PABRA

Beans for impact and nutrition in Africa

Alliance

Bioversity International

CIAT

International Center for Tropical Agriculture

Since 1967 Science to cultivate change

CGIAR

PABRA and the power of beans in Africa: 25 years of transformation

The **Pan-Africa Bean Research Alliance** (**PABRA**) is a consortium of three regional bean networks:

The Eastern and Central Africa Bean Research Network (ECABREN), Southern African Bean Research Network (SABRN), and Western and Central Africa Bean Research Network (WECABREN), consisting of national agricultural research systems from 31 countries in sub-Saharan Africa, bean value chain actors from the public and private sectors, and the Alliance of Bioversity International and CIAT. PABRA is supported by a dedicated group of International development partners.

PABRA's focus is to improve bean productivity, use, and commercialization for the benefit of smallholder farmers and urban populations. Our goal is to enhance food and nutrition security, and income generation of poor communities in a gender-equitable and environmentally friendly manner.

www.pabra-africa.org

PABRA is facilitated by the **Alliance of Bioversity International and the International Center for Tropical Agriculture** (**CIAT**). The Alliance delivers research-based solutions that harness agricultural biodiversity and sustainably transform food systems to improve people's lives. Alliance solutions address the global crises of malnutrition, climate change, biodiversity loss, and environmental degradation.

With novel partnerships, the Alliance generates evidence and mainstreams innovations to transform food systems and landscapes so that they sustain the planet, drive prosperity, and nourish people in a climate crisis.

The Alliance is part of **CGIAR**, a global research partnership for a food-secure future.

https://alliancebioversityciat.org **www.cgiar.org**

N.Palmer (CIAT)

Acronyms and abbreviations

ACIAR	Australian Centre for International Agricultural Research
AGRA	Alliance for Green Revolution in Africa
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AVISA	Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa
BMGF	Bill & Melinda Gates Foundation
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CIAT	International Center for Tropical Agriculture (now part of the Alliance of Bioversity International and CIAT)
CIDA	Canadian International Development Agency
CORAF/WECARD	West and Central African Council for Agricultural Research and Development
DACA	Digital AgroClimate Advisory
DLB	Demand-led breeding
ECABREN	Eastern and Central Africa Bean Research Network
EIAR	Ethiopian Institute of Agricultural Research
ESG	Environmental, social, and governance
FAOSTAT	Food and agriculture data from the Food and Agriculture Organization of the United Nations
GAC	Global Affairs Canada
GAP	Good agricultural practices
GDP	Gross domestic product
H.Gvt	Hosting government
ICT	Information and communications technologies
IDRC	International Development Research Centre
ISABU	Institut des Sciences Agronomiques du Burundi
MERCI	Modernizing Ethiopian Research on Crop Improvement
NARS	National agricultural research systems
NGO	Non-governmental organization
PABRA	Pan-Africa Bean Research Alliance
PICS	Purdue Improved Crop Storage bags
QDS	Quality declared seed
SABRN	Southern Africa Bean Research Network
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SFSA	Syngenta Foundation for Sustainable Agriculture
SME	Small- and medium-sized enterprise
SROs	Subregional organizations
SSA	Sub-Saharan Africa
TAAT	Technologies for African Agricultural Transformation, a program of the African Development Bank
USA	United States of America
USAID	United States Agency for International Development
WECABREN	Western and Central Africa Bean Research Network

Contents

From the Director

I am delighted to present this report, which showcases the success and impact of the Pan-Africa Bean Research Alliance (PABRA) and its journey of transformation over the past 25 years. As PABRA evolved, the power of beans to positively change lives in Africa became clearer and grew much stronger.

At the heart of the success and impact are the innovations, dedication, and commitment of all those involved throughout PABRA's history – from the research institutes in Africa, international and national government agencies and non-governmental organizations, and regional economic communities to the smallholder farmers, entrepreneurs, funders, and investors who have partnered with PABRA to generate positive impacts through the power of beans. Together, we have all improved the performance of beans in Africa.

Despite Africa's food security being challenged by social crises, climate extremes, and economic shocks, PABRA's approach has enabled the bean sector to thrive, thus positively impacting livelihoods throughout Africa. Indeed, beans are not just a subsistence crop, but an income earner for millions of smallholders and the national economy at large. By helping to improve soil fertility while withstanding limited soil moisture, high temperatures, and less rainfall, beans enhance the resilience of our agri-food systems.

The dedication of all PABRA partners shines a light on what is possible. Collaboration and diversity among our growing partnerships demonstrates the power of all institutions combining synergies towards a common vision to achieve greater impact. Through a process of learning and adapting, we have become more empowered to improve the performance of the bean value chain – from farmers to consumers.

Our long-term commitment to generate better beans that nourish a growing population reveals lessons for the future of agri-food systems. PABRA demonstrates the use of science and partnerships to effectively scale innovations at continental, regional, subregional, national, and local levels. Coordination across scales has enabled PABRA to solve problems, alleviate constraints, and unlock bottlenecks, thus developing the sector through dynamic and expanding market demand.

The challenges to nourish and feed a growing population within the planetary boundaries and having the capacity to manage climate extremes are immense. Nevertheless, PABRA provides an example of what is possible when innovations are embedded in a diverse, multi-level, and coordinated alliance of people and institutions.

Please join me in celebrating the power of beans in Africa and PABRA's 25 years of transformation.

Jean Claude Rubyogo

Leader of the Global Bean Program, Alliance of Bioversity International and CIAT, and Director of PABRA

Acknowledgements

We gratefully acknowledge the contributions of PABRA donors, in particular:

- **Government of Canada** through **Global Affairs Canada (GAC)**, formerly the Canadian International Development Agency (CIDA)
- **Swiss Agency for Development and Cooperation (SDC)** and
- the **United States Agency for International Development (USAID)**

who are founding donors and who continue to support PABRA.

For strongly contributing to the PABRA agenda, we also express great gratitude to:

- **Australian Centre for International Agricultural Research (ACIAR)**
- **Bill & Melinda Gates Foundation (BMGF)**
- **African Development Bank** through **Technologies for African Agricultural Transformation (TAAT)** and contributions to national bean programs and investments
- **International Development Research Centre (IDRC)**
- **Rockefeller Foundation**
- **Syngenta Foundation for Sustainable Agriculture (SFSA)**
- **Alliance for Green Revolution in Africa (AGRA)** and
- **KirkHouse Trust.**

A big thank you goes to **PABRA members and their countries, bean farmers, and other value chain actors** who tirelessly work to invest in and upgrade bean value chains and continuously contribute to the research agenda. Finally, we would like to acknowledge the great contributions of the subregional organizations:

- **Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)**
- **Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA)**
- **West and Central African Council for Agricultural Research and Development (CORAF/WECARD)**
- **Forum for Agricultural Research in Africa (FARA).**

"Beans are a superfood, a powerful contributor to reducing poverty, improving nutrition and health, generating jobs, and being kinder to the planet"

CIAT

Executive summary

The release of 657 new bean varieties, in 31 countries of Africa over 25 years, which have reached more than 37 million farmers (58% of whom are women), along with good farm management have more than doubled yields in many cases, thus significantly improving nutrition, health, and food security in Africa.

Bean quality has improved as well. Advances in iron and zinc biofortification empower beans to provide more dietary protein and micronutrients to more than 400 million people in sub-Saharan Africa (SSA), especially women and children living in rural areas and vulnerable urban settlements.

