



For more than 400 million people in the tropics, an inexpensive bowl of common beans is the centerpiece of the daily diet. It provides important quantities of dietary protein, complex carbohydrates, and valuable micronutrients. It also reduces the risk of chronic disease such as diabetes, cardio-vascular disease, and certain types of cancer.

The primary mission of CIAT's Bean Program is to contribute to household and global food security in a way that is both eco-efficient and culturally acceptable.

Our goals are to make bean production more profitable for small farmers in Latin America and the Caribbean (LAC)¹ and Africa; and to augment the nutritional value and supply of beans; targeting both resource-poor farmers and consumers, and specific groups such as people living with HIV/AIDS.

Outputs and impact

- Disease- and pest-resistant germplasm, for example, virus-resistant varieties for Central America and the Caribbean, where more than 40% of the bean area is planted to improved varieties. This task is now largely taken over by the region's breeding programs, backed up by population development in CIAT.
- Developing germplasm that is acceptable to farmers and tolerant of abiotic stresses, especially drought, low soil P, and Al toxicity.
- Introduction and promotion of high-yielding climbing beans to mid-altitude Africa, thus tripling yields and improving food security. These beans were further improved for warm-temperature adaptation and marketability.
- Developing beans with higher iron contents. The first of these have been released to farmers in SSA and Central America, and are expected to help improve nutrition and health. They are also suitable for marketing, and some are resistant to abiotic stress.
- Facilitating impact pathways for improved varieties to reach more than 6 million households in Africa—this was achieved in 5 years.
- Farmers were linked to regional and international markets. African farmers

increased their exports to nearly \$100 million per year.

- Creating impact-oriented, bean-seed delivery systems for the poor in Malawi, Mozambique, and Tanzania. Novel strategies (e.g., packaging seed in inexpensive small packets) permit small farmers who rarely buy inputs to purchase seed of new varieties.
- Developing a wide range of user-friendly molecular markers (especially SSRs) to apply in breeding programs.

Main activities and projects

Some bean projects are global in reach; others regional. In Africa, the Pan-Africa Bean Research Alliance (PABRA) unites CIAT's efforts with 28 national programs in East, West, and southern Africa. Program activities follow two major lines of research:

Nutritional improvement

Beans, a source of iron and zinc, can be used to address the world's most common health problem: iron-deficiency anemia. Improvement of the nutritional value of beans (referred to as biofortification) is carried out under:

- The HarvestPlus Challenge Program. Its bean component focuses on Rwanda and DR Congo, with PABRA sharing results with its partner countries.
- The AgroSalud project, which addresses nutritional needs in LAC.

1. For an explanation of acronyms and abbreviations see www.ciat.cgiar.org/newsroom/pdf/acronyms_syntheses.pdf

Productivity

CIAT has a long history of developing bean varieties with genetic resistance to major pests and diseases, to avoid yield losses and to reduce pesticide use and environmental contamination. Today, more attention is being given to improving beans that tolerate abiotic constraints such as soil problems and drought, now increasing in significance as climate change alters the patterns and intensity of both abiotic and biotic constraints. Results show that stress-tolerant bean germplasm can also yield well under favorable conditions.

Major activities include:

- Improving drought tolerance in beans, emphasizing marginal areas of East and southern Africa (under Tropical Legumes I and II projects).
- Enhancing genetic diversity (several projects with the GCP).
- Combining tolerance to multiple edaphic stresses and drought by integrating genomics, phenotypic screening, and participatory research with women and small farmers.
- Implementation of marker-assisted selection for important disease resistance genes.
- Expanding the adaptation range and use of climbing beans in eastern, Central, and southern Africa.

The tools that the Bean Program uses to support these broad goals include exploiting the biodiversity of more than 35,000 bean accessions held in CIAT's collection; use of biotechnology, particularly marker-assisted selection and gene discovery; use of social sciences to develop products, enhance impact, understand acceptability to farmers and consumers, and create economic impact; and monitoring and evaluation of these projects to guide research and measure progress (conducted by PABRA).

Main partners

Angola: IIA • **Brazil:** Embrapa • **Burundi:** ISABU
• **Colombia:** CORPOICA; FENALCE • **Costa Rica:** Ministry of Agriculture; UCR • **Cuba:** Ministry

of Agriculture • **DR Congo:** INERA • **Ethiopia:** EIAR • **Guatemala:** ICTA • **Honduras:** DICTA; EAP–Zamorano • **Kenya:** KARI • **Malawi:** DARTS • **Mexico:** INIFAP • **Mozambique:** IIAM • **Nicaragua:** INTA • **Rwanda:** ISAR • **Tanzania:** ARI; SARI • **Zambia:** ZARI • **Zimbabwe:** AREX • **ARIs:** Dry Grain Pulses CRSP; KU–Leuven; Penn State University; USDA

Donors

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