

# One million hectares

## world wide - Varietal change in potatoes and the contribution of the International Potato Center

Over 1 million hectares are planted worldwide with potato varieties bred by or obtained through the International Potato Center (known by its Spanish acronym CIP). According to a 2007 survey of 23 countries in Asia, Africa, and Latin America, the area planted with CIP-related material in those countries has increased from 6.4 percent to 13.1 percent in the last decade. This important milestone has come more than ten years earlier than was predicted in the best case scenario envisioned in 1997 and represents a 150 percent increase in area covered.

In terms returns on investment in CIP breeding, the current adoption area implies a rate of return of approximately 20 percent per one dollar invested, and a net present value of discounted net benefits of more than US\$121 million.



### Background

Expanding area planted with CIP-provided materials results in pest- and virus-resistant varieties that are more suited to their environment. CIP-related varieties have been bred for resistance or tolerance to specific biotic or abiotic factors (e.g., late blight, viruses, drought), which cause yield loss. They incorporate general agronomic (e.g., earlier maturation, better adaptability) and quality improvements, which add consumption or market value.

### Methodology

Findings are based on a survey questionnaire sent to the leaders of 23 national potato breeding programs in countries where CIP works. Information was collected on the number of varieties released, breeders' estimated adoption rate for each variety, and parentage, including CIP and other sources. The 23 country sample represented almost 80 percent of total potato area in the developing world and more than 76 percent of total potato production. Using publicly available data on potato area, the estimated adoption rates were converted to estimated area under each variety by country. With the information on parentage, it was possible to estimate the area planted with material related to CIP and to compute the aggregate estimated figure for all countries. The study classified released varieties by their origin into four general categories:

- CIP-NARS: NARS-bred varieties distributed by CIP, NARS selections from CIP crosses, NARS crosses from CIP progenitors
- Developing country National Agricultural Research Systems (NARS): NARS-bred varieties with no CIP role
- Developed country NARS: varieties introduced from developed country NARS
- Other: native varieties (landraces grown by farmers), sports (somatic mutations), farmer varieties, private sector varieties

Data were compared with those from a similar survey in 1997.

### Results

In the 10-year period covered by the study, total potato area in the sample of developing countries increased by 25 percent. The area under cultivation with CIP-related varieties surpassed one million hectares, compared to 410,000 hectares registered in 1997. The share of area planted with CIP-related varieties increased from 6.4 percent to 13.1 percent, making this category the second largest source of genetic material for planted varieties after developing country NARS.

In terms of geographic distribution:

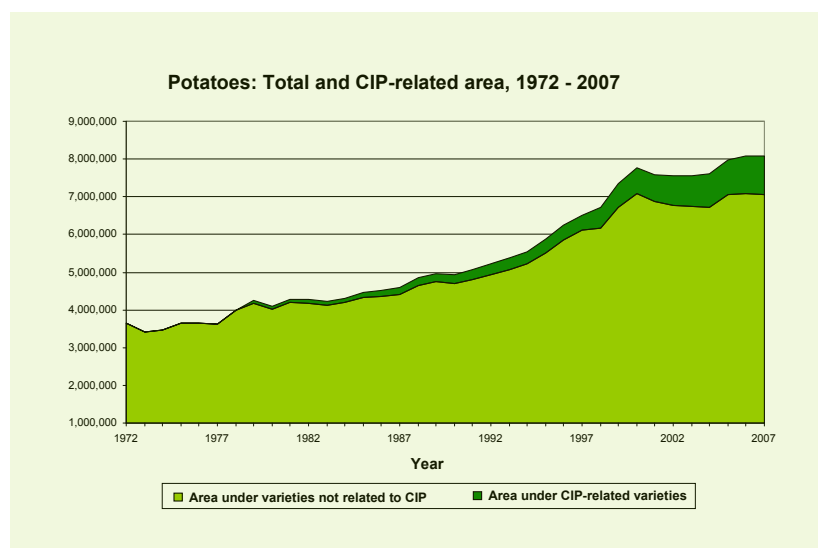


Figure 1. Potatoes: total and CIP-related area, 1972-2007.

- In Kenya, Uganda, Rwanda, Tanzania, and Ethiopia the aggregate area under CIP-related varieties increased by more than 230,000 hectares, the outstanding varieties including Kirundo, Victoria, and Tigoni.
- In Latin America, CIP's contribution is especially strong in Peru, where CIP-related varieties have been adopted on more than 100,000 hectares. CIP-related varieties are now planted on over 11,000 hectares in Ecuador (comprising 22 percent of the total) and in Bolivia on over 17,000 hectares, twice the level of 1997.
- In Asia, NARS-bred varieties have predominated, including Kexin1 in China which is the world's most planted variety. However, in China, 10 percent of the potato area was planted with CIP-related varieties in 2007, up from 3.5 percent in 1997. In India 43,000 hectares were planted to one single CIP-related variety and in Nepal CIP-related varieties made up almost one quarter of the country's total potato area.