More than 5 million households in 10 African countries have seen a 30% increase in household income, with some farmers earning an additional US$800 to US$1,000 per hectare with the use of improved varieties and good agricultural practices. Impact assessment studies[1] have shown that, when smallholders use an additional 10 kg of improved varieties, this raises per capita consumption expenditure by 9% and increases the probability that a household is food secure by 6% while decreasing the likelihood of being poor by 6%. Beans are a powerful contributor to reducing poverty, improving livelihoods, and creating jobs.

Gender equality and youth inclusion form the heart of all PABRA initiatives and impacts. Using a reach-out, empowering, and transformative approach to fostering change, we have enhanced the technical capacity of more than 50% of the women across the value chain. Of the more than 14.6 million households that have accessed climate-smart and farmer- and market-demanded improved varieties from 2017 to 2021, 58% are led by women. Of the 3.5 million farmers that were linked to more profitable markets, 49% were women. Of the more than 11.3 million Africans who have consumed high-iron beans in 15 SSA countries, 53% were women. And, of the half a million bean value chain actors who have been trained by PABRA, 73% were women. Our approach has empowered and continues to empower women. This is illustrated in Zimbabwe and Burundi, where women's participation in decision-making bodies increased from 30% in 2015 to 50% in 2021.

PABRA takes on the challenges of climate change. Our improved varieties mature early in 65 to 90 days, thus helping to reduce the risk of drought and harvest failure. In addition, improved pest and disease tolerance and access to timely climate information enables farmers to further diminish risks. As a result, many smallholder farmers are already achieving significantly higher bean crop yields, thus enhancing their household income and food security.

1 Katungi EM, Larochelle C, Mugabo JR, Buruchara R. 2018. The effect of climbing bean adoption on the welfare of smallholder common bean growers in Rwanda. *Food Security* 10(1):61-79. https://doi.org/10.1007/s12571-017-0753-4

Strong partnerships within the three PABRA regional networks, their constituent national research organizations, and the private sector enable the process of change. PABRA helps to not only coordinate and prioritize research, but also facilitates the timely dissemination of promising varieties and complementary innovations and the sharing of lessons learned across SSA. The national agricultural research systems (NARS), many of whom are founding members of PABRA, are key entry points in the development and dissemination of bean research. Based on agreed complementary and synergistic roles, PABRA helps to inform national and regional bean programs priorities and activities by providing a space for leveraging and integrating support and resources, joint implementation of activities, and mutual learning and performance reporting.

PABRA's approach is diverse, dynamic, responsive, and agile. PABRA removes constraints that hinder the performance of entire bean value chains – from farmers to consumers.

The success of PABRA has come through:

- Supporting institutional development
- Developing consumer- and farmer-preferred varieties
- Finding solutions to specific bottlenecks through a multi-disciplinary approach
- Building sustainable partnerships
- Providing excellent leadership and stable governance
- Using multiple impact pathways to accelerate access to improved bean-based technologies
- Bundling innovations
- Constantly evolving to meet new challenges
- Ensuring orientation to inclusive impact.

Social conflict, climate extremes, and economic shocks along with the high cost of nutritious foods and growing inequalities continue to challenge food and nutrition security in SSA. Despite this difficult context, PABRA will continue to:

- Expand the power of demand-led bean breeding with increased attention to farmer and consumer priorities, using innovative financial models, and through regional and international partners
- Assure greater smallholder profits from improved bean varieties that produce larger harvests and earn higher return on their investments
- Build resilience to climate change and the regenerative capacities of farming systems
- Foster women and youth entrepreneurship and generate new jobs
- Advance gender-transformative research and development for inclusive future agri-food systems
- Share PABRA's bean corridor model and insights into value chain performance with a range of private-sector investors having national, regional, and international perspectives

- Influence national policies to create an enabling environment that attracts greater public and private investments in the bean value chains
- Embrace efficiencies generated by information and communications technologies (ICT) that scale out innovations in value chains and change livelihoods
- Assist in expanding the PABRA model and experiences to other regenerative food crops, particularly legumes
- Ensure healthier dietary outcomes through the nutritional "power" of beans.


N.Palmer (CIAT)

Affordable and nutritious beans for all

More than 11.3 million people in Africa (53% women) have eaten high-iron beans to address food and nutritional security at the household level in 15 SSA countries. More than 275,000 school-age children (51% girls) in Tanzania, Rwanda, Uganda, Cameroon, and Zimbabwe now regularly enjoy high-iron beans in school feeding programs (https://bit.ly/3wACako). This bean consumption has been shown to improve school performance (https://bit.ly/3R5CBLQ). In Tanzania, the number of schools serving high-iron beans increased from 23 in 2018 to 492 in 2021, with a population of 238,972 pupils. In Madagascar, absenteeism declined from 10 days a month to 2 days a month when school children consumed a nutrition collation composed of 40% bean flour three mornings per week.

PABRA has also developed and promoted healthy, nutritious, and convenient bean-based products that have been obtained or consumed by more than 5.2 million children, women, and men across Africa.

In Ethiopia, shifting from old varieties to improved beans on 1 hectare increases per capita household annual consumption by 23% and, if combined with fertilizer application, increases per capita annual consumption by 37%. In Rwanda, beans can provide 75% of women's daily iron needs.

N.Palmer (CIAT)

Why beans in Africa?

Beans are a superior source of dietary protein and one of the best sources of iron and zinc, two of the most common nutritional deficiencies affecting more than two billion people worldwide.

The common bean has shown great potential to improve the health, food security, and income of rural smallholder farmers and the most marginalized communities in Africa.

The common bean is rapidly evolving from a subsistence crop to a highly nutritious and valuable crop, making a significant contribution to national economies. The common bean is the most important widely grown and consumed grain legume in Eastern, Central, and Southern Africa, where about 6.3 million hectares of land are used to grow beans every year. Per capita bean consumption in Eastern Africa is the highest in the world: in Western Kenya, Rwanda, and Burundi, people consume above 30 kg per capita per year. Beans are quickly gaining importance in Central and West African countries such as Cameroon and Guinea.

Beans are a highly attractive and versatile crop. The current value of dry bean production in PABRA countries is approximately US$3.84 billion per annum at farm gate prices, with an export value of approximately US$300 million.[2]

Early-maturing (65–90 days), higher yielding, and climate-resilient varieties can provide farmers with good harvests up to three times a year, thus guaranteeing productivity and improving income and household food security throughout the year. Beans enhance soil fertility; can be planted with other crops such as maize, cassava, and banana; after harvesting can be stored for a long time without deteriorating; and are easily converted to cash to meet urgent household needs while contributing to a healthy, more nutritious diet to overcome malnutrition.

Improved bean varieties, particularly densely cultivated climbing beans, offer great potential for increasing yield. So, where bean farming households in rural areas retain about 50% of their beans for domestic consumption, higher yields help put more food on plates, as well as increased sales and higher household income.

2 Adapted from FAOSTAT. 2022. https://www.fao.org/faostat/en/

"PABRA understands the situation on the ground. They solve issues facing smallholder farmers and value chain actors"

CHARLES KATABALWA - CEDO MANAGER
(SEED COMPANY AND GRAIN AGGREGATOR) UGANDA.

S.Malyon (CIAT)

PABRA's unique approach

Concerned about the declining bean production and productivity with a growth in demand, PABRA was established in 1996 to enhance food and nutrition security, income generation, poverty reduction, empowerment, and the health of poor communities through bean research, capacity building, networking, and partnership building.

Today, PABRA, facilitated by the Alliance of Bioversity International and CIAT (the Alliance), is a mature model of research and development partnership. Through effective and stable governance (Figure 1), it brings together NARS from 31 countries across sub-Saharan Africa, the Alliance, and more than 934 value chain actors (private and producers' organizations) in three regional networks that have a joint planning framework to coordinate research implementation and achieve synergy in outcomes.

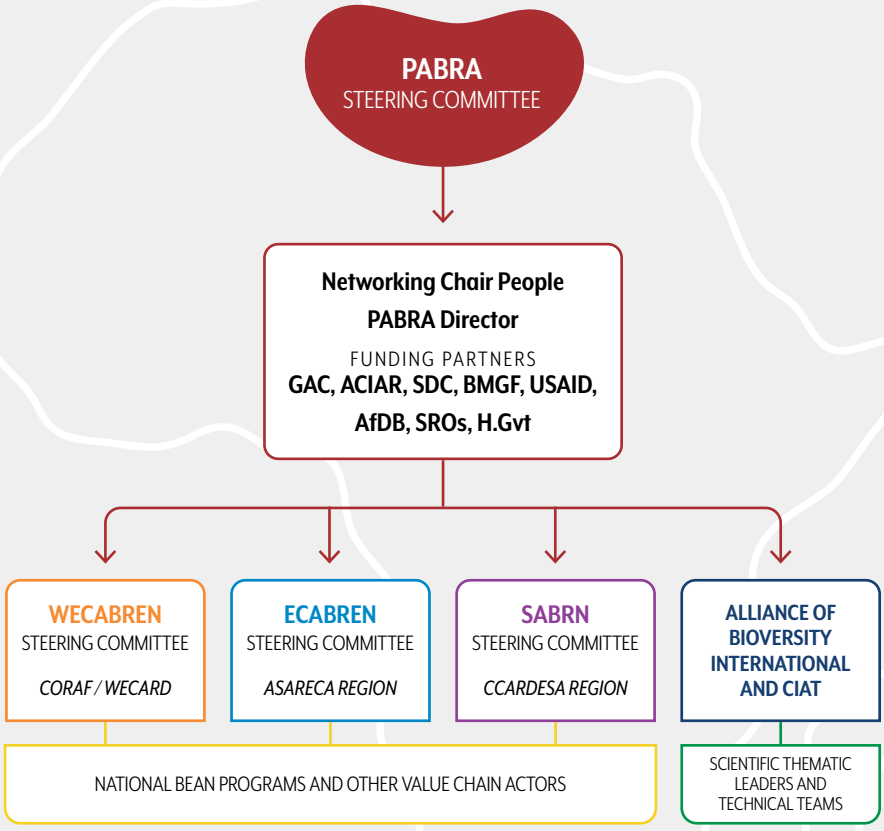


Figure 1: PABRA governance structure.

Through the Bean Corridor Approach, PABRA has adopted a food system approach that links consumption to responsive production systems supported by demand-led research.

PABRA has boosted the power of beans to improve livelihoods across Africa by being:

- **Dynamic** in finding solutions to specific challenges, considering the many voices and views to not only see what can be improved, but also how best to do so in different and changing biophysical, socioeconomic, and cultural contexts. This dynamic approach informs the research methods that are multi-disciplinary and are applied and adapted according to context, thereby helping identify key investments and actions that enhance the performance of the entire bean value chain. NARS, many of them who are founding members of PABRA, are bedrocks of the development and dissemination of bean research. Based on agreed complementary and synergistic roles, PABRA helps to inform national and regional bean research programs priorities and activities by providing a space for leveraging and integrating support and resources, joint implementation of activities, mutual learning, and performance reporting.
- **Responsive** in bundling innovations that generate multiple impacts at different scales, such as improved varieties maturing early in 65–90 days to reduce the risk of drought and harvest failure. In addition, improved pest and disease tolerance and access to timely climate information enable farmers to further diminish climate risks.
- **Agile** by not only foreseeing needs and opportunities, but also ensuring that research results stimulate action. PABRA facilitates participation in forming new partnerships that continue to learn and evolve to meet arising challenges.
- **Diverse** in ensuring inclusive participation and partnership. Gender equality and youth inclusion form the heart of all PABRA initiatives and impacts. Supporting and fostering change is central to PABRA's approach to diversity and inclusion

PABRA has demonstrated its ability to contribute to ending hunger, food insecurity, and malnutrition through scientific innovations and efficient research and development partnerships. The approach **provides lessons for the global agri-food system** to effectively meet these challenges and advance towards the Sustainable Development Goals (SDGs).

PABRA uses the power of science, innovation, and partnership to benefit smallholder food producers and consumers. It is a participatory approach that enables a wide range of value chain actors to contribute to the development of breeding strategies and varietal selection. These considerations include bean grain size, color, and cooking time, higher iron and zinc, as well as resilience to the major biotic and abiotic production constraints.

Importantly, PABRA has focused on building institutional capacity for all those involved in its partnerships

Through a long-term commitment to people and partnership since 1997, PABRA and its members have:

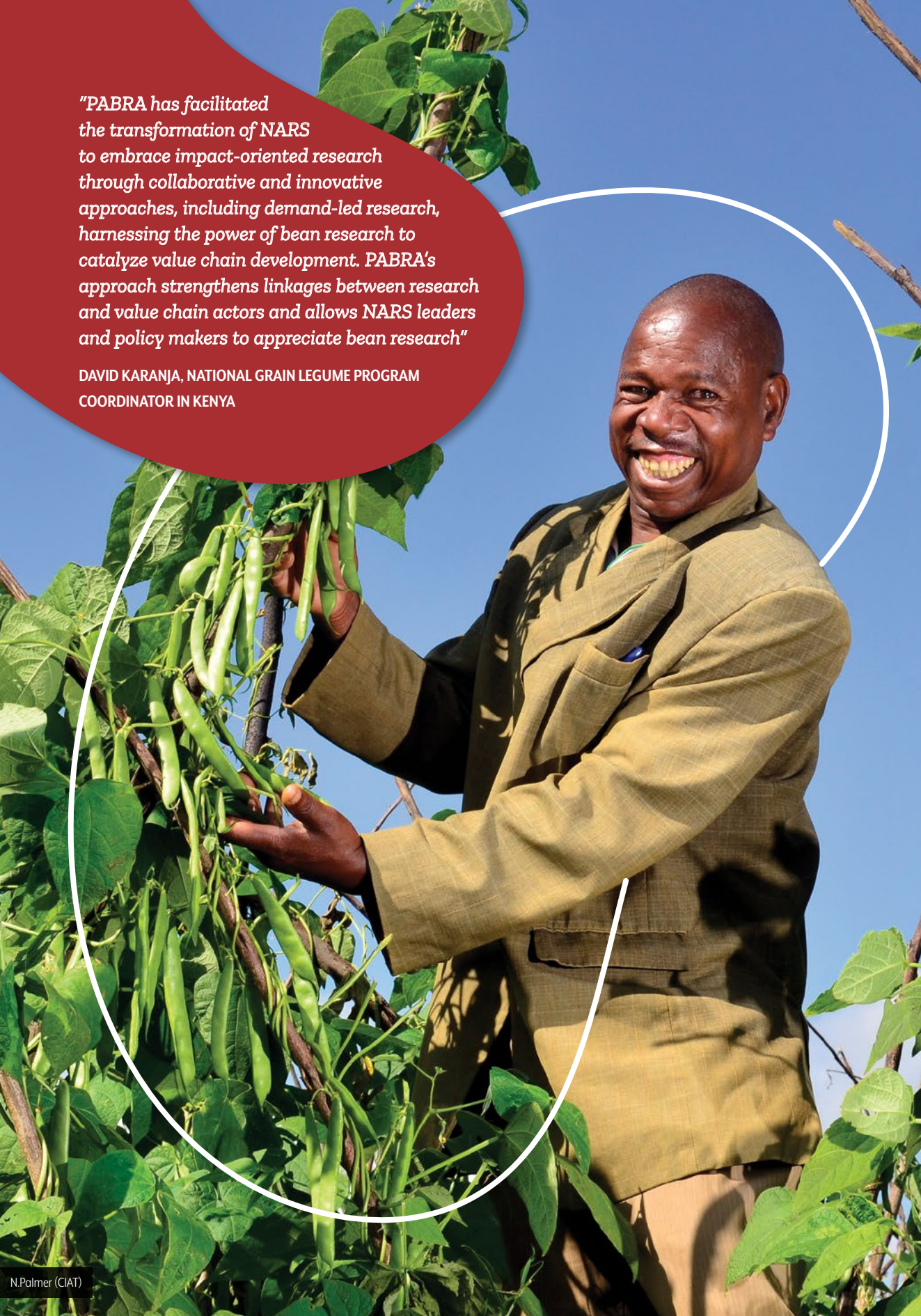
- Delivered improved bean varieties to over 37 million African farmers, with 800,000 farmers directly trained in the management of improved varieties across 22 countries
- Released over 657 new bean varieties across 27 countries that increase yields
- Enabled the use of high-iron and high-zinc beans that improve nutrition in vulnerable communities, households and individuals
- Provided commercial opportunities for women bean entrepreneurs both on- and off-farm
- Linked more than 1.4 million farmers with more profitable markets.

This impact has been generated by a long-term commitment by all stakeholders and a willingness to shape the direction of PABRA through:

1. The focus on collaborative, transparent, and inclusive decision-making, and the ability to bring together various actors, public and private, to work together for a common goal
2. The focus on institutional development with the public and private sectors, which builds capacity throughout the value chain
3. The long-term approach taken by all partners, including national governments, private-sector partners, and international funding agencies
4. The ability to work at all levels in the value chain, bringing all stakeholders together
5. The focus on innovations that will improve livelihoods through effective market engagement
6. Demand-driven multi-disciplinary research that can be applied in various contexts.

"PABRA has facilitated the transformation of NARS to embrace impact-oriented research through collaborative and innovative approaches, including demand-led research, harnessing the power of bean research to catalyze value chain development. PABRA's approach strengthens linkages between research and value chain actors and allows NARS leaders and policy makers to appreciate bean research"

DAVID KARANJA, NATIONAL GRAIN LEGUME PROGRAM COORDINATOR IN KENYA



N.Palmer (CIAT)

PABRA's evolution

Pre-1996

Beans were mainly a subsistence crop

Research partnerships between NARS & CIAT started in mid-1980s in the Great Lakes Region and East Africa but were disconnected and disrupted by civil unrest

1996 2003

PABRA, at the formative stages, focused on strengthening its institutions and bean breeding, particularly understanding market demand with the initiation of market-led breeding. New varieties were released in several countries

2003 2009

Consolidation of market-led breeding

Initiation of wider impact seed access and nurturing market partnerships

2009 2013

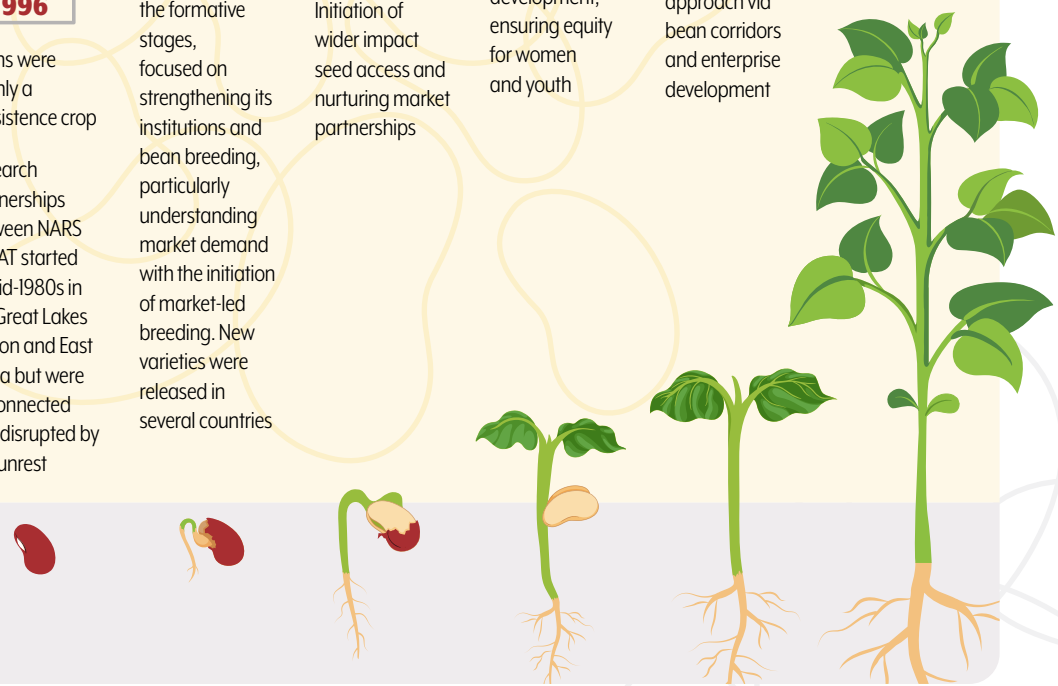
With an increasing focus on nutrition and value chains and a demand-led research and development, ensuring equity for women and youth

2014 2022

As the transformation continues, PABRA delivers multiple impacts through an integrated and inclusive food systems approach via bean corridors and enterprise development

To 2030 and beyond

Using PABRA's strength to build resilience to climate extremes and economic shocks, while meeting consumer demands of nutritional quality and new bean products

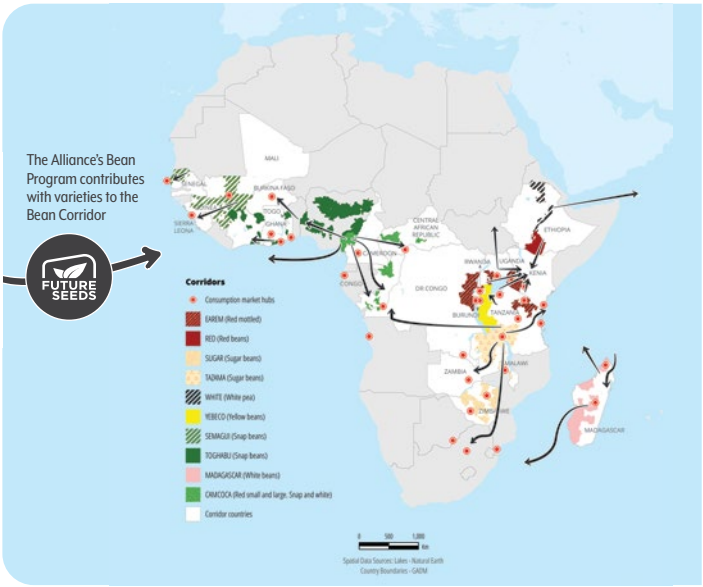


At the heart of PABRA's success over 25 years is its ability to be **dynamic, responsive, and agile,** and **to build partnerships** that **deliver benefits** and impact to smallholder farmers and other value chain actors and consumers. This impact has been underpinned by long-term engagement and partnerships with national governments and long-term sustainable investment by international development agencies, led by the Governments of Canada, Switzerland and the USA since 1997.

In 1996, when PABRA was being designed, beans were a **staple crop in the subsistence** agriculture sector facing significant production challenges. CIAT (now part of the Alliance of Bioversity International and CIAT) and

partners engaged in addressing these challenges and identified the potential of beans to improve livelihoods in African food systems. At this stage, the African bean sector was largely informal and had **spare capacity with research and development actions disconnected in several countries**.

The PABRA breeding activities are linked to the trait discovery and early generation development work of the **Alliance of Bioversity International and CIAT Bean Program** in Colombia, and to the genebank **Future Seeds** at the Alliance Americas hub in Colombia – which safeguards the global bean collection – through germplasm and knowledge exchange, along with capacity strengthening in breeding and related crop improvement disciplines.



In addition to the sharing of germplasm from Colombia with Africa, the **Global Bean Research Program of the Alliance of Bioversity International and CIAT** is a member of PABRA and has focused its efforts in building capacity of the NARS bean programs, some of whom have now evolved from being able to focus on late generation testing, variety release, adaptive research in seed, food and cropping systems to include trait discovery and early generation development, thus benefiting from strategic and applied research across a diversity of ecosystems.

Map source: Bean Atlas. 2020. https://hdl.handle.net/10568/110556

During the early focus on **farm productivity** through **improved varieties**, on **farm management** and functioning **seed systems**, regional bodies were maturing.

As PABRA developed, the challenge of **sustainable scaling** was identified. This needed to be resolved to deliver the greatest benefit to millions of smallholder farmers and consumers. These challenges, with the support of effective leadership, drove a transformation in PABRA that enhanced its **capacity to respond to demand**.

This demand response is multi-layered: first responding to smallholder farmer demand through such innovations as disease-resistant and early-maturing varieties to combat the challenges of climate change; then to consumer demand with the development of nutrition-rich beans that can be cooked and processed more efficiently, thus saving labor, women's time in the kitchen, and resources; and to the changing demand of investors wanting to deliver wide-scale nutrition outcomes through diet diversity.

PABRA's work stretched along the **research-development continuum** to cover aspects of variety development, seed systems, integrated crop management, linking farmers to markets, nutrition, value addition, gender mainstreaming and transformative change, capacity strengthening, monitoring and evaluation, impact assessment and communicating our successes, and experience capitalization stories and lessons learned with the research community, partners, and funders.

As these challenges were addressed, **entrepreneurial opportunities** were identified for **women-based businesses** to process and add value through product development and marketing of beans. Youth were able to take advantage of the opportunity to provide services to farming enterprises that were profitable and market driven. These were opportunities for women and youth to **increase income** and improve livelihoods as the value of the bean sector in Africa grew.

The next step was **bean corridors** of Africa, enabling regional and national public and private investment platforms to **connect and coordinate** all aspects of the value chain, including embedded research driven by market demand. These bean corridors enhanced the efficiency of bean production, distribution, and consumption through context-specific bottleneck solving at each node of the value chain. Importantly, the bean corridors were also able to improve the approach to innovative policy development, which made the movement of beans across national and international borders more efficient.

As PABRA evolved and matured, partnerships diversified and the **leadership and governance** kept pace, resolving context-specific bottlenecks using the strength and capacity of all partners.

The **future looks bright** for building on the significant outcomes of PABRA and the transformation of the bean sector in Africa to continue to benefit both smallholder farmers and consumers in Africa and beyond.

Emerging from conflict, a friend in need is a friend indeed

PABRA has supported Burundi and Zimbabwe,[3] helping them to emerge from periods of political, social, and economic unrest. The release of 15 climate-smart farmer- and consumer-preferred varieties in Burundi has significantly improved nutritional outcomes. The three new varieties released in Zimbabwe have supported the revival of the canning industry. In each case, the support that led to an increase in bean production and productivity has also catalyzed public and private investment in the bean sector.

3 Buruchara RA, Onyango P, Rubyogo J-C, Mutari B, Zulu R, Nkalubo S, et al. 2021. PABRA means partnership: Transforming agriculture in Africa together. https://hdl.handle.net/10568/113037

"Innovative approaches to delivering impact at scale is key to PABRA's success and can be used by others"

J.Marin (CIAT)

PABRA's institutional influence

PABRA's strong focus on innovative partnerships and research approaches to solving complex problems to generate impacts that have great influence and significant spillover effects on how other institutions can approach their challenges. PABRA has been at the forefront of tackling issues in a new way, which other research and development institutions are now adopting.

These include the following examples:

- **Participatory plant breeding** building on CIAT's pioneering work in participatory breeding.[4] The approach embraces new forms of cooperation between farmers and researchers for the selection and testing of new varieties along with innovative strategies for local seed production and distribution.
- **Demand-led breeding,** which increases the availability and adoption of high-performing crop varieties that meet consumer and market demand, and harnesses private-sector investment in the bean value chain. This approach has been expanded in recent years in the partnership between PABRA and the Demand-led Breeding (DLB) project (www.demandledbreeding.org/), which has used beans in Africa as an example of how to identify farmer and consumer preferences to guide bean breeding programs. The approach is applicable to many other crops.
- **Impact-oriented seed systems** foster partnerships for scaling up access to quality seed. This evaluates diverse models of seed production and delivery, supports farmer-informed choices, catalyzes private seed enterprise development, and shapes policy to the benefit of millions of smallholder farmers through the adoption of new varieties.
- **Product corridors** are used to enhance the business environment by improving linkages and providing coordination among farmers, researchers, seed suppliers, buyers of products, and consumers, and engaging with policymakers to support investment in bean value chains and cross-border trade.
- **Gender mainstreaming** integrates a gender perspective into the preparation, design, implementation, and monitoring and evaluation of approaches with a view to promoting equality between women and men, and combating discrimination, thus making sure that women have access to production assets and benefits from the value chain while also having an enhanced role in leadership and decision-making. For example, PABRA

4 Ashby JA. 2009. The impact of participatory plant breeding. In: Ceccarelli S. et al. (Eds.). Plant breeding and farmer participation. 649-71. https://bit.ly/3Q6T7Kw

works with the CGIAR Gender, Diversity and Inclusion (GDI) Knowledge Hub, when developing new bean varieties that meet women's preferences.[5]

- **Private partnerships** have been used to leverage public funds, enhance efficiency, and improve the adaptation of innovations to demand with the aim of fostering wider and faster diffusion and sustainability.
- **Improving school meal programs** mainstreams the integration of high-iron beans in school meals to ensure that school-age children have access to nutritionally balanced and healthy diets, thus catalyzing community-based (women-owned) food businesses.

Recognition for PABRA

PABRA's success has been recognized as the winner of the 2019 **Al-Sumait Prize for African Development** (https://bit.ly/3CGfYcO) for its contribution towards food security through bean research in Africa and as a CGIAR "Golden Egg" for its contribution to healthy diets, management tools, and scaling methods (https://bit.ly/3CH0ViS).

5 Nchanji EB, Lutomia CK, Ageyo OC, Karanja D, Kamau E. 2021. Gender-responsive participatory variety selection in Kenya: Implications for common bean (*Phaseolus vulgaris* L.) Breeding in Kenya. *Sustainability*. 13(23):13164. https://doi.org/10.3390/su132313164

N.Palmer (CIAT)

"Thanks to PABRA, common beans now represent more than 25% of our processing and trading business, which has grown significantly to more than 6,000 t per annum. PABRA has played a key role in building our capacity and the capacity of more than 7,500 smallholder farmers that we work with in technical and financial skills, but also in areas such as management and leadership"

G2L COMPANY LTD.

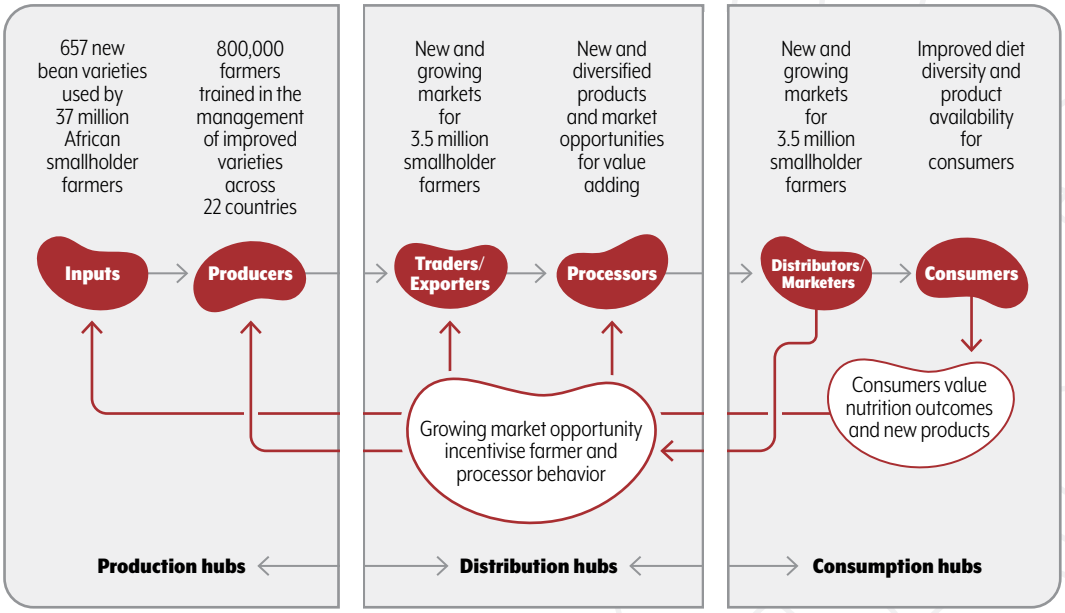
N.Palmer (CIAT)

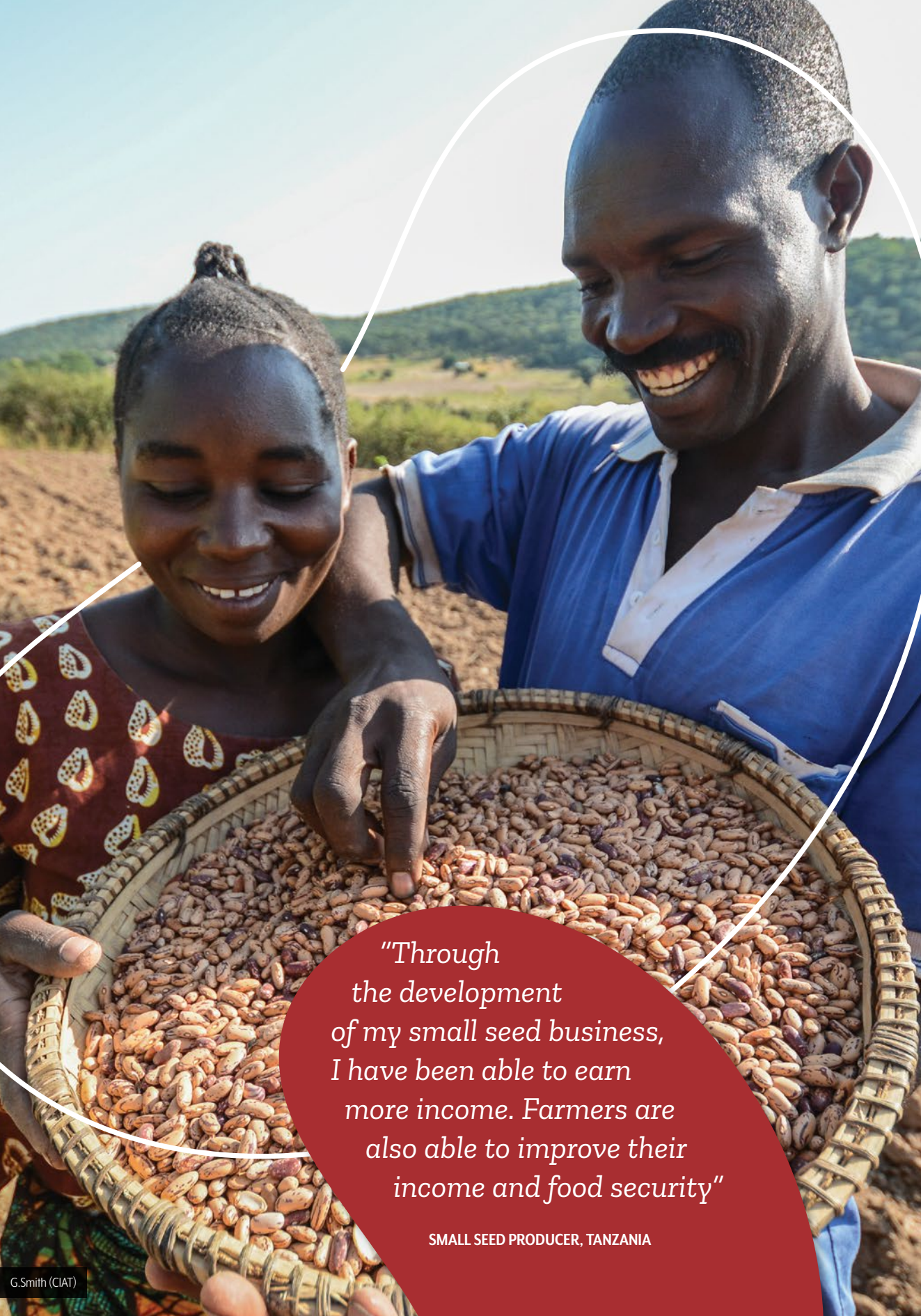
The power of value chains within bean corridors

SUCCESS STORY

Aggregators adding value and improving livelihoods in Rwanda – Aggregator Trust

After a thorough analysis, Aggregator Trust was established to deliver what farmers and consumers want in Rwanda. Aggregator Trust works with more than 4,000 smallholder farmers and community groups providing seeds and fertilizer and building capacity to improve the quality and quantity of bean production. The partnership has also improved access to finance from institutional lenders. Aggregator Trust has big plans, all of which involve a continuous partnership with PABRA. Over the next 3 years, Aggregator Trust plans to work with 25,000 smallholder farmers, supporting their transition to becoming a profitable bean business that delivers wide consumer benefits.





"Through the development of my small seed business, I have been able to earn more income. Farmers are also able to improve their income and food security"

SMALL SEED PRODUCER, TANZANIA

G.Smith (CIAT)

Country transformations

Demand-led research in transforming the economy – an Ethiopian case study[6]

In Ethiopia, the adoption of new bean varieties bundled with improved farm management has increased food consumption, diet diversity, and annual consumption expenditure, and significantly grown profitable export markets.

Economic liberalization in the 1990s enabled the development of the agricultural sector of Ethiopia and has benefited the growth of the bean sector, in which yields increased 6% annually from 2006 to 2016 and exports increased threefold in the same period. This growth has been jointly supported by the Ethiopian government and PABRA through the Ethiopian Institute of Agricultural Research (EIAR) in partnership with the Alliance of Bioversity International and CIAT, intensifying efforts under the Tropical Legumes II and III, Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa (AVISA), and Modernizing Ethiopian Research on Crop Improvement (MERCI) project financed by BMGF and long-term SDC and GAC support. These efforts have not only returned benefits to smallholder farmers and consumers; in some years, beans have provided more than 10% of the agricultural export earnings of Ethiopia. In addition to the improved farm productivity and new bean varieties with multiple resilience to abiotic and biotic constraints that address pest, disease, drought, and low soil fertility challenges, as well as market-desired traits, the efforts have developed an innovative decentralized seed system that has improved linkages between formal and informal systems and led to a framework for wider dissemination and scaling of improved varieties.

This effective scaling (supported by a functional and coordinated seed system) has provided more than 3 million smallholder farmers with access to improved varieties that are being grown on 290,000 hectares, about 3% of Ethiopia's area planted to grain crops.

The adoption of the improved varieties, bundled with soil fertility improvement options, has led to increased food consumption, diet diversity, and consumption expenditure for rural households. The impact analysis shows that, if 1 hectare of cropping land uses improved bean varieties, annual consumption expenditure for the household increases by 23%. If the adoption of the new bean variety is bundled with fertilizer application, annual consumption expenditure rises by 37%. In addition to these increases in consumption expenditure, non-food

6 Habte E, Katungi E, Yirga C, Berhanu A, Ratz B, Mukankusi C, et al. 2021. Adoption of common bean technologies and its impacts on productivity and household welfare in Ethiopia: Lessons from tropical legumes project. https://hdl.handle.net/10568/119754

household expenditure increases by 54% when the household is able to sell all harvested beans. The new varieties are early maturing, thus avoiding stress from drought during maturation and allowing harvest and sales to occur early in the growing season, providing both food and income at an early stage of the season.

As the sector developed, farmer cooperative unions in regional states supported production increases for export, with small white bean canning-type varieties grown for export markets and other varieties grown for domestic consumption. Efforts were made to ensure that all categories of consumers were reached via multiple delivery channels. The development of the export market enabled the value of small white bean exports from Ethiopia to grow substantially from US$8 million in 2008 to more than US$184 million in 2018.

A range of innovations help smallholder farmers to adopt new varieties. These innovations include demand-led systems centered around grain market demand, diversification of seed production models, seed pack size to meet farmer demand, and breeding for consumer traits (e.g., bean grain color, size, and shape, taste, short cooking time, and nutritional value).

Perhaps the most significant outcome of the efforts to support the growth of the Ethiopian bean sector is the success in diminishing the long lag from varietal release to farmer adoption. Prior to the coordinated efforts of PABRA, it was estimated to take 21 years for 50% of the farmers to be aware of new varieties and 23 years for 50% of the farmers to cultivate new improved varieties, thus severely restricting the return on investment. Following the sustained and coordinated efforts in Ethiopia and building of smallholder farmer capacity, this lag to adoption declined from more than 20 years to 2 to 7 years. A key part of the success in reducing the lag time was resolving the disconnect between those who multiply the seed as a business and those who distribute the seed to smallholder farmers, with capacity building in the informal sector to identify and market improved varieties.

Demand-led research in enhancing nutrition and improving farmers' livelihoods – a Burundi case study[7]

Burundi is a landlocked country in central East Africa and the second most densely populated country in Africa (463 people/km^2 in 2022). The country's population has been expanding faster than its agricultural outputs and is expected to double by 2030 and triple by 2050, with almost half of the population under 15. Burundi went through more than a decade of civil war (1993-2005) with severe socioeconomic effects on the population. The country's economy depends on agriculture, which contributes about 40% of GDP and more than 95% of the food supply. High pressure on land is a leading cause of soil fertility depletion, thus eroding the country's capacity to improve its food production for a growing population.

7 https://bit.ly/3PXQ2we

As a result of its membership in PABRA, the Institut des Sciences Agronomiques du Burundi (ISABU) has released 30 climate-smart farmer- and consumer-preferred bean varieties (including climbing) developed through demand-led approaches. The adoption of drought-tolerant medium-altitude climbers expanded the area grown to beans from seven agroecological regions in 2015 to ten in 2021. Old varieties were replaced by new varieties at scale. The higher demand for improved varieties resulted in an increased number of small and medium seed enterprises from 15 producing 10 t of certified and quality declared seed (QDS) in 2014 to 315 (175 of them women-led) producing 1,595 t in 2021. Combining improved varieties with improved crop management enabled farmers to harvest 26% more from the same area of land than they would have with local landraces, thus making extra income available for households. An impact assessment study (https://bit.ly/3e5lz22) conducted in 2019 showed that improved varieties are 15.8% more profitable than local varieties. It was also found that more than 95% of the harvested quantity is used for home consumption irrespective of the variety grown. The yield gain resulting from the adoption of improved varieties and crop management practices in Burundi raised national bean production by more than 87,000 t, enough to feed almost 2 million people per year if most people in the region eat on average 45 kg of beans a year. Considering the expansion of area under beans as well, annual national bean production increased from 250,000 t in 2014 to 420,000 t in 2021.

Transforming food systems in Rwanda[8]: the impact of iron-biofortified bean adoption on bean productivity, consumption, purchases, and sales

In Rwanda, farmers, consumers, and traders have benefited from the adoption of a high-iron bean variety (RWR2245). Farmers who adopted RWR2245 obtained a yield gain of 20–49% over traditional bush bean varieties. Growing RWR2245 for at least one out of two annual growing seasons increases the length of time beans are consumed from own production by 19–20 days and reduces the time beans are purchased for consumption by 22–23 days. Growing RWR2245 also increases the probability of selling beans by 12%. Adoption can thus improve household nutrition via two channels: primarily by increasing iron intake via substituting biofortified harvested beans for less nutrient-dense beans from the market and additionally by increasing household income that can be spent on nutritious foods through the decrease in bean purchases and increased likelihood of selling beans.

Further country insights can be found in Kessy et al. 2020.[9]

8 Vaiknoras K, Larochelle C. 2021. The impact of iron-biofortified bean adoption on bean productivity, consumption, purchases and sales. *World Development*. 139:105260. https://doi.org/10.1016/j.worlddev.2020.105260

9 Kessy R, Omondi E, Onyango P, Rubyogo J-C, Persley G, Yao N. 2020. Counting on beans Building bean business investment and strengthening PABRA breeding approach. https://hdl.handle.net/10568/108591

N.Palmer (CIAT)

Outputs, outcomes and impact

Outputs achieved by PABRA

- **657 new varieties** that are climate smart and improve nutrition released by NARS partners since 1997
- **Improved farm management** for smallholder farmers
- Input **service providers gain** employment
- **New commercial opportunities** in processing healthy, nutritious, and convenient bean-based products

Outcomes benefiting users

- 2x **Doubling bean yields** among adopters
- **Increased consumption expenditure** by 37%
- **Climate challenges** managed
- **Over 11.3 million consumers** accessing biofortified beans
- **37 million households** accessing bean varieties that improve livelihoods

Impacts changing lives

- **400 million consumers with improved diet diversity** through beans including women and youth

"Over the past 25 years, PABRA members have released over 657 new bean varieties aimed to meet market demand and human nutritional needs."

J.Marín (CIAT)

Outputs and outcomes

PABRA has delivered outputs and outcomes that have benefited a range of users.

Outputs: creating new varieties and farming practices and services

The foundation of PABRA's success is the development, scaling, and adoption of **new varieties** by the bean farmers of Africa. These new varieties meet the demand of smallholder farmers, value chain actors (including processors), and consumers. Over the past 25 years, PABRA members have released more than 657 new bean varieties in 31 countries within the three regional networks (Figure 2).

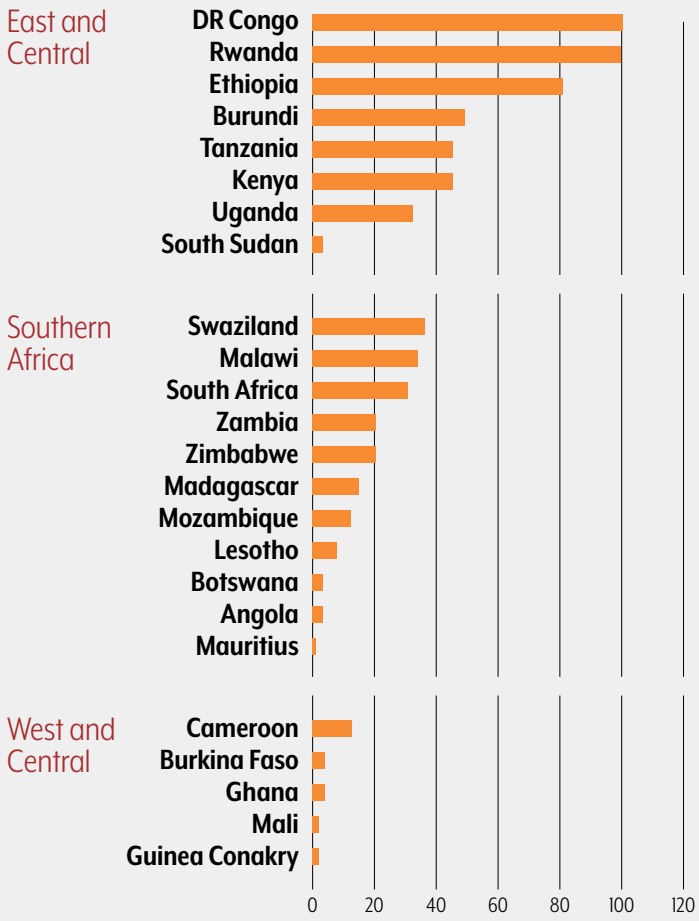


Figure 2: Release of new varieties from 1996 to 2021 in three bean regions.

The release of new varieties has grown since the inception of PABRA (Figure 3).

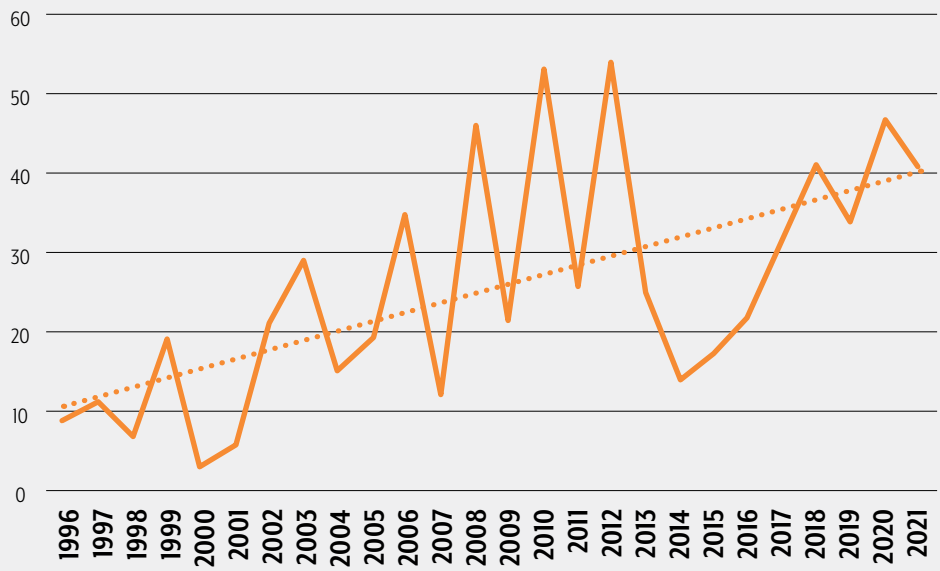


Figure 3: The growing release of new varieties from 1996 to 2021.

These varieties meet market demand and address micronutrient deficiencies. A total of 54 iron- and zinc-rich varieties improve nutritional outcomes. Smallholder farmers use multiple-stress-tolerant and climate-smart varieties (early-maturing, drought-tolerant, pest- and disease-tolerant) to adapt to the challenges of climate change. The pest- and disease-tolerant varieties enable farmers to use more efficient and effective management systems and reduce on-farm losses.

The introduction of new varieties to African farming systems alongside **improved farm management** has, in some cases, doubled yield and driven an 86% increase in the area of bean production (https://bit.ly/3TqOaPf). This improved farm management has ensured that African smallholder farmers have maximized the benefit of new varieties and have built skills to overcome farming constraints and risks, particularly those posed by climate extremes.

In addition to these on-farm improvements, opportunities for entrepreneurs, particularly youth, to provide **farm services** have arisen. Using mechanization to decrease labor on-farm provides income and increases the productivity of the farming system.

Introducing a new variety and farm management practices does not, in itself, lead to adoption and practice change.

SUCCESS STORY

Empowering women agri-preneurs to offer multiple services and generate impacts

The Institut des Sciences Agronomiques du Burundi (ISABU), in partnership with the Alliance of Bioversity International and CIAT, and through the Pan-Africa Bean Research Alliance (PABRA), empowered Ms. Regine Kabirori (https://bit.ly/3CGtvRB), a bean farmer and agri-preneur from Kirundo Province, who has been producing new early-maturity bean varieties with large grain size and others traits preferred by consumers. Before 2016, Ms. Regine produced 1.25 t of bean seed on her 4-hectare farm. With identified demand, Ms. Kabirori rented other farms from her neighbors to grow more beans and sold more seed to farmers' organizations in distant communes, NGOs. and other development partners. In 2021, she produced and supplied 86.7 t of certified bean seed. Ms. Kabirori also attended a training activity on the use of Purdue Improved Crop Storage (PICS) bags. These bags are triple-layered, airtight, and sealed, thus preventing insects from burrowing into the seed. Within six months, she was surprised to find that none of the bean seeds had been attacked by bruchid. This was proof enough for her to invest in more bags. She uses the bags not only on beans but also on other crops such as maize and rice.

The profit she made from selling seed was used to buy two cows, eight goats, and four pigs to include in her farm. She also paid her daughter's university fees and built her own store for the grains. She now supplies seed of new varieties, including high-iron bean seed, to 100 smallholder farmers (98 women and 2 men) in her community. Empowering women entrepreneurs such as Ms. Kabirori has helped women to increase crop productivity and seed production beyond beans and improve their incomes and family livelihood while delivering quality agri-services, supporting their communities, and raising their social status.

As such, a significant contribution from PABRA has been a focus on effective methods to **scale innovations**. The approaches are context-specific, address bottlenecks, and enable those adopting the innovations (smallholder farmers, value chain actors, consumers) to manage risk.

As new varieties and management went to scale, driven by market conditions, **value-addition opportunities**, such as processing to produce innovative bean products, emerged. These opportunities were particularly suitable for women and youth entrepreneurs. Recently, PABRA has developed and promoted healthy, nutritious, and convenient bean