each year nearly 30 kg per capita of fresh potatoes and another 25 kg of processed products.

8. United Kingdom

The potato reached the United Kingdom towards the end of the 16th century and was being grown in London by 1597. The new crop established itself rapidly in Ireland but less so in England and Scotland.

The potato's moment in the United Kingdom came later, during the Industrial Revolution of the 18th and 19th centuries, when the rise of towns – and the new working class – created demand for cheap, energy-rich, non-cereal foods. The rest is history. By 1948, production in England and Wales was peaking with almost 400 000 hectares under potato.

Since 1960, the harvested area has shrunk by half, and the number of registered potato growers from 70 000 to just 3 000. But the United Kingdom still ranks No. 11 among world potato producing countries, recording

LINDA WRIDE

Fast food kiosk in Oxford, United Kingdom

a 2007 harvest of 5.6 million tonnes and average yields exceeding 40 tonnes per hectare. With annual per capita potato consumption of 102 kg, demand for potato exceeds domestic supply: in 2005, the United Kingdom imported more than 1.2 million tonnes (raw equivalent) of processed potato products.

9. Romania

Romania is among the world's top 20 potato producers. It is also one of the few European countries where potato production has actually been increasing – from 2.8 million tonnes in 1961 to more than 4 million tonnes in 2006 – while potato consumption per capita has more than doubled since 1990.

The *cartof* was introduced to Transylvania from Germany in the 1700s. Today it is an important crop for Romania's agriculture and national economy, and for the estimated 2.2 million Romanians who harvest tubers from their own small potato patches each year. Almost all of Romania's potatoes are marketed for fresh consumption, with just 2 percent being processed. In 2005, potato imports totalled more than 140 000 tonnes, while exports amounted to less than 5 000 tonnes.

Romanian researchers are exploring the potential of the potato as a source of ethanol for fuel – tubers produced in the southern zone of Romania under irrigation have yielded enough starch to produce around 4 000 litres of ethanol per hectare.

10. Belgium

Old documents show that a Belgian official in Mons received potatoes as a gift from a friend of the Vatican ambassador in 1587 (the following year, he sent samples on to a botanist in Vienna). Within a century the Belgians had made a landmark contribution to potato development, with the invention – they claim – of French fries.

Today, Belgium ranks No. 19 among the world's potato producing countries, with output in 2007 of nearly 2.9 million tonnes. Thanks to average yields of 42 tonnes per hectare, the potato is the country's main food crop, even though the cultivated area is less than 5 percent of total farmland.

Less than 15 percent of Belgian potatoes are eaten fresh – about 86 percent are processed into crisps, frozen fries, starch and other products. In 2006, the country exported more than one million tonnes

of processed potatoes and 21 000 tonnes of seed potatoes. It also imported more than 1.2 million tonnes of fresh potatoes and 140 000 tonnes of potato products, mainly from France, Germany and the Netherlands.

11. Spain

While no one knows the exact date of the potato's arrival in Europe, its entry point was probably Spain's Canary Islands, where *S. tuberosum* was cultivated at least as early as the mid-1500s (later records show that potatoes were served to patients in the Hospital de la Sangre in Seville in 1573).

While initially prized more for its flowers than as a food crop, the *patata* was a mainstay of Spanish agriculture throughout most of the 20th century, with annual production exceeding 5 million tonnes up to the 1990s. Today, however, as elsewhere in western Europe, potato production is on the wane in Spain. In 2007, the country produced 2.5 million tonnes of tubers, while the harvested area has fallen from 270 000 ha in 1990 to less than 90 000.

As a result, Spain is now a major potato importer. Since 1990, annual imports of raw and processed potatoes, mainly from France, Germany, Italy and Morocco, have risen from 395 000 tonnes to 1.2 million tonnes.

12. Italy

In 1565, Spain's King Philip II is said to have sent to Rome a gift of potato tubers for Pope Pius IV, who passed samples on to a cardinal in Belgium. Along with the tubers went their Italian name – *tartufoli* (or "little truffles") – which, as the samples were cloned and disseminated throughout Europe, was adopted in German (*kartoffel*), Romanian (*cartof*), Russian (*kartófil*) and even Icelandic (*kartafla*).

Although the potato – called *patata* by modern Italians – was a staple food for generations of rural families, potato growing in Italy has been declining since the 1960s, when farmers produced 4 million tonnes from 380 000 ha of land. Large areas unsuitable for potato have since been abandoned, although per hectare yields have increased from 10 tonnes to around 25 tonnes.

Pasta-loving Italy has one of the lowest levels of potato consumption in Europe, less than 40 kg per capita annually. Even so, satisfying domestic demand required imports of more than one million tonnes of raw and processed potato in 2005.

Harvest in Calabria, Italy

13. Denmark

Although the first potato tuber was planted in Denmark's Royal Botanical Garden in 1642, Danish farmers did not start growing it until almost a century later, around 1720. It is believed that farming of potatoes was introduced either from England and Ireland or by the Huguenots emigrating from France.

Potato production in Denmark totalled some 1.6 million tonnes in 2007, with yields of 39 tonnes per hectare. Little more than one third of total output is consumed directly as fresh potatoes. In fact, more than half of Denmark's potato harvest is processed into potato starch and flour, while nine percent is used as seed potatoes for replanting.

Each year, the average Dane consumes about 73 kg of potatoes. While per capita consumption is below that of other European countries, such as Ireland, potatoes are nevertheless an important part of the national diet. Potatoes are almost ubiquitous in Danish cooking, and an essential side dish to every hot meal. Denmark's legendary *akvavit* is distilled from potatoes.

GIOPUO

JOHN DIX

A field of práta, Ireland

25. Ireland

No, Ireland is not a *very* big potato producer, but it deserves special recognition. The Irish were the first to give the tuber a truly warm welcome to Europe in the early 17th century, and the *práta* has been an intimate part of the country's history ever since.

It is also associated with a national tragedy. By the 19th century, potatoes supplied 80 percent of people's calorie intake and was a major source of livestock feed. But dependence on the potato proved a double-edged sword: in the 1840s, potato blight destroyed most of Ireland's potato crop, leading to a famine that caused the deaths of one million people and the emigration of millions more.

Today more potatoes are still eaten in Ireland than in most other countries of the world. In 2007, Ireland's 830 potato farmers produced an estimated 455 000 tonnes of potatoes, 85 percent being ware potatoes for consumption, and the rest seed potato for replanting.

Latin America: Potato production, 2007

country	*area harvested (hectares)*	*quantity (tonnes)*	*yield (tonnes/ha)*
Argentina	68 000	1950 000	28.7
Belize	55	730	13.3
Bolivia	135 600	755 000	5.6
Brazil	142 327	3 375 054	23.7
Chile	54 528	831 054	15.2
Colombia	110 000	1 900 000	17.3
Costa Rica	2 220	53 500	24.1
Cuba	12 000	290 000	24.2
Dominica	12	120	10.0
Dominican Republic	2 450	52 000	21.2
Ecuador	52 000	355 000	6.8
El Salvador	237	5 218	22.0
Guatemala	11 000	300 000	27.3
Haiti	880	10 000	11.4
Honduras	1 350	22 000	16.3
Jamaica	580	9 000	15.5
Mexico	64 709	1 750 797	27.1
Nicaragua	2 400	33 000	13.8
Panama	1 300	26 000	20.0
Paraguay	200	1 300	6.5
Peru	269 441	3 388 147	12.6
Uruguay	7 925	118 362	14.9
Venezuela (Bolivarian Rep. of)	24 552	456 661	18.6
Latin America	**963 766**	**15 682 943**	**16.3**

Source: FAOSTAT

Top producers, 2007

1 Peru
2 Brazil
3 Argentina
4 Colombia
5 Mexico
6 Chile
7 Bolivia
8 Bolivarian Republic of Venezuela
9 Ecuador
10 Guatemala
11 Cuba

Latin America

The potato originated in South America, yet the region has the world's lowest level of potato production, less than 16 million tonnes in 2007. The potato remains a traditional crop for small farmers in the Andean region, where it is cultivated along with potato species unknown elsewhere. In other countries – Argentina, Brazil, Colombia and Mexico – production of Solanum tuberosum *by large scale commercial growers is increasing.*

DANIEL DABOVE

Treasure of Peru

1. Peru

The potato has been essential to the diet of Peruvians for millennia. Archaeological evidence indicates that the potato was cultivated in the Peruvian Andes 8 000 years ago, and recent research suggests the potato's centre of origin lies in Peru, just north of Lake Titicaca. Today, Peru's farmers cultivate four species of potato: *Solanum tuberosum*, plus three other species exclusive to the Andes.

Peru is also Latin America's biggest potato producer, with a record harvest in 2007 of almost 3.4 million tonnes. Annual consumption is a high 80 kg per capita. The potato is produced mainly by small farmers, at altitudes of from 2 500 m to 4 500 m in the central Andes, while a smaller area in coastal valleys is devoted to irrigated commercial production.

The great genetic diversity found in Peruvian potatoes is considered "under threat" from new commercial varieties that are often grown to satisfy urban consumer preferences. To help conserve the country's rich potato heritage, the Government of Peru created in July 2008 a national register of Peruvian native potato varieties.

2. Brazil

Brazil is the centre of origin of the world's premier root crop, cassava. Yet cultivation of potatoes was virtually unknown until the late 1800s, when European immigrants introduced the tuber to relatively temperate areas of southern Brazil (in the state of São Paulo, potato can be grown and harvested almost every month of the year).

While the potato, known locally as *batata inglesa*, is still a minor crop for Brazilian agriculture, the country ranks as Latin America's second biggest potato producer, with production of more than 3.3 million tonnes in 2007. Over the past 15 years, the country's potato output has grown by an average of five

Tuber transport in Antioquia, Colombia

percent a year, and average yields have increased from 14 tonnes to 24 tonnes per hectare.

Although few of Brazil's potatoes are exported, annual consumption is estimated at a low 14 kg per capita. But that is expected to change: as one of the world's emerging economic giants, Brazil is considered a prize market for processed potato snacks.

3. Argentina

Although western Argentina lies within the area of origin of wild potatoes, evidence of potato production there dates from the 1870s, when 2 400 hectares were planted with tubers almost certainly imported from Europe.

At 2 000 m in the Argentine Andes

DUILIO BARRO

Today, potato production is large-scale and highly mechanized, and concentrated around Buenos Aires and Santa Fe.

Over the past 50 years, Argentina's potato output has changed very little: the 2007 harvest of 1.9 million tonnes was only slightly less than that of 1961. Since the early 1960s the national harvest has averaged around 2 million tonnes, with only occasional peaks (in 1998, it reached 3.4 million). Levels of potato consumption – around 44 kg per capita per year in 2005 – have changed little since 1990.

However, yield has improved markedly. Along with a steady drop in the size of the harvested area, from 200 000 ha in 1961 to around 68 000 in 2007, per hectare yields have more than tripled to almost 30 tonnes. In 2005, Argentina exported 33 000 tonnes of potatoes and 4 000 tonnes of potato flour.

4. Colombia

In 1538, a Spanish visitor to the central mountain ranges in present-day Colombia noted that local people cultivated "a kind of earth truffle" – which were probably potatoes. In fact, Colombia lies along the northern edge of the Andean centre of potato origin and domestication.

While the "earth truffle" is still a subsistence crop for many small farmers in Colombia, it is also the focus of the largest commercial potato industry in the Andean region. In 2000, production reached more than 2.8 million tonnes, thanks largely to yields of around 17 tonnes per hectare, far above those achieved in Bolivia, Ecuador

CARLOS ANTONIO MONROY ESCUDERO

and Peru. Since then, the harvested area has shrunk from 170 000 to 110 000 hectares, and production in 2007 stood at 1.9 million tonnes.

Potato is grown mainly at altitudes of 1 800 to 2 300 m in the Cordillera Central and Cordillera Oriental mountain ranges. Since the 1990s, there has been a rapid increase in potato processing, which accounts for 12 to 14 percent of the total harvest.

5. Mexico

The presence of wild potato plants in Mexico indicates that it lies within the potato's area of origin. However, some evidence suggests cultivated varieties were brought there by Spanish conquerors during the 1500s.

Until the early 1960s, potato growing was limited to rainfed areas above 2 000 m in volcanic zones of central Mexico, with annual production of about 300 000 tonnes and yields below six tonnes per hectare. Over the following 20 years, production expanded into irrigated commercial areas in the north and west, where yields today reach 40 tonnes. While the area dedicated to potato has changed little since 1980, average yields have almost tripled since 1961 and production reached a record 1.75 million tonnes in 2007.

Per capita consumption of potato in Mexico stands at 17 kg a year, very low compared to its maize intake of 400 kg. But potato imports from Canada and the USA have grown in recent years, reaching 65 000 tonnes of fresh potatoes and 122 000 tonnes of frozen products in 2006.

6. Chile

Although the potato originated in the Andes, recently uncovered DNA evidence indicates that varieties grown around the world today were developed mainly from Chilean cultivars. While the Andean potato predominated in Europe in the 1700s, germplasm introduced from Chile became predominant in the 1800s.

Chile is the sixth biggest potato producer in Latin America, with a record harvest in 2006 of almost 1.5 million tonnes, on a par with the country's output of maize and wheat. Although potatoes can be grown throughout Chile, production is concentrated in the provinces between Coquimbo, in the north, and Chiloé (including Chiloé Island, where it was already cultivated in pre-Colombian times).

More than half of Chile's potatoes are eaten fresh (consumption is estimated at 51 kg per capita per year, almost unchanged since 1990), while around 10 percent is processed, and 15 percent is used as seed potato. By value, seed potato accounts for almost half of the country's potato exports, destined mainly for Brazil and Venezuela.

7. Bolivia

Cultivated in the Bolivian Andes for thousands of years, the potato is today the country's most important food crop, along with soybeans. It is grown across some 135 000 hectares of land by an estimated 200 000 farmers, the vast majority of them smallholders who produce mainly for household consumption.

Most farmers rely heavily on traditional varieties that are well adapted to Bolivia's "high climatic risk" (on the *altoplano*, especially, the potato crop is exposed frequently to hail, frost and drought). One such native variety is the hardy "bitter potato", which is cultivated at altitudes as high as 4 300 m and processed into a dried product, *chuño*, that can be stored for up to 10 years.

Over the past decade, Bolivia's potato production has expanded steadily, thanks mainly to higher yields, and stood at 755 000 tonnes in 2007. However, recent growth in imports of wheat and rice is creating strong competition for potato farmers, especially in urban markets.

8. Bolivarian Republic of Venezuela

The northern extensions of the Andes in western Venezuela are home to some 20 species of wild potato and account for most of the country's potato production. In subsistence farming areas between 2 000 and 2 500 m, the potato is the main cultivated crop, while commercial production is concentrated in hilly areas of the state of Lara.

Potato output has grown steadily since the 1960s, and nearly doubled between 1990 and 2007 to a record 450 000 tonnes. Almost all of Venezuela's potatoes are fresh marketed, prompting government efforts to diversify production to varieties suitable for processing. Although per capita consumption is a low 12 kg a year, demand was sufficient to require imports of more than 80 000 tonnes of raw and processed potato in 2005.

Cultivation in the high Venezuelan Andes is threatened by the loss of potato genetic diversity adapted to the region's climatic and ecological conditions. An ongoing programme is encouraging farmers to produce disease-free seed potatoes using local varieties.

9. Ecuador

Ecuador's Andean region lies within the potato's area of genetic diversity, and particularly rich diversity of wild potato is found in central Ecuador. Cultivation is generally undertaken by small farmers with less than five hectares of land, one of which is typically devoted to potato.

Input costs and the higher profitability of other crops has led to marked fluctuations in the country's potato output: over the past decade, total production has fallen from more than 450 000 tonnes to 350 000, while the cultivated area has shrunk from 65 000 ha to around 50 000.

Potato production is becoming more commercially oriented in response to demand from Ecuador's growing urban sector, which accounts for more than 60 percent of the

KEITH DANNEMILLER

Potato seller in Antigua, Guatemala

population. Almost all potatoes produced are consumed locally, with per capita consumption of around 25 kg per year.

10. Guatemala

The highlands of central and western Guatemala offer often ideal conditions for potato growing. At altitudes of between 1 500 and 2 800 m, where average temperatures range from 7°C to 25°C, farmers can harvest potatoes within 100 days of planting, and in frost-free irrigated areas, tubers are cultivated throughout the year.

As a result, Guatemala ranks as Central America's leading potato producer, with a record harvest in 2007 of 300 000 tonnes. Average yields are estimated at more than 27 tonnes per hectare, second only to Argentina in the Latin American region.

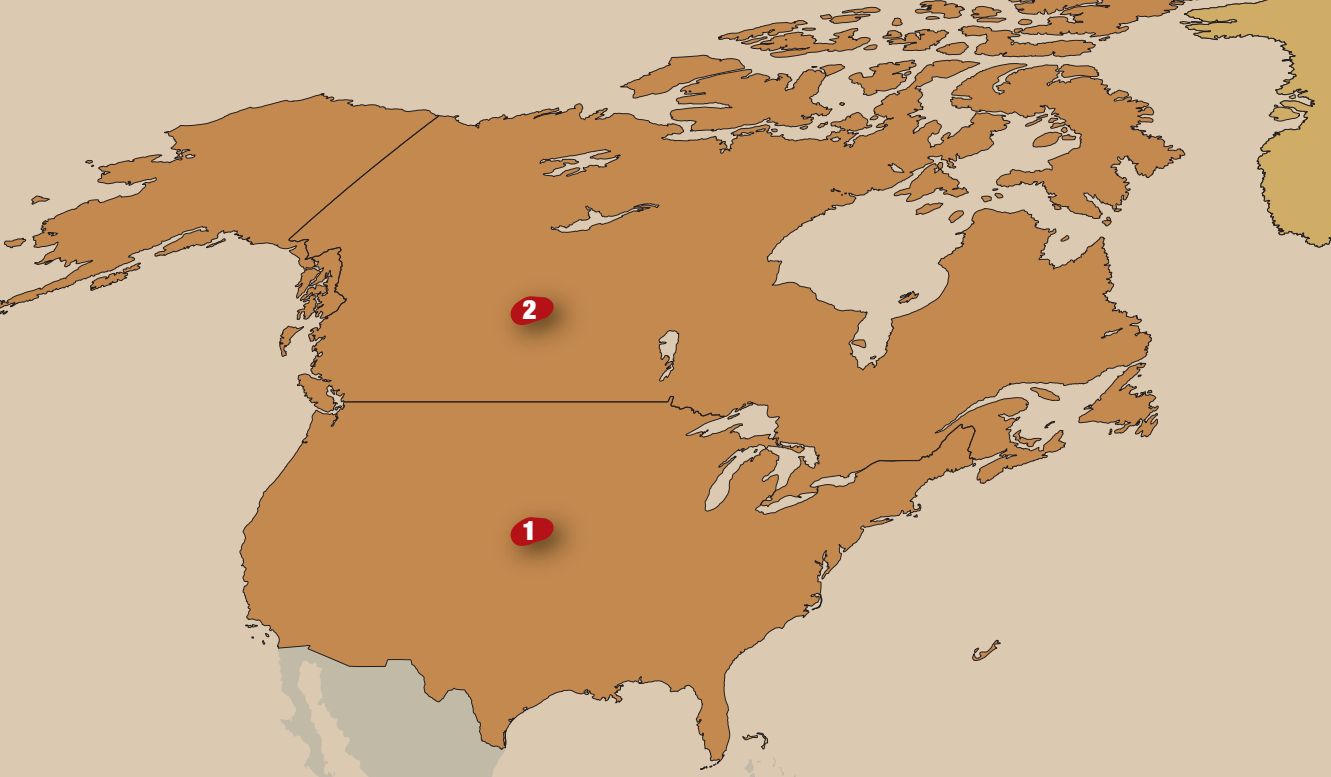
The potato has become a valuable cash crop for small farmers, who grow it mainly for sale to urban areas and for export to neighbouring countries. However, Guatemala's potential as a potato producer is constrained by a shortage of certified planting material and fragmentation of supply chains. Recently, the government approved importation of seed potato from Argentina and is promoting the creation of small-scale potato producers' associations.

11. Cuba

The first reference to potato in Cuba dates from 1798, when a land-owner complained about a shortage of suitable seed potato. In fact, the lack of varieties adapted to Cuba's tropical island climate discouraged generations of farmers from growing the tubers.

Since the 1970s, production has increased steadily thanks to the use of seed potato imported from France and the Netherlands, which can be reproduced locally for up to three consecutive years. Cuba's potato output reached a record 370 000 tonnes in the year 2000 and, since then, annual harvests have averaged more than 300 000 tonnes.

Yields have doubled since 1990. Today, per hectare output is more than 24 tonnes, amongst the highest levels in Latin America and 50 percent higher than the world average. Production is concentrated in areas around the capital, Havana, and is used mainly for French fries. Annual per capita potato consumption is around 30 kg.



North America: Potato production, 2007

country	*area harvested (hectares)*	*quantity (tonnes)*	*yield (tonnes/ha)*
Bermuda	45	1 100	24.4
Canada	158 927	4 970 938	31.3
United States of America	456 906	20 373 267	44.6
North America	**615 878**	**25 345 305**	**41.2**

Source: FAOSTAT

Top producers, 2007

1 United States of America

2 Canada

North America

North American potato production is concentrated in two countries – the United States of America and Canada, which rank 4th and 13th, respectively, in the potato producing world (their closest regional rival, Bermuda, produced 1 100 tonnes in 2007). Since 1990, both countries have achieved notable increases in yields, which now average around 44 tonnes in the United States. Both are also major exporters of frozen potato products.

1. United States of America

Although the potato was grown in South America for millennia, the first potato patch in North America was only planted in 1719, in New Hampshire (the first French fries were served at the White House during the Presidency of Thomas Jefferson some 80 years later).

In 2007, the United States harvested 20.3 million tonnes of potatoes, enough to make it the world's fourth biggest producer. Potatoes in the United States are grown in nearly every state, although about half of the crop comes from Idaho, Washington, Wisconsin, North Dakota, Colorado, Oregon, Maine, Minnesota, California and Michigan. Most potatoes are harvested in September and October.

Only about one third of the potatoes grown in the United States is consumed fresh. Around 60 percent of annual output is processed into frozen products (such as frozen fries and wedges), crisps, dehydrated potato and starch, while 6 percent is re-used as seed

SKYE COMPTON

Potato harvester in Anza, California

potato. Americans eat more than 54 kg of potatoes per capita every year. However, fresh potato consumption has declined from more than 22 kg per person in 1993 to just 16 kg in 2006.

2. Canada

Potatoes were first grown by settlers in New Brunswick, on Canada's Atlantic coast, as early as the mid-1600s. Today, Canada ranks as the world's 13th largest potato grower, with 2007 output of almost five million tonnes. The potato accounts for one third of all vegetable farm cash receipts, or $846 million in 2007, making it Canada's most important horticultural crop.

Since the early 1990s, Canadian potato production has expanded to meet international demand for frozen potato products. In 2006-07, Canada shipped 970 000 tonnes of frozen French fries to foreign markets, making it the second largest French fry exporter after the Netherlands. In the same period, it exported 120 000 tonnes of seed potatoes valued at $38 million and 470 000 tonnes of table potatoes worth $140 million.

Potatoes account for about 36 percent of all fresh and processed vegetables consumed in Canada. Despite the potato's popularity, however, total consumption has declined from 76 kg per person in 1994 to 65 kg in 2007.

Potato fields on Prince Edward Island, Canada

BRUCE BOUTILIER

IYP around the globe

People observed the International Year with scientific conferences, potato growers' congresses, festivals of biodiversity, cooking contests, art exhibitions, block parties and school events. Highlights of a global celebration...

Flowering potato plants are showered with ribbons at a festival in the Andes, Peru

JANUARY

India

International expo in Kolkata

The world's No. 3 potato producer, India, helped launch the Year of the Potato with an International Potato Expo in Kolkata. Organized by the Indian Chamber of Commerce and the Government of West Bengal State, the expo showcased the potential of India as a hub for potato production and processing. Activities included a two-day conference, field visits, and three days of exhibitions and cultural events. The host state, West Bengal, is India's second largest potato producer, with annual output of more than 7 million tonnes.

Ecuador

A seminar, then a carnival

Ecuador was one of the first countries to form a national committee for IYP celebrations. Events got under way with a workshop organized by FAO and CIP on strategies for small farmer participation in the potato economy. The seminar, attended by delegates from producer organizations, NGOs and local governments, was followed by a potato carnival in the farming area of Alto Guanujo, where 200 people sampled potato dishes and shared the results of a three-year study on the uses of native potato varieties.

ALEJANDRO BALAGUER/CIP

FEBRUARY

CIP

Switzerland

Odyssey of the potato in Europe

The International Potato Center in Peru launched a travelling exhibit "The Odyssey of the Potato", which visited 10 European cities during 2008. The exhibit, which opened at the Federal Institute of Technology in Zurich, Switzerland, on 1 February, illustrated the domestication of the potato in Peru, its introduction to Europe and dissemination worldwide, and its important role today in food security and economic development.

Ireland

Challenge for Irish schoolkids

Primary school children across Ireland received potato seed tubers as part of a "Meet the spuds!" Challenge – a potato-growing competition sponsored by the country's AgriAware Trust, the IYP national committee and the Irish Department of Agriculture. As the plants grew, pupils recorded progress with drawings, photos and written observations. In June, photos of the harvested crop were submitted for final assessment. The eight winning schools received a cash grant.

Canada

Potato technology on show

Warming up for the new potato planting season, two of Canada's premier potato-growing provinces hosted conferences and technology exhibitions in February. The New Brunswick Potato Conference and Trade Show featured two days of deliberations on topics ranging from demand prospects to late blight and climate change. On neighbouring Prince Edward Island, the biennial Technology Expo provided a showcase for 100 leading suppliers.

Syrian Arab Republic

Workshop at Damascus University

Damascus University hosted a national workshop on the potato which included presentations on the results of FAO projects to strengthen the Syrian Arab Republic's capacity for virus-free seed potato production using tissue culture, monitor aphid pests of potato, and set standards for seed certification.

MARCH

United States of America

Gnocchi night in Seattle to raise funds

Sabrina Tatta, a lecturer in Italian Studies at the University of Washington in Seattle, hosted a cooking evening where she prepared *gnocchi* (Italian dumplings made from boiled and sieved potatoes mixed with flour). "The objective," she said, "is to celebrate Italian cooking and raise funds for undergraduate scholarships. We also hope to raise awareness about Italian culture, biodiversity and the potato as a tool for achieving Millennium Development Goals."

Egypt

Potato on display in Cairo

Egypt is the biggest potato producer in Africa, with an output in 2007 of some 2.6 million tonnes. It was, therefore, an appropriate venue for FAO's Near East Regional Conference, which was attended by high-ranking agriculture officials from 32 countries stretching from Morocco to Afghanistan. Between discussions on transboundary animal diseases, pesticide management and climate change, delegates viewed a presentation on IYP and the potato.

Peru

Papa, madre on display in Cusco

French photographer Jean-Louis Gonterre held an exhibition entitled *Papa, madre* at the Inca Museum in Cusco for most of the month of March. On display was a collection of 50 striking photographs taken in Bolivia, Ecuador and Peru with the potato – or *papa* – as the central theme. In documenting the age-old cycle of potato planting and harvesting, Gonterre paid homage to the Andean farmers who have nurtured *Solanum tuberosum* and moulded it into countless varieties.

Italy

IYP celebrated in northern Italy

The Regional Agency for Rural Development, in northern Italy's Friuli Venezia Giulia region, organized a potato exhibition during the annual horticulture show in Pordenone. Visitors were offered potato dishes from around the world prepared by a women's intercultural association. The agency also sponsored on 8 March an international potato conference, with participants from FAO, the European Union, the Italian Ministry of Agriculture and the Alpe-Adria region.

Argentina

Course in papa production

The agricultural research station at Balcarce, near Buenos Aires, began breeding potatoes in 1940. Today, the station covers some 2 000 ha of land, with a staff of 250, and specializes in research on genetic enhancement, seed analysis, micropropagation and nematology. The station shared its knowledge with agricultural science graduates from Argentina and other Latin American countries through a six-day course on potato production, beginning on 10 March.

United States of America

IYP on the web

Representing 4 000 potato growers, the United States Potato Board says further growth in the industry will come from innovation. To celebrate IYP 2008, the Board bought prime cyberspace – on the Food Network website – to supply busy mothers between the ages of 25 and 50 (among the most active users of the internet) with meal ideas and nutrition information.

Peru

CIP

Global potato conference in Cusco

The historic city of Cusco, Peru, at the heart of the potato's Andean centre of origin, hosted in March one of the major events of the International Year: a landmark global conference on "Potato science for the poor" sponsored by the International Potato Center and the Food and Agriculture Organization.

During the four-day conference, more than 100 of the world's leading authorities on the potato and on research-for-development shared insights and recent research results to develop strategies for increasing the productivity, profitability and sustainability of potato-based systems.

They addressed potato development challenges facing three distinct economic typologies – outlined in the *World Bank's World Development Report 2008* – in the developing world. The first is agriculture-based countries, mainly in Africa, where the poor are concentrated in rural areas and produce potato for home consumption first and then sale to local markets. CIP and FAO say a priority for these countries is research and technology sharing to support a "sustainable productivity revolution" and to link producers to domestic and regional commodity markets.

Different strategies are needed for the "transforming economies" of Africa, Asia, the Middle East and North Africa, where potato systems are characterized by very small, intensively managed farms and by a widening rural-urban poverty gap. The challenge for those countries is to sustainably manage intensive systems, increasing productivity while minimizing health and environmental risks.

In the urbanized economies typical of Latin America, Central Asia and Eastern Europe, where agriculture plays a reduced role, the challenge is to ensure the social and environmental sustainability of potato-based systems and link small potato producers to new food markets.

Farmer-researchers. Conference participants visited a 12,000 ha "Potato Park" near Cusco, where farmer-researchers have restored to production over 600 traditional Andean potato varieties, providing the genetic building blocks of future varieties.

One of the outputs of the conference has been dubbed the "Cusco Challenge", a year-long dialogue within the global potato science community that will address issues and opportunities in the future development of this essential crop.

Potatoes seen as answer to high cereal costs

Food scientists are meeting in Cusco, Peru, to find ways of boosting world potato production to ease the strain of surging cereal prices on the world's poorest countries. The conference aims to expand the role of a crop that produces more food on less land than maize, wheat or rice.

Financial Times 27 March 2008

MARCH

Australia

Spud Day, and a recipe book

The Wimmera Home Educators' Group – parents who educate their children at home – has celebrated International Years for Mountains (2002) and for Deserts and Desertification (2006). For IYP, the group held a potato day in the town of Dimboola on 13 March and produced a potato recipe book. Farmers grow cereals on Wimmera's drylands, but are now turning to higher value crops such olives and potatoes.

Canada

Homage to St. Patrick and "the spud"

Each year on St. Patrick's Day (the feast day of Ireland's patron saint), a group of citizens in Vancouver, Canada, organize a "Homage to the Spud" celebration in recognition of the potato's contribution to Irish life and culture. Participants bring dishes in which potatoes are the main ingredient, and prizes are awarded for the most creative dish. The event also serves to raise funds for local charities that support youth outreach services.

APRIL

China

Call for action at potato congress

More than 120 delegates from China and abroad met in Beijing for the ninth China Potato Congress, co-organized by the Chinese Potato Association and the Ministry of Agriculture. Describing the potato industry as vital to national food security and rural development, the Vice-Minister of Agriculture, Wei Chaoan, said action was needed to improve seed potato quality, introduce new varieties and improve processing technology.

Sri Lanka

Potato symposium in Sri Lanka

To celebrate IYP, Sri Lanka's Department of Agriculture hosted a symposium on "Potato: Opportunities and challenges in the new millennium" at its Sita Eliya Agricultural Research Station. Established in 1960, and proposed as a national potato research centre, the station currently produces disease-free planting material and develops early maturing, high yielding varieties adapted to the country's cropping systems.

Netherlands

Patents, potatoes and sharing technology

An international conference was held at Wageningen University and Research Centre on 11 April to discuss "possible tensions" between the practice of public organizations to patent their innovations in the life sciences, and the need to ensure developing countries' access to new technologies. International experts presented their views on this complex issue, with particular reference to the case of potato research at Wageningen, and offered potential solutions to the dilemmas at hand.

MAY

China

Progress report on late blight

Late blight – the mould disease that caused Ireland's disastrous "potato famine" – remains one of the most destructive diseases of *S. tuberosum*. But the last five years have seen major advances in many areas of research on late blight and its causal agent, *Phytophthora infestans*. Leading scientists met in Beijing for the Third International Late Blight Conference, to consolidate new knowledge and foster greater international collaboration.

Brazil

"Potato's importance to humanity"

Delegates from 21 countries of Latin America and the Caribbean celebrated IYP at the FAO Regional Conference held in Brasilia. The Independent Chairman of the FAO Council, Mohammed Saeid Noori-Naeini, said that through IYP the world had recognized "the importance of the potato to humanity" and the contribution to agriculture of other crops domesticated in the region, including maize, cassava, beans and cacao.

Australia

Outdoor art "inspired by spud"

Every two years, the city of Sydney hosts a one-day "Art in the park" exhibition of contemporary art. Inspired by IYP, the subject of the exhibition in 2008 was the "humble spud". The curator urged local and visiting artists to contribute "artworks inspired by the potato – potatoes as metaphor, potatoes as subject, potatoes as medium". The day's event included entertainment and workshops for both adults and children.

Peru

First national potato congress

Peru held its first ever National Potato Congress in the city of Huancayo, in the country's central highlands, from 20 to 23 May. Organized around the theme of "Science, art and business", the congress included presentations on potato production, processing, marketing and utilization, exhibits on biodiversity and potato gastronomy, and a visit to the national potato research station at Santa Ana.

France

Potatoes as haute cuisine

The Cordon Bleu School in Paris held a one-day course on applying French culinary techniques in the preparation of potato dishes. Working under the supervision and guidance of a chef, students prepared five recipes using different types of *pommes de terre*. The students were free to take home and consume their day's work. The Cordon Bleu school, a world leader in gastronomic education, first opened in Paris in 1895.

Bangladesh

Launch of country-wide campaign

As part of IYP, Bangladesh launched a nation-wide Potato Campaign. Jointly organized by the Bangladeshi Ministry of Defence, the Ministry of Agriculture and FAO, the campaign aimed at promoting the potato as part of a diversified diet, and increasing consumption of the country's 2007 bumper harvest of 4.3 million tonnes. The launch was followed by initiatives at district and sub-district level throughout the month of May.

MAY

China

Potato cuisine promoted in Beijing

IYP representatives distributed promotional materials and mounted a photographic exhibition on the potato at the annual convention of the China Cuisine Association, held in Beijing. The convention was attended by 1 000 people from local cuisine associations, catering companies and research institutes. Addressing visitors, the governor of Dingbian County, in Shaanxi Province – China's main potato growing region – said the food industry should increase investments in the potato.

Slovenia

Monument to the *krompir*

In Slovenia, an association dedicated to pan-frying potatoes with onions unveiled a monument to the potato in the mountain town of Šencur on 25 May. The monument depicts Maria Theresa, the archduchess of Austria (who decreed in the mid-18th century that Slovenian farmers should start growing potatoes) with a tuber in her hand.

B. ZRIMŠEK

Switzerland

Europatat: 60th general assembly

Europatat, an umbrella organization of wholesale potato merchants in 16 European countries, held its 60th general assembly in Bern, Switzerland from 29-31 May. The meeting, which focused on "the potato in the future", featured presentations on the influence of climate change on potato farming, the potential of genetic modification, and the viewpoints of producers and consumers on genetically modified potatoes.

Peru

National Potato Day

Peru celebrated its National Potato Day on 30 May with ceremonies and festivities. In Cusco, local authorities held a native potato gastronomy festival, while in Lima potato growers from 14 regions of Peru gathered for a potato fair in the Park of Legends.

JUNE

South Africa

Potato exhibition in Pretoria

The University of Pretoria in South Africa hosted a potato photographic exhibition provided by the Embassy of Peru for the whole month of June as part of the country's IYP celebrations. The potato producers and processors' association, Potatoes South Africa, announced that, in support of the Millennium Development Goal of eradicating poverty, five cents would be donated to charity for every bag of potatoes sold up to December 2008.

Netherlands

All about seed systems

The Wageningen University and Research Centre in the Netherlands held a three-week course on seed potato technology, certification and supply systems. The course covered the use of modern technology in both formal and informal seed supply systems in different agro-ecological regions of the world. Relevant examples from the Dutch seed potato industry were demonstrated and discussed.

FAO

Kenya

President Kibaki visits IYP exhibit

The President of Kenya, Mwai Kibaki (*left*) and FAO's Director General, Jacques Diouf (*right*), toured the IYP exhibit at the FAO Regional Conference for Africa, held in Nairobi. They were briefed by Juan Landeo (*centre*), Senior Potato Breeder at CIP's Office for Sub-Saharan Africa.

Republic of Korea

"Month of the potato" festival

With an average summer temperature of around 23°C, the mountainous county of Goesan, in the Republic of Korea, is well suited to potato production. In June, the county's potato farmers invited city dwellers to participate in cooking contests at the annual "Month of the potato" festival. As well as growing excellent potatoes, Goesan is known for its chili peppers and ginseng.

Poland

Potato processing and storage

Top-level experts from the potato science and business communities made presentations at the International Potato Processing and Storage Convention held in Warsaw in June. Topics ranged from pest and disease control strategies to trends in food safety legislation, business opportunities in emerging markets, and GMO risks in the supply chain.

Austria

Potato a "collective heritage"

A report to the FAO Regional Conference for Europe, held in Innsbruck, Austria, said Finland's *lapin puikula* potato was one of many traditional agricultural and food products in Europe that are "a collective heritage resulting from a complex, historical interaction between humans and their environment". The Conference was attended by delegates from 42 countries and the European Union.

Peru

Biodiversity awards for Peruvian farmers

The future of world potato production depends on efforts to conserve and use the rich potato genepool in the crop's centre of origin, Peru. To honour those who have contributed to conserving Andean native potato varieties, the Peruvian government and the national IYP committee awarded prizes to 35 farmers, farming families and communities in Lima on 25 June, which is also Peru's National Farmers' Day.

Ecuador

Potato congress in Quito

With the support of FAO, the Central University of Ecuador hosted in Quito the country's Third Potato Congress, which focused on environmental impacts of potato production, new opportunities for processed potato products and a land suitability assessment. The congress was attended by 380 delegates from 50 institutions.

JULY

Romania

European Association for Potato Research

Potato experts gathered in Brasov, Romania, in July for the four-day congress of the European Association for Potato Research (EAPR). Lectures, workshops and poster presentations covered advances in genomics and breeding, micropropagation innovations, new insights into crop management, potato product development, climate change, and the changing role of the potato in Central Europe.

United States of America

Maine Potato Blossom Festival

Every year in July, for the past 60 years, the citizens of Maine – where potato is the No. 1 crop – have celebrated the blossoming of the state's potato plants. The year 2008 was no exception: hosted in the town of Fort Fairfield, the festival featured nine days of sports tournaments, music concerts, mashed potato wrestling, an antique tractor show, and a pageant to select the Potato Blossom Queen.

WWW.FORTCC.ORG

Italy

Italy's national potato meeting

One of the key events of the International Year of the Potato in Italy was the biennial national potato meeting held in Budrio, near Bologna. The event included a conference on industrial use of potatoes, a technology expo, an exhibition of vintage potato farming equipment, a tractor race and harvesting contest, and a meeting of officials from the country's *patata*-producing areas.

Honduras

Potato brunch in Tegucigalpa

FAO, the Peruvian embassy and a department store chain inaugurated IYP in Honduras with two days of festivities, including a potato brunch, in Tegucigalpa. For the occasion, FAO published a book of 100 potato recipes. The inauguration was followed by a seminar on potato production and marketing in the city of Esperanza, one of the country's main potato growing areas.

AUGUST

Canada, United States of America

Potato harvest festivals

August is potato harvest time in much of southern Canada and northern United States. To celebrate the end of the season, many towns threw a party in honour of *Solanum tuberosum*. Among them: the 36th annual potato festival in Alliston (Ontario), Potato Days in Clark (South Dakota) and Barnesville (Minnesota), and the traditional potato celebration in Manhattan (Montana).

United Kingdom

IYP conference in Scotland

Scotland's contribution to the Year of the Potato was a major conference on improving potato production, held in Dundee on 8 August. Organized by the Scottish Crop Research Institute, the conference was attended by a high level delegation from China. The conference followed the United Kingdom's largest annual potato field event, "Potatoes in practice", held in Dundee on 7 August.

Indonesia

National potato week in Lembang

Indonesia is one of Asia's middle-ranking potato producers, with a 2007 harvest of just over 1 million tonnes. To celebrate IYP, the Indonesian Vegetable Research Institute organized a National Potato Week held in Lembang, western Java, an area famous for its fruits and vegetables. IVEGRI is a partner of the International Potato Center in programmes for the improvement of potato and sweet potato varieties.

SEPTEMBER

MSIRI

Mauritius

IYP event promotes potato production

On the Indian Ocean island of Mauritius, the Ministry of Agro-Industry and Fisheries and the country's Sugar Industry Research Institute hosted a potato conference and exhibition on 21-22 August. At the conference, the Ministry launched an interactive CD-ROM on potato for farmers and extensionists, with a map of land suitable for growing potatoes and a book of potato recipes.

Canada

Growers raise funds for women's shelter

The farmers' association Potato Growers of Alberta (PGA) took potatoes to the annual Cornfest in Taber, southern Alberta, Canada, in late August. Over the space of two days, the PGA's potato stand sold $3 000 worth of baked potatoes, mashed potatoes, French fries and potato chips to raise funds for a local women's crisis shelter. The shelter provides free food and lodging to women and children who are attempting to escape from a life of abuse and poverty.

China

Festival at heart of China's potato industry

The county of Xiji, in the mountainous Ningxia Hui Autonomous Region of northwest China, hosted in September the country's biggest annual potato fair. Xiji and surrounding rural counties are the centre of China's rapidly expanding potato industry, with a total production of more than 2.5 million tonnes a year. The county's 2 000 potato processing companies ship potato products throughout China and to markets in Japan, South America and Europe.

Peru

Peru celebrates "bread of the Andes"

La papa, pan del mundo Andino – or, "Potato: Bread of the Andean world" – was the title of an exhibition at Lima's Museo Nacional de Arqueología, Antropología e Historia that ran until 31 December. On display were exhibits on the potato's pre- and post-Columbian history, its biodiversity, nutritional value and role in Andean culture, and a series of paintings of Andean farmers by Japanese artist Tadayuki Noguchi (*below*).

Belarus

Art-bulba exhibition in Minsk

Belarus' State University of Culture organized an art exhibition in the capital, Minsk, dedicated to the *bulba*. "It must be true art when people grow plants purely for pleasure," said the university's gallery director. "Just as the Japanese enjoy watching cherry trees blossom, Belarusians love to plant potatoes in May and dig them up in September". Belarusians eat more potatoes per head than any other country – an estimated 180 kg a year.

United States of America

57th Posen Potato Festival

Polish immigrants who settled in the town of Posen, Michigan, in the United States, brought with them their national passion for potatoes, which grow well in the area's deep, sandy soils. For more than 50 years, the end of the harvest season has been celebrated at the Posen potato festival, which features free concerts, children's entertainment, a potato cooking contest and selection of the Miss Posen beauty queen.

SEPTEMBER

Slovenia

World Festival of Sautéed Potatoes

Gourmets from Europe and the United States attended the 8th World Festival of Sautéed Potatoes in Crna na Koroškem, in northern Slovenia. The annual event brings together cooking teams who pan-fry tons of potatoes with a variety of ingredients, including goose liver, ostrich, sour cream and walnuts. The festival is hosted by a Slovenian association dedicated to enjoyment of the country's national dish, *pražen krompir*.

B. ZRIMŠEK

France

PotatoEurope 2008

Billed as Europe's "most significant potato industry convention", PotatoEurope 2008 was held in Villers-Saint-Christophe, northern France, on 10 and 11 September. More than 3 000 visitors came to the event, which featured workshops on potato genetic resources, agronomy, soil conservation, crop optimization and sustainability, and demonstrations of innovative harvesting and post-harvest technologies.

POMMES DE TERRE 5e Journées Internationales

10 et 11 septembre 2008
Villers-Saint-Christophe
Aisne, France

Italy

Sagra della patata in Tuscany

In Italy's rural areas, September is the time for festivals (or *sagre*) that celebrate the fruits of the agricultural year. In potato-growing areas, visitors and locals get together in village piazzas for concerts, antique markets and sporting events, all accompanied by tasty potato dishes, such as *gnocchi*. One of the oldest running potato harvest festivals has been held since 1968 in the town of Oreno, in Tuscany.

Germany

Potato dumplings celebrated in Thuringia

The German state of Thuringia is famous for its potato dumplings and the potato dumpling museum which opened in 1999 in the town of Heichelheim. In September, the Heichelheimer Potato Foundation hosted the state's annual potato festival, where celebrities harvested tubers, and visitors enjoyed a range of attractions, including a photography exhibition, a competition for the longest potato peel, and lots of potato dumplings.

United States of America

VALLEYFEST

A potato-shaped hot air balloon

The annual Spokane ValleyFest in Washington, the United States, honoured the potato with a variety of activities, including the launching of a potato-shaped hot-air balloon and a community "hunger run" to raise money for the Spokane Valley Food Bank. This year, the Washington Potato Commission donated half a tonne of potatoes for sale at the festival. In 2007, Washington's potato harvest was 4.6 million tonnes.

OCTOBER

Finland

"Potatoes today and in the future"

Peru's embassy in Helsinki celebrated IYP by hosting a potato photography exhibition, a sampling of potato dishes and a lecture on "Potatoes today and in the future", which was delivered by Jari Valkonen, an award winning plant virologist at Helsinki University. The event was co-sponsored by Finland's Ministry of Agriculture and FAO. In 2007, Finland produced 680 000 tonnes of potatoes.

Spain

Potato science links Europe, Latin America

The 3rd Spanish-American Congress on Potato Research and Development was held in Vitoria-Gasteiz, Spain, in October. The congress, which aimed at forging closer ties between the potato sectors in Latin America and Europe, addressed recent developments in genetic improvement, genetic engineering, micropropagation of seed potatoes, industrial processing and quality marketing. The congress was held as part of "Potato week".

United States of America

Living with potatoes

To raise awareness of the importance of the potato for world food security, the College of Agricultural Science and Technology at California State University, Fresno, hosted an international symposium on "Living with potatoes" on 7 October. The event provided a global forum for potato growers, researchers, processors and equipment suppliers who are interested in promoting sustainable potato production.

Ukraine

The latest on potato pests and diseases

The European and Mediterranean Plant Protection Organization (EPPO) and Ukraine's plant quarantine service organized a European phytosanitary conference on potato and other arable crops in Chernovtsy in October. The meeting reviewed the latest EPPO standards for potato, and discussed major pest and disease threats, including wart disease and cyst nematodes. It also examined emerging pests of the Solanaceae family of plants.

Australia

Irish potato famine remembered

During the Irish "potato famine" of 1845-1850, more than 4 000 female orphans were shipped to British colonies in Australia to work as servants. To commemorate the 160th anniversary of their arrival, an Irish-Australian historical society hosted a week-long event in Galong, near Canberra, entitled "Far from famine". The programme included workshops, Irish music and dancing, a tree planting ceremony and a commemoration service.

culture ireland
cultúr éireann

Rwanda

Potato celebrated on World Food Day

Rwanda's national IYP committee celebrated the International Year in conjunction with World Food Day in the potato-growing district of Nyabihu on 16 October. Rwandans had much to celebrate: the country is among sub-Saharan Africa's biggest potato producers (1.2 million tonnes in 2007), and potato consumption stands at a high 125 kg per capita per year.

FAO

United Kingdom

Sausage and mash

People in Lincolnshire, in the east of England, are so proud of their distinctive "Lincolnshire sausage" that they are seeking to register the name to protect it from imitations. And since the sausages are usually served with mashed potatoes – and Lincolnshire is one of the United Kingdom's biggest potato producers – the organizers decided to celebrate both foods together, at the Lincolnshire Sausage and Mash Festival on 25 October.

IBAN

OCTOBER

Turkey

Harvest day in Anatolia

With its hot, dry summers and cold winters, Anatolia's central plateau is Turkey's most important potato producing region. It is also the site of the country's National Potato Research Institute, at Niğde, which is responsible for potato breeding, producing virus-free seed potatoes, conducting research projects and training potato farmers. In October, while the region's potatoes were being harvested, the institute held a field day in honour of the International Year.

NINA ARETZ

Democratic Republic of Congo

Big day in Mbanza-Ngungu

IYP in the Democratic Republic of Congo culminated on 29 October with a potato festival organized by the Ministry of Agriculture and FAO in Mbanza-Ngungu, in the province of Bas-Congo, from where potato farmers supply markets in Kinshasa. During 2008, the national IYP committee publicized the International Year with TV spots and radio programmes, and made a video on potato cultivation.

NOVEMBER

E.T.

Peru

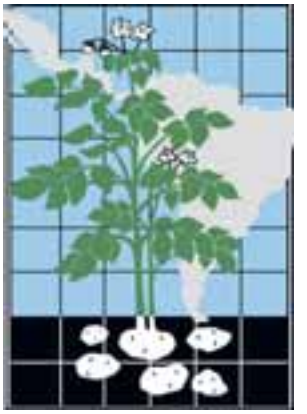
Potato food festival by Lake Titicaca

The city of Puno sits by the side of Lake Titicaca in Peru, at the centre of origin of the cultivated potato. To celebrate the International Year, Puno's Regional Agricultural Department sponsored in November a food festival at which special guests of honour were the potato and *tunta*, a dehydrated potato product. Activities included a contest among the city's restaurants for the best potato dish.

Argentina

Latin American potato congress

The Latin American Potato Association, which links producers, researchers, extensionists and processors, held its 23rd annual congress in Mar del Plata City from 30 November to 5 December. Sponsored by Argentina's National Agricultural Technology Institute, the congress aimed at disseminating research results and technological innovations and fostering ties between private and public sectors in the region.



2009

DECEMBER

G. THOMAS

Italy

Potato on display at FAO, Rome

As lead agency for observation of IYP, the Food and Agriculture Organization ended the International Year with a potato exhibition in its glass-domed atrium. The exhibition consisted of three separate displays: one, in Italian "The magic voyage of the potato", provided by Italy's Fruili Venezia Giulia region, CIP's travelling exhibition "Odyssey of the potato", the winning entries in the IYP World Photography Contest, and paintings of Andean farmers by Tadayuki Noguchi.

Belgium

Prizes for potato quality

Winners of the Belgian Potato Quality Award received their prizes at Belgium's Interpom trade fair in Kortrijk in December. The awards are given each year to potato farmers and processors who have improved the public image of agriculture in general and of potatoes in particular. Interpom also featured exhibits covering the entire production chain, from crop protection to processing.

India

Global conference marks end of IYP 2008

The task facing potato scientists is to enhance productivity, quality and added value at a time of diminishing availability of land and water, new biotic and abiotic stresses, and fast changing consumer preferences. Those challenges were to be addressed at a Global Potato Conference organized in New Delhi by the Indian Potato Association, India's Central Potato Research Institute and the Indian Council of Agricultural Research.

New Zealand

The story continues...

The biennial World Potato Congress will be held in Christchurch, New Zealand, in March 2009. With the theme "Nourishing our future", the four-day congress will review the latest developments in crop management, environment and energy issues, food and non-food processing, and food safety and quality. More than 500 delegates, representing the potato industry in both developed and developing countries, are expected to attend.

Focus on a global food

A major event of the International Year was its World Photography Contest, Focus on a global food, sponsored by FAO and Nikon Europe. Entries were received from 90 countries around the world

1st prize, Professional category:
Eitan Abramovich, Peru

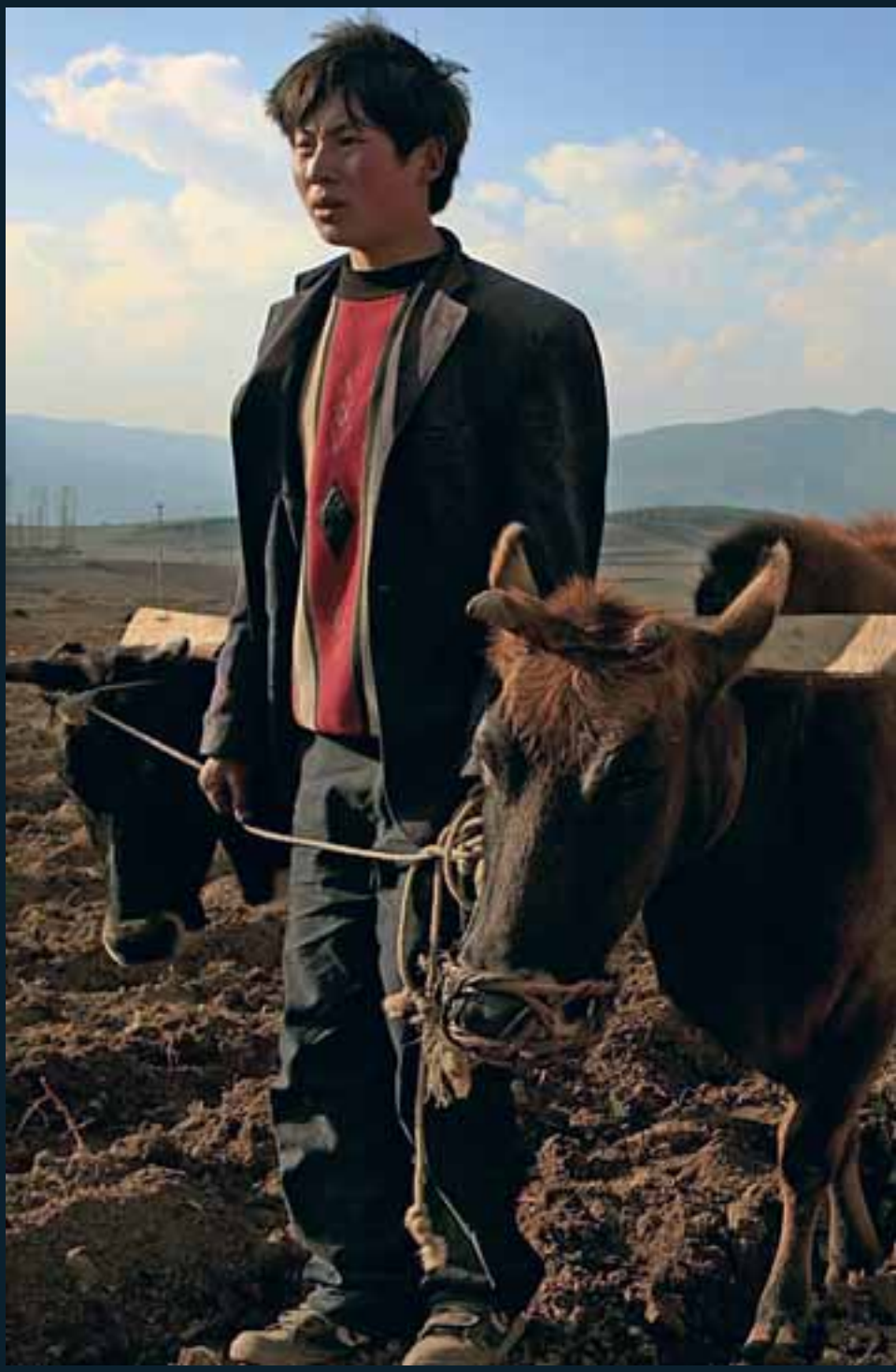
from the photo essay, “Harvest of native potatoes”

2nd prize, Professional category:
Pablo Balbontin, Spain

from the photo essay, “The custodians of biodiversity”

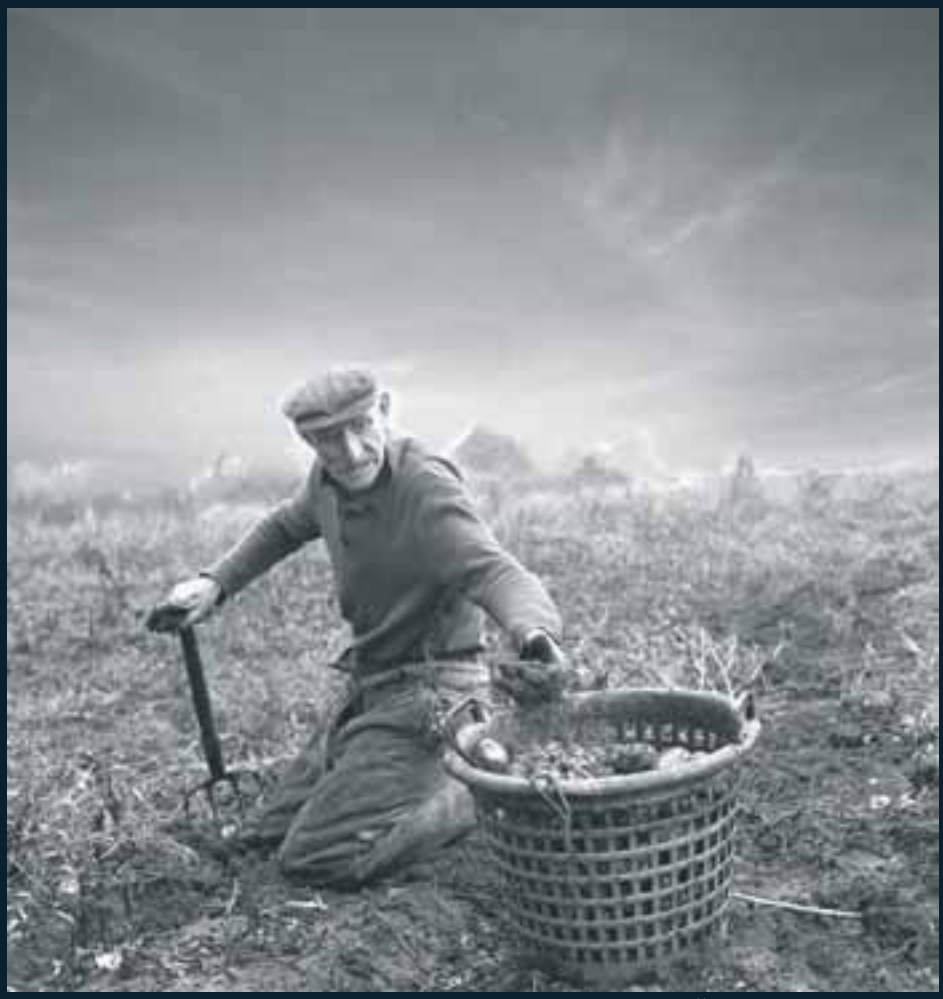
3rd prize, Professional category:
Viktor Drachev, Belarus

from the photo essay, “Belarus soldiers eat potatoes”



1st prize, Amateur category:
Xi Huang, China

from an untitled photo essay



"Digging up potatoes"

2nd prize, Amateur category:

Dick Gerstmeijer, the Netherlands

"Bamboo boat"

3rd prize, Amateur category:

Marlene Singh, the Philippines

World Photography Contest

Selection panel

NeBambi Lutaladio IYP Executive Secretary (Chairman)
Manuel Antonio Alvarez Espinal Permanent Representative of Peru to FAO
Lucy Conticello Photo editor
Adrian Evans Director, Panos Pictures
Steve McCurry Photographer (Magnum Photos)
Andrea Sonnino Senior Agricultural Research Officer, FAO
Maria Wood Picture Editor, "Time", Asia edition
Francesco Zizola Photographer (Noorimages)

Perspectives

For many of those who work daily with the potato, it has become a passionate way of life. During the International Year, we gathered viewpoints from "potato people" around the globe...

Collecting the harvest in Munshiganj, Bangladesh

Research

Potato science for the poor

Pamela Anderson *is Director General of the International Potato Center (CIP) in Peru. In March, CIP co-sponsored one of the flagship events of the International Year – a working conference in Cusco to develop a new research agenda for potato in the developing world.*

You say the potato can make a great contribution to achieving the UN's Millennium Development Goals. Why?

"First, because of the potato's importance for food security. Potatoes are the third most important food security crop in the world. In the developing world, there's been strong growth in potato production across all regions since 1990, especially in the low-income food-deficit countries. In Africa, the area under potatoes grew by 120% between 1994 and 2004, and we've seen growth of almost 50 percent in China in the past 10 years. Since 2005, more potatoes are being harvested in the developing world than in the industrialized world, and the area planted is showing the same trend."

How can potato science take best advantage of those trends?

"Potato science can be a significant vehicle for targeting the poor and hungry. At CIP, we have adopted a pro-poor research and development cycle, which starts by identifying areas where rates of poverty, hunger and maternal and child mortality are high. Then we overlay that data with our maps of potato production zones to see where our research can have the greatest impact. We also try to understand the larger sustainable livelihoods framework: what assets vulnerable communities have, what shocks they are vulnerable to, the institutional arrangements that determine their constraints and opportunities."

What are the priority geographic areas for potato research today?

"We need to address three developing worlds: agriculture-based countries, transforming countries and urbanized countries. The agriculture-based countries are primarily in Africa and the challenge there is to boost productivity. World average potato production is around 15 tonnes per hectare,

KHALED SATTAR

compared to 35 to 40 tonnes in Europe and North America. To increase productivity, research needs to provide breakthroughs in overcoming intractable problems, such as lack of clean seed potato, diseases such as late blight and viruses, and storage problems. The transforming countries are primarily in Asia, where increases in agricultural productivity have driven poverty reduction in countries like India and China. But even in China, we have a poverty belt of 23 million people, most of them in potato-producing counties, which is why China has named potatoes specifically as one of their vehicles out of poverty. India has also declared its intention to double potato output in the next 5 to 10 years, focusing on the poverty belt in the country's northeast."

What about the third "developing world", the urbanized countries...

"A good example is our host country, Peru. Here we have 50 poverty pockets where more than 90% of the population lives in extreme poverty, and 35 of those areas are potato producers. Potato output here has almost doubled in the last 30 years, so the challenge is to find ways to convert increased productivity into income. With the Swiss Agency for Development and Cooperation, CIP has started an initiative called Papa Andina which uses innovative ways to connect small scale potato growers to urban markets, both domestic and international. That involves developing new products based on native potatoes, market information systems, integrated pest management and improved post-harvest management. Papa Andina has been highly successful; one of its products is the *T'ikapapa* brand of native potatoes, which links the poor producers in the highlands to the urban market in Lima. In 2007, the *T'ikapapa* concept won the BBC-Newsweek-Shell World Challenge Award and a 2007 United Nations SEED [Supporting Entrepreneurs for Environment and Development] award. We are now looking at how to scale-out the approach to Africa and Asia."

More than 100 of the world's leading potato scientists attended the Cusco conference. What did it achieve and what happens next?

"Our aim was to share their insights and the results of the latest research in the development of new strategies and approaches that are needed in each of those developing worlds. We have published a website on the conference, and will continue to share the outcomes with the international potato science community during the other international conferences being held throughout the International Year of the Potato. We're calling this the 'Cusco Challenge' – the challenge to formulate a research agenda that puts potato science at the service of the poor in order to make a more significant impact on poverty and hunger."

Taxonomy

Roadmaps to the origins of the potato

David Spooner *is a taxonomist at the United States Department of Agriculture (USDA) who collects wild and cultivated potatoes and studies their species boundaries and relationships. His recent discoveries have helped re-write much of what we thought we knew about the origin and evolution of the cultivated potato.*

In 2005, you co-authored a paper that overturned previous ideas about the evolutionary history of the potato. What were your findings?

"What we demonstrated was that the cultivated potato has a single place of origin, in Peru. Up until then, all publications had hypothesized that the early Andean and Chilean cultivated forms of potato had evolved from different progenitors. For the potato, the domestication hypotheses had suggested complex hybrid or multiple independent origins from what is known as the *Solanum brevicaule* complex, a group of 20 morphologically very similar, tuber-bearing wild taxa, broadly distributed from central Peru to northern Argentina. Now, as part of a study of the taxonomy of that complex, I and a group of scientists from the Scottish Crop Research Institute were analysing accessions of potato landraces when we made a surprising discovery. At the molecular level, the accessions all group together, not in separate places on a 'phylogenetic tree' with different wild species, as would be expected with many separate origins. Based on our initial results with these cultivated species, we broadened the study to analyse DNA markers in 261 wild and 98 cultivated potato varieties, and our data indicated that those early cultivars originated from a single ancestral line in the 'northern' component of the *S. brevicaule* complex in central or southern Peru."

And how important is that finding?

"For Peru, of course, it was great news, and a source of national pride. But that aside, the purpose of taxonomy is to help determine what is a species and to classify species into related groups, providing other scientists with a roadmap to guide them down proper research paths. If the taxonomy is bad, research goes awry. In fact, another of our

findings was that what were considered member 'species' of the *S. brevicaule* northern group were poorly defined, and that further studies might reduce them to a single species."

Another of your recent papers has broken new ground by reclassifying the cultivated potato into four species.

"That was from a study done with the International Potato Center [CIP] in Peru. We carried out one of the largest molecular marker studies ever done on crop landraces, covering 742 landraces of all cultivated potato species and eight closely related wild species progenitors. Until that paper, there were many different ideas about the number of cultivated potato species – the widely used classification of [British plant geneticist] J.G Hawkes identified seven species and seven subspecies, while Russian taxonomists recognized as many as 21 species. But, in combination with the findings of earlier morphological analyses done with CIP, our analysis found just four: *Solanum tuberosum*, divided into Andean and Chilean cultivar groups, and three hybrid cultivated species of 'bitter potato'. We also found that consistent and stable identification of the other purported 'species' was impossible, and only created confusion."

Now, to your third recent discovery, published in 2008, about the introduction of Chilean germplasm in the modern potato. What was at issue there?

"All modern potato cultivars have predominantly Chilean germplasm. To explain that, Russian investigators proposed that the potatoes introduced into Europe were Chilean landraces, while British investigators thought they came from the Andes but were killed off in the late blight epidemics of the 1840s, and replaced by introductions from Chile. My student Mercedes Ames and I addressed this question by examining 49 European herbarium specimens collected between 1700 and 1910, for a DNA marker that distinguishes Andean from Chilean landraces. The results showed that, yes, the Andean potato predominated in Europe in the 1700s and persisted until 1892 – long after the late blight epidemics – while the Chilean potato first appeared in Europe in 1811 and became predominant long before the late blight epidemics."

This may be an unusual question. Having collected potato throughout the Americas every year since 1989, have you formed a "spiritual connection" with the plant?

"I'm not driven primarily by potatoes. I am directed by USDA to work on the potato, but my real motivation is the intellectual exercise of finding answers to the complex taxonomic and biological questions posed by the potato. What makes this job so fascinating for me is the great infrastructure that is available for potato research and which makes those answers possible."

History

How the potato changed the world

In a long career, **John Reader** *has photographed Rolling Stones' recording sessions in London and australopithecine footprints in Tanzania, and written acclaimed works such as* Man on earth *and* Africa – biography of the continent. *His new book is* Propitious esculent: the potato in world history.

How did people react when they heard your next book was about potato?

"The potato is the best bundle of nutrition known, but it's not easy to persuade people to take it seriously. As a topic of conversation, it inevitably evokes some degree of mirth – or a condescending smirk from those who consider the topic not just amusing, but foolish too. People simply do not believe such a commonplace commodity deserves serious attention."

When did you first take an interest in *Solanum tuberosum*?

"To be fair, I didn't take the potato seriously either until I lived in the far west of Ireland for 18 months in the 1960s. There, the potato was ubiquitous – in books I read (especially Cecil Woodham-Smith's *The great hunger*), in gardens and heaped on the plates at meal times. But even then I looked upon it mostly as an item that soaked up the gravy and filled the bellies of people who couldn't always afford anything better. It was only 20 years later that I began to appreciate the potato's true worth. Awareness of environmental issues was widespread by then. Science had long since demonstrated that people, society and culture are integral elements of the planet's ecological webs, and now some fascinating examples of human ecology were trickling through to a lay audience. I, for one, was impressed by the ecological explanations of Marvin Harris [in *Cows, pigs, wars and witches*, 1974] for such – apparently – irrational cultural practices as India's sacred cow and the Jews' avoidance of pork. My interest developed into a book [*Man on earth*, 1988], for which the academic literature provided many examples from around the world of how an environment and the staple foods it provides can influence human affairs."

In *Man on earth* you devoted a chapter to "the potato growers"...

"In particular, the work of Stephen Brush [Professor, Faculty of Agricultural and Environmental Science, University of California, Davis] on the economy and human ecology of an Andean valley introduced me to a fuller appreciation of the potato's merits. He and other scientists showed how astutely Andean farmers had adapted the inherent variability of the potato to their own ends, developing patterns of land-use and cultivation that not only created a sustainable way of life for themselves but also ensured the continued survival of the potato's extensive gene pool. Popular interest in the preservation of genetic diversity was growing at the time, so the potato fitted well into the theme of *Man on earth*. But I was struck too by the economic role the potato has played as people have moved from closed self-sustaining farming communities to societies for whom trade and economic activity have been the principal means of sustenance. That was worth a book in itself."

So, briefly, what has been the impact of the potato on world history?

"The potato played a crucial role in the development of a succession of imperial states in its cradle land – the Andes – but its influence has been most dramatically illustrated in Europe, following its introduction by the Spanish in the late 16th century. Nothing like this had happened before – anywhere. After depending upon grain for thousands of years, Europe now had a supplementary crop that not only flourished in a wider range of soil and climatic conditions but also produced four times more carbohydrate per unit of land and labour. Wherever the potato was adopted, populations grew rapidly, which in turn supplied a large and cheaply nourished labour force just at the time when trade and industry were replacing agriculture as the dominant feature of European economies. Thus the potato fuelled the Industrial Revolution, and from Europe has spread around the world – staving off hunger, improving nutrition and fuelling the development of economies."

And how do you see the role of the potato in the world today?

"Today, the potato is grown in more countries than any crop except maize, and is increasingly consumed in a processed form as more and more people take to living in cities. Already, more than half the global population are city-dwellers – their higher incomes and improved standards of living have generated a taste for something more than the simple boiled potato. Of course, industrial processing favours large-scale production, but that in no way detracts from the advantages the potato offers small farmers in the developing world. They will always take the potato seriously."

Biodiversity

A view from the Andes

Lino Mamani *is a* papa arariwa *("potato guardian", in Quechua) in the Sacaca farming community near Pisac, in the Peruvian Andes. The community where Mamani lives, together with five neighbouring communities, have established a 12 000 ha "potato park" where they cultivate and conserve Andean potato varieties.*

How did the potato park come into existence?

"Our communities signed an agreement in December 2004 with the International Potato Center [CIP], to establish the park and to work together to preserve our potato biodiversity. This area has about 600 native varieties that we have always grown here. CIP has also repatriated to us hundreds of varieties from its collection, and with the help of our *Pacha Mama* [Mother Earth] we are adapting them to live here."

How many varieties are you now cultivating?

"We have about 1 000 varieties of native potatoes here. We have planted the repatriated varieties in different parts of the mountains, where they are learning how to adapt themselves, how to live in the places where we have put them. We know that some like it a little bit colder and some a little bit warmer. *Pacha Mama* knows how to nurture them. With a larger number of varieties we make *Pacha Mama* happy, so she will allow us to have bigger harvests and provide food for our families."

Do you grow any modern varieties?

"We don't like modern potatoes – we have had bad experiences in the past because they need chemicals and pesticides, which poison the earth, and they don't grow well on our land. Our native varieties live well with their wild relatives, which you will find all around here. They have a good relationship, like a family. But our potatoes don't live well with modern varieties. The potatoes you see here belong to us. They came to us from our ancestors and will go on with our children."

How do the communities work together?

"If we succeed in adapting a variety to our area, we share it with the other communities.

All of the communities in the park work together like one person. But we are concerned about our legal status. We want the national government to recognize the potato park and the work that we do, so that the park will continue to be managed by and for the communities. We have asked the Regional Government of Cusco to create a biodiversity fund that will protect the traditional life of the communities and provide legal status for the potato park."

Have you seen the effects of climate change in this valley?

"In the old days, the rain came at the right time, the land was very fertile, and the sun used to shine in the right amount. Now we see that the sun is hotter, the rains do not come at the right time, we have hailstorms and freezing temperatures, and droughts like we have never seen before. There is also an increase in insect pests and diseases. The potato varieties that our grandfathers grew down by the river are now moving higher up the mountain slopes. In this land, we have our *apu* [sacred mountains] around us, which help our potatoes and the other crops and animals to grow. Once there was snow on those mountains, now they look sad, because the climate is getting warmer and there is no more snow. Other species and animals are suffering – the condor, foxes, deer, ducks and fish that have always lived with us and are very dear to us. We know that *Pacha Mama* is not happy with all these changes and we have to work together to make her happy again."

Climate change

Who gains, who loses

Marco Bindi, *of the Department of Agronomy and Land Management at the University of Florence, Italy, has participated in EU-funded projects on the impact of climate change on natural and agricultural ecosystems, and is a lead author of the Fourth Assessment Report,* Climate Change 2007*, of the Intergovernmental Panel on Climate Change (IPCC).*

How does the build-up of atmospheric greenhouse gases affect potato production?

"In C3 plants, such as potato, an increase in atmospheric concentrations of carbon dioxide leads to a higher rate of photosynthesis. Currently, the level of CO_2 is about 385 parts per million [ppm], and the latest IPCC emission scenarios project levels by the year 2100 ranging from 540 to 970 ppm. Experiments on potatoes have shown that increasing CO_2 concentrations has little effect on the production of biomass above ground, but the below-ground biomass is significantly enhanced through higher numbers of tubers and bigger tuber size. The yield increases by about 10 percent for every extra 100 ppm. As for the effects of increasing levels of ozone, experiments indicate an overall reduction of photosynthetic efficiency and a significant decrease in tuber starch content, but an increase in the ascorbic acid concentration."

What effect will global warming have on the potato?

"This century could see a rise in average global surface temperature of from 1.8° to 4°C. Since potato's tuberization rate declines above a temperature of 17°C, increasing temperatures may lead to reduced yields in potato varieties now cultivated close to the upper climatic limits of the crop that would not be recovered by higher levels of carbon dioxide. On the other hand, a simulation study has shown that in northern European countries, a warmer climate would bring a longer growing season and big increases in yields. Areas that are now too cold for potato – for example, parts of Canada, Siberia and Scandinavia – may become viable, as would highland areas such as the altopiano in Peru and Bolivia. But the global picture is

worrying: worldwide research shows that, without adaptation, higher temperatures reduce yield by 10 to 19 percent in 2010-2039 and 18 to 32 percent in 2040-2069. The most vulnerable area is the tropical belt, where the loss could be more than 50 percent."

Potato is highly sensitive to water stresses. How will climate change affect water availability?

"The change in temperature will be uniform, but not that of rainfall. There will be an increase in rainfall in mid- to high latitudes – areas with no water shortages – and problems instead for the Mediterranean and subtropical zones, where we will see rainfall on fewer days but with greater intensity. A crop growth simulation experiment on an EU scale reported that, under the present climate change scenario, yields under rain-fed conditions were strongly affected by water shortages, with reductions of up to 50 percent. In arid regions, where drought is expected to become more frequent and more intense, there will clearly be a drop in productivity."

Could climate change also lead to an increase in potato pests and diseases?

"Given the thermal limit for late blight – 22°C – increases above that temperature threshold in Europe may prevent infections. At the present northern limit of potato cultivation in the USA, Canada and central Russia, late blight could increase significantly as the temperature increases, but at the same time, warming further north may open up new zones for potato production, with minimal late blight risk. An increase in the quantity and frequency of rainfall would also create conditions more favourable to viral disease vectors. Other researchers have predicted an increase in the Colorado potato beetle's area of diffusion in Europe, as well as in the area infested by potato cyst nematode."

How can potato cultivation adapt to climate change?

"Anticipating the planting date, using different potato varieties and improving soil water supply, especially in dry regions, might be useful. According to one study, those strategies could cut by half the expected decrease in global yields. In southern Europe, earlier planting increases potato yields and reduces water requirements in both present and future climate scenarios. But in practice, adaptation options may be not so simple. The planting season also depends on factors such as the preceding crop, water availability, pests and diseases, and markets. Cultivars better adapted to a changed climate exist, but may not be available to farmers in some regions. Another strategy is shifting potato production towards areas of higher productivity or areas where there is currently no potato production. In some tropical highland regions, cultivation could expand into higher altitudes. At high latitudes, there could be considerable potential for expansion of the potato area."

Genetics

Unravelling the potato genome

Christian Bachem, *of the Department of Plant Sciences, Wageningen UR, the Netherlands, is coordinator of the Potato Genome Sequencing Consortium (PGSC), an international research network that aims at revealing the potato's complete set of DNA by the end of 2010.*

Why is it so important to sequence the potato genome?

"Cultivated potato is what we call a highly heterozygous, self-incompatible outbreeder – in practice this makes it impossible to produce true breeding lines and so genetic improvement is a complex and lengthy process. We estimate that well over 40 000 genes are encoded by the genome. The problem is these genes are not conveniently located in clusters. By unravelling the complete DNA sequence, we aim at localizing and identifying the genes coding for important traits such as disease resistance, but also for nutritional attributes, such as starch quality, protein and vitamin content. Genomic sequencing will deliver molecular markers that breeders can use to increase the efficiency and rapidity of their breeding programmes. In the longer term, the full genome sequence will form the basis for understanding the biological processes underlying complex traits such as yield and quality."

What do we already know about the potato genome?

"The potato has 12 chromosomes, each one about 70 million base pairs long, which makes it about a quarter the size of the human genome. We estimate the size of the complete sequence at 840 Mbp [Mega base-pairs], which means 840 million nucleotides that line up in a particular order to form the potato's chromosomes."

How is the Potato Genome Sequencing Consortium organized?

"The consortium consists of nationally supported scientific research institutes in Argentina, Brazil, China, Chile, India, Ireland, Netherlands, New Zealand, Poland, Peru, Russia, the UK and the United States. Each national partner will sequence at least a third of a chromosome, and each chromosome has been assigned to one or more countries."

What is your approach to sequencing the potato genome?

"Mapping the DNA code of over 800 million base pairs is a huge technical and bio-informatic challenge. At Wageningen's Laboratory of Plant Breeding we are using a novel approach for mapping and aligning a library of large chunks of potato genomic DNA called "bacterial artificial chromosomes", or BACs, which are small, manageable parts of the entire genome, averaging 120 000 nucleotides. The technique involves first creating an ultra-high density genetic map of the potato genome using molecular DNA markers. The DNA markers with a known genetic location can then be used to identify groups of overlapping BACs to form a physical map."

What is the current status of the PGSC project?

"We are currently assembling the Potato BAC library into a physically and genetically anchored map, which will allow the sequencing of relevant chromosome sections by consortium partners. Most of the partners have been able to raise funding for sequencing the chromosomes assigned to them and, in most cases, have established sequencing facilities. One important initiative the PGSC is pursuing is a collaborative training scheme with countries that have identified specific gaps in their know-how. Through this collaboration, junior scientists will visit our facilities for training, for example, in bioinformatics. These arrangements have been made with China and Brazil and discussions are underway with other consortium members."

How much will the entire project cost?

"Sequencing of the human genome was achieved in 2003 at a total cost of about $800 million. Since then, the cost of sequencing has been very much reduced. The total cost of sequencing the potato genome would be, we estimate, around €25 million. An equal amount is probably needed for closing gaps and for the bioinformatics needed for assembly and annotation. A worldwide effort of around €50 million is therefore likely to be needed."

What is the PGSC policy on sharing genome data?

"We have an open information policy. All data is intended to be freely shared between the consortium partners and the scientific community at large. The data of the potato genome sequence is shared within the consortium for six months for quality control, after which it is being released as nucleotide flat files in the public domain."

Private sector

"Knowledge and expertise we can share"

McCain Foods Ltd is the world's largest producer of frozen potato products, mainly French fries destined for restaurants, fast food and retail chains around the globe. **Bertrand Delannoy**, *who joined the company in 1989 as an agronomist, is now Director of Public Affairs and Sustainability for McCain Continental Europe.*

Among private sector companies, McCain has been the strongest donor to the International Year. Why did McCain decide to back IYP?

"McCain has been in the potato business now for more than half a century, starting from a small factory in Florenceville, New Brunswick, and expanding since then, first to North America, Europe, and Australasia, and since the mid-1990s to Latin America, South Africa and Asia. Today we operate in 130 countries and have 57 production sites on five continents. But for us the potato is more than simply business. We share the UN Millennium Development Goals, and we saw IYP as an opportunity to help educate the world about the nutritional value of potatoes and about key issues in fighting hunger and poverty – sustainability, delivering nutritious and affordable food, strengthening farming capabilities in developing countries, and collaboration in development of new varieties. McCain has a global presence that can reach the world's hungry, with knowledge and expertise we can share."

McCain provided funding for the activities of IYP national committees in 14 developing countries. What do you hope your support will achieve?

"The committees aim at bringing together the entire community of stakeholders – farmers, public and private sectors, NGOs, civil society and scientific institutions – in promoting the potato, increasing potato production and adding value. They are catalysts for national potato development programmes in the future. We are proud that the support McCain provided has gone into IYP information campaigns in Turkey, South Africa and Rwanda, the preparation of a potato development strategy in Côte d'Ivoire and a study of potato trends in China, and

Peru's first national potato congress. In the Democratic Republic of Congo, the national committee is now working with an ongoing partnership McCain has built up with local institutions in Kinshasa to promote good practices in peri-urban potato farming. We hope to see the benefits of that collaboration in the years ahead."

Potato production and consumption is expanding strongly in the developing world. What is McCain's strategy for entering those emerging markets?

"McCain is expanding its business in the developing world. Our strategy is, first, to assess the local potato platform – factors such as farming practices and upstream logistics, including storage. It is also important to us to create a direct, long-term 'win-win' relationship with our growers. Sometimes we acquire existing processing plants, such as in South Africa, or we develop 'green sites', from scratch, as we did in Argentina. When we started in Argentina, farmers were still harvesting by hand. We introduced modern production techniques and since then we have seen double-digit growth, thanks largely to exports to the big Brazilian market. In India, we recently opened a new processing plant in Gujarat State that draws on a network of contract farmers whom we train in improved practices, such as drip irrigation, which cuts growing costs, and high temperature potato storage, which means big savings in power. In China, we are in a learning process, with the huge opportunity of growing, processing and distributing our products in what promises to be the world's biggest market."

Your core business is potatoes. How do you respond to criticism that potatoes, particularly as French fries, are responsible for overweight and poor nutrition?

"Potatoes are among the most efficient sources of energy and nutrients, with a higher content of Vitamins A and C and other micronutrients when compared to rice or maize tortillas. It also has some of the highest levels of potassium, which has very positive benefits for heart health. So it is an essential part of a healthy diet. But at McCain we are committed to continually improving the nutritional profile of our products to meet consumer needs and concerns. For example, we changed all of our cooking oils worldwide to virtually eliminate trans fat and reduced our overall saturated fats to levels well below WHO guidelines. In mature markets, such as Europe, we are developing non-fried solutions, with significant diversification toward oven and pan products. In South Africa, where logistics can be a problem, we also aim at producing and distributing dried potato product solutions, enriched with macro- and micronutrients, which are cheaper to distribute and also contribute to an affordable and nutritious meal for low-income consumers."

The International Year

New light on a hidden treasure

As the roots-and-tubers specialist at the Food and Agriculture Organization of the United Nations in Rome, **NeBambi Lutaladio** *found himself with an additional task in 2008: that of coordinating the implementation of the International Year of the Potato.*

The announcement of the International Year was met with scepticism. Do you think people are starting to see the point now?

"Some people were surprised to see the UN dedicating a whole year to something as common as potatoes. But we saw it as a great opportunity to raise global awareness of the potato's true value for rural people, for the economy and for world food security, and also to focus attention on FAO's overall mandate, which is agricultural development. The momentum is really building now. That is partly thanks to our information campaign and to the positive response of governments and the private potato sector. Also, with world food prices rising, the potato is attracting a lot of attention as an alternative food crop."

The slogan of IYP is "hidden treasure". In what way has it been "hidden"?

"Many people were simply unaware that the potato feeds the world – it is our most important non-cereal food, and its production has been increasing in developing countries faster than that of any other major crop. Its role in nutrition is also often under-valued, and in developed countries the potato is often associated with weight problems. So, one of the objectives of IYP is to teach people that potatoes have positive nutritional benefits, that they are rich in fibre, vitamin C and potassium, and have good quality protein. Finally, the potato also has great 'hidden potential' for productivity increases – some potato scientists say a 30 percent increase in yields is now within reach."

IYP maintains that potato production can help achieve UN Millennium Development Goal No. 1, to reduce poverty and hunger. How?

"The potato is very well suited to places where land is limited and labour abundant. They grow fast, they are adaptable, high yielding and responsive to low inputs. Farmers in highland areas of Africa can

harvest 25 tonnes of tubers from one hectare in just 90 days, which is why potato production is booming in countries like Uganda. When you add value to production like that, through better storage and processing, you not only meet food needs, but have a highly profitable cash crop that can drive economic development and sustain livelihoods."

Potato yields in the developing world are a third of those achieved in some developed countries. What needs to be done?

"To increase productivity, IYP is promoting a shift in developing countries to potato-based farming systems that use quality and reliable seed potato, varieties that are virus-free and drought resistant, improved plant nutrition and integrated pest management. But technology improvements need to be accompanied by other, more general measures for agricultural development, such as improved farmer access to extension, credit and production inputs, better post-harvest management and links to agro-processing and markets."

How are countries around the world celebrating IYP?

"Naturally, we've seen a lot of enthusiasm in the Andean countries of South America, with national potato days, potato growers' congresses, festivals of biodiversity, cooking contests. Elsewhere, we have a nation-wide campaign to promote potato consumption in Bangladesh, scientific conferences on potato production, poverty alleviation and late blight, and potato harvest festivals in rural areas and towns across North America and Europe. Ordinary people are organizing art exhibitions, block parties, and school events. We have limited funds to support these events, but we are providing seed funding for national IYP committees in 20 countries of Africa, Asia and Latin America to support awareness campaigns."

You mentioned food price inflation. Can potato really help lower food prices?

"That is something FAO is studying very closely now. International prices of most agricultural commodities – not just for cereals, but for vegetable oils, soybean and dairy products – are at very high or even record levels. One of the longer term strategies that can help ease the strain of food price inflation is to diversify the crop base to nutritious and versatile staples such as the potato. Unlike major cereals, the potato is not a globally traded commodity – its prices are determined usually by local supply and demand, so it escapes the kind of speculation we are seeing with cereals."

Culture

"In front of a potato, we are all equal"

Stanislav Menard *is a businessman whose paper factory in Slovenia churns out 3.5 billion envelopes a year. But away from his high-speed machinery, he has a special interest: he's president of the Slovenian Society for Sautéed Potato and Onions...*

When we first heard about your association, we thought it was a joke...

"Yes, it did start as a joke. Our society was founded in 2000 by five professional people in [Slovenia's capital] Ljubljana, who all enjoy eating our national dish, *pražen krompir*, which means sautéed potato. But over the years it has grown into an association of more than 2 000 people in more than 20 countries, and in September we expect 15 000 people to come to our 8th World Festival of Sautéed Potatoes."

What's so special about sautéed potatoes, Slovenian style?

"They are delicious. First you cook the potatoes in simmering water, very slowly, for up to 40 minutes. After they're cooked, you wash them in cold water for a minute and peel them. Then you pan fry the onions in a little pork fat or olive oil, also very slowly, for about 15 minutes at low temperature, until they practically disappear. Then you add the potatoes cut into thin slices and stir for another 20 minutes. That's the basic recipe. You can add mushrooms, vegetables or *prosciutto*. It's a full meal – in fact, our society's full name is 'Slovenian Society for the Recognition of *Pražen Krompir* as an Independent Dish'."

But that's nearly 90 minutes of preparation time...

"And that's the beauty of *pražen krompir*! One of the basic rules of our association is that members should get together to prepare a meal of sautéed potato and onions at least once a month. In 90 minutes, over a frypan, you rediscover the importance of sharing time with your friends and enjoying a meal together, two things that are being lost in our fast food culture. The other rule is that no one should talk politics – in front of a potato, we are all equal."

Is any particular variety best for *pražen krompir*?

"Each year we plant 20 to 25 different varieties of potato in our field in Ljubljana and in September we harvest them for testing. It's a big event, with 20 members serving as judges. Each variety is prepared in exactly the same way and we have strict judging criteria. What we are looking for is a potato with a creamy, buttery taste, one that melts in your mouth. Each year a different variety wins, but some members are particularly fond of our Slovenian traditional variety, the Igor, while others prefer the Royal Jersey. As an association we organize trips to potato growing areas of other countries to sample their potatoes as well. Our members have been to Jersey, the Czech Republic, Ukraine, Poland and even to Peru in 2006."

So Slovenia has had a long love affair with the potato?

"Actually, we were one of the last countries in Europe to adopt it, and then only by force. Agriculturally, Slovenia in the 18th century was a poor country, and famines were frequent. After a series of famines in the mid-1700s, Maria Theresa, the archduchess of Austria, decreed that our farmers should start growing potatoes. It was the beginning of a new era. Slovenia is a mountainous country and ideal for potato. Suddenly farmers had a reliable food supply, and feed for farm animals. There is one town, Šencur, that became such an important exporter of potatoes to Austria and Germany that it was called Kartoffeldorf [literally, "potato town" in German]. So what the International Year of the Potato is preaching is absolutely true – the potato *did* save Slovenia from hunger."

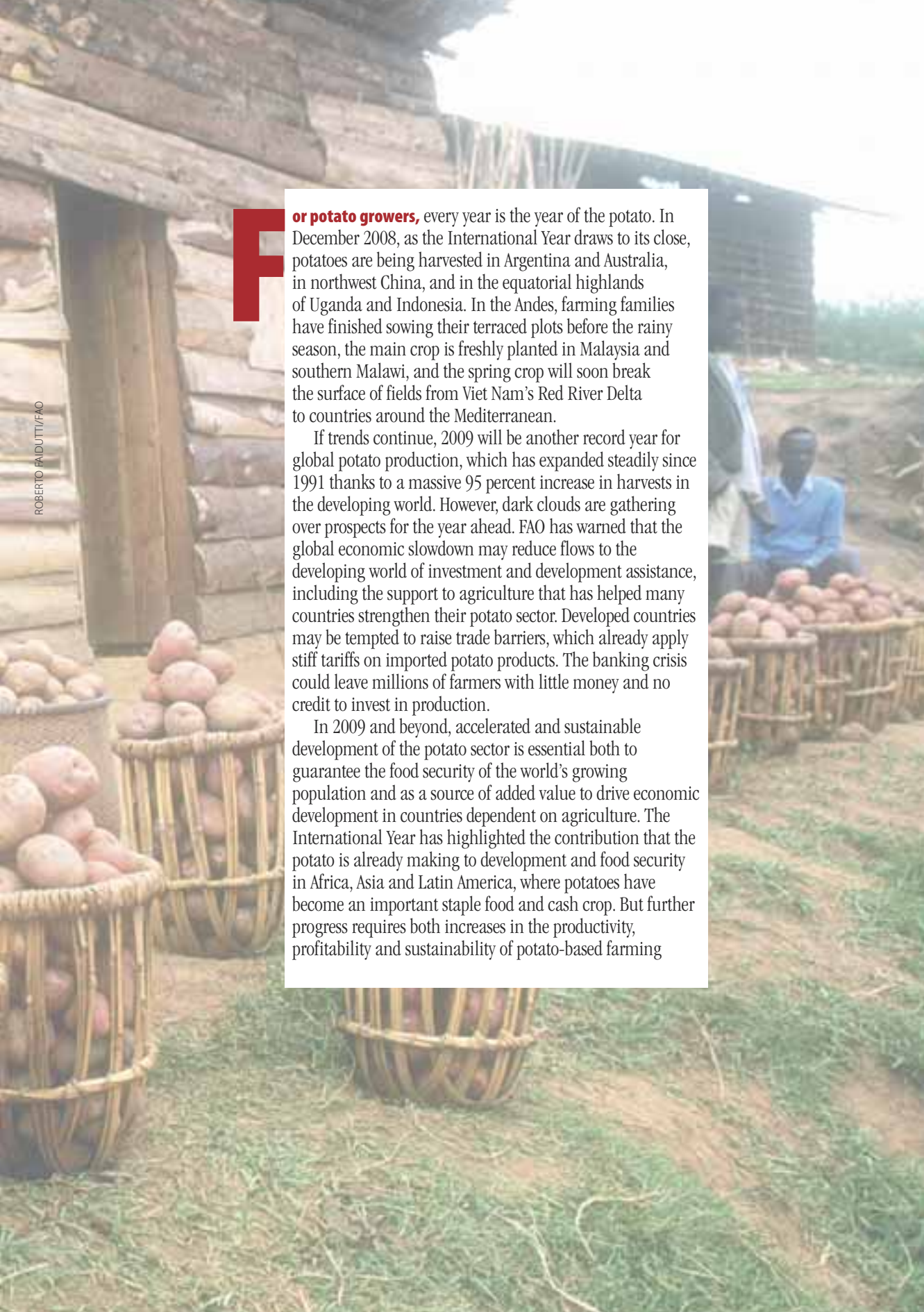
And it's in Šencur that you unveil a monument to the potato on 25 May...

"Yes, it's a bronze, life-size statue of Maria Theresa in peasant's clothing, seated and offering a potato in her outstretched hand. It's a mark of gratitude to her and to the potato. We are expecting a big crowd, including the European Ministers of Agriculture who will be meeting in Slovenia on the same weekend – but they will have to queue up for the potatoes like everybody else."

Beyond 2008

Accelerated, sustainable development of the potato sector is essential both to guarantee world food security and to drive economic development in countries dependent on agriculture

Potatoes for sale by the roadside in Kabale district, Uganda



ROBERTO FAIDUTTI/FAO

For potato growers, every year is the year of the potato. In December 2008, as the International Year draws to its close, potatoes are being harvested in Argentina and Australia, in northwest China, and in the equatorial highlands of Uganda and Indonesia. In the Andes, farming families have finished sowing their terraced plots before the rainy season, the main crop is freshly planted in Malaysia and southern Malawi, and the spring crop will soon break the surface of fields from Viet Nam's Red River Delta to countries around the Mediterranean.

If trends continue, 2009 will be another record year for global potato production, which has expanded steadily since 1991 thanks to a massive 95 percent increase in harvests in the developing world. However, dark clouds are gathering over prospects for the year ahead. FAO has warned that the global economic slowdown may reduce flows to the developing world of investment and development assistance, including the support to agriculture that has helped many countries strengthen their potato sector. Developed countries may be tempted to raise trade barriers, which already apply stiff tariffs on imported potato products. The banking crisis could leave millions of farmers with little money and no credit to invest in production.

In 2009 and beyond, accelerated and sustainable development of the potato sector is essential both to guarantee the food security of the world's growing population and as a source of added value to drive economic development in countries dependent on agriculture. The International Year has highlighted the contribution that the potato is already making to development and food security in Africa, Asia and Latin America, where potatoes have become an important staple food and cash crop. But further progress requires both increases in the productivity, profitability and sustainability of potato-based farming

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systems, and a stronger commitment by the international community to agricultural and rural development.

The "Cusco challenge" (*page 113*) launched by the International Potato Center underlines the urgency of framing a new, vigorous research-for-development agenda. Potato science at the service of the poor will help boost potato yields in the developing world by providing improvements in the quality of planting material, potato varieties that are more resistant to pests, diseases, water scarcity and climate change, and farming systems that make more sustainable use of natural resources. The raw material of those new varieties must be drawn from the totality of potato genetic resources, which includes thousands of Andean varieties. Needed is a renewed sense of responsibility for conservation of the potato gene pool, as well as concrete steps to ensure that developing countries have the capacity to utilize it.

Extending the benefits of potato growing also requires action on a wider front. The best strategy for achieving the first of the United Nations Millennium Development Goals – to eradicate extreme poverty and hunger – is agricultural development that benefits small-scale farmers, who constitute most of the world's poor and undernourished. As the United Nations' lead agency for agriculture and rural development, FAO will be a key partner in that process – advising on policies and strategies to modernize the potato sector, sharing its extensive knowledge of potato farming systems, promoting appropriate technology for sustainable intensification of production, and forging links among decision-makers, producers, processors and marketing chains.

The International Year of the Potato has helped raise awareness of the potato and support for its development. Beyond 2008, IYP will serve as a catalyst for potato development programmes worldwide that can make a real contribution to the fight against hunger and poverty.

New light on a hidden treasure: early morning harvest near Buenos Aires, Argentina

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"The potato is on the frontline in the fight against world hunger and poverty."

Jacques Diouf
Director-General, FAO