**Area under CIP-NARS varieties by country & total potato area, 1997 vs. 2007 ('000 of hectares).**

Region	Country	1997 CIP-NARS	Total	2007 CIP-NARS	Total	Change
Africa	Burundi	14.9	15.0	9.5	10.0	-5.4
	Congo, D R	24.3	24.4	20.0	20.0	-4.3
	Ethiopia	6.1	47.5	56.0	160.0	49.9
	Kenya	6.7	95.0	43.9	121.9	37.2
	Madagascar	35.6	45.0	32.1	42.3	-3.4
	Rwanda	43.4	45.0	135.6	136.0	92.2
	Tanzania	5.6	35.0	19.3	37.0	13.7
	Uganda	29.1	56.0	66.1	86.3	37.0
	Total	165.5	362.9	382.4	613.5	216.9
Asia	Bangladesh		123.2	5.6	373.0	5.6
	Bhutan	1.5	5.6	0.1	3.7	-1.4
	China	127.2	3,499.8	448.4	4,794.0	321.2
	India	n/a	1,499.6	43.0	1,335.9	43.0
	Indonesia	n/a	47.0	0.1	62.8	0.1
	Nepal	28.5	116.3	35.8	146.9	7.3
	Pakistan	0.0	99.6	n/a	113.1	n/a
	Philippines	0.1	7.0	0.1	5.5	0.0
	Sri Lanka	n/a	7.1	0.0	5.5	0.0
	Vietnam	9.4	30.4	4.8	34.7	-4.6
	Total	166.7	5,435.7	538.0	6,874.9	371.3
Latin America	Bolivia	9.6	137.7	17.2	134.2	7.5
	Colombia	n/a	184.4	n/a	102.6	n/a
	Ecuador	n/a	65.8	11.4	51.7	11.4
	Peru	66.5	248.5	102.1	258.3	35.6
	Venezuela	1.9	16.9	2.0	22.5	0.1
	Total	78.1	653.3	132.7	569.2	54.7
	Total	410.3	6,451.9	1,053.2	8,057.6	642.9

Source: 1997 and 2007 survey data

The results suggest that contribution to the increase in potato area and in CIP's share is due mostly to the success of specific varieties in different countries. The twenty most popular CIP-related varieties account, on aggregate, for almost 800,000 of the one million hectares planted. Late blight resistance is mentioned as the most appreciated trait. High yield is also a primary consideration, closely followed by culinary quality and taste. Earliness and market acceptability (including for processing) also feature in the selection of varieties.

Differences can be seen within and across regions. In China alone, Co-

operation 88, a late blight resistant variety used for table consumption and for making chips, is planted on more than 118,000 hectares. The total area in India, planted to material with CIP parentage, corresponds to one single variety with high processing suitability (Chipsona-I). In Peru, Canchan - INIA is a variety highly successful among farmers because of its marketability linked to cooking quality.

## Return on investment

The speed with which CIP has reached the one million hectare milestone, originally estimated for 2021, has led to a re-estimation of the returns to CIP's investment. The current adoption area implies rates of return of 20 percent, a US\$1.2 benefit on every \$1 invested, with net benefits generated by the breeding program of more than \$120 million. This is based on the following assumptions:

- Project duration is of 50 years until 2021.
- Source of benefit is a yield increase of 2.0 tons per hectare in adopted area which represents a 10 – 15 percent yield increase.
- Potato price is US\$ 110 per ton.
- Breeding costs estimated to be 55 percent of total potato crop improvement expenditures by CIP.
- Additional costs of NARS research, seed, and extension are equivalent to 50 percent of gross benefits.
- Net benefits are adjusted to 2007 prices using the US Consumer Price Index.
- Logistic patterns of diffusion, 2007 total potato area for the 23 countries surveyed is held constant (no growth in total area)
- Discount rate of 10 percent is employed.
- Adoption ceiling of 1.5 million hectares in 2021.

## Returns to CIP investment, 1997 vs. 2007 estimations

	1997	2007
Area under CIP-related materials ('000 Ha)	410	1,053
Adoption ceilings in 2021 (%)	15%	18.5%
Internal Rate of Return (IRR)	16.7%	20.0%
Net Present Value (NPV), million US\$	\$71	\$121

## Conclusions

Development and availability of appropriate crop varieties and crop technologies are critical if we are to meet rising food security needs, including an increased potato demand at affordable prices for the poor. The study shows that CIP-related varieties are making a significant contribution in some of the poorer countries, especially in Africa (e.g., Burundi, Congo D.R., Rwanda, Uganda). For an institution whose mandate is primarily pro-poor research this result is encouraging.

CIP is responding to new challenges to breeding for pro-poor traits, such as drought tolerance, which is likely to become increasingly important as global warming occurs. If new materials are developed and continue to be successful in responding to farmers' demands, the aggregate area under CIP-related varieties should continue to rise and to sustain the high rate of return on investment in CIP's breeding programs.

This study shows the extent of worldwide adoption of CIP-related varieties. Providing a finer grained analysis of the impact of the expanded adoption and its specific contribution to poverty in local contexts remains an important task for the future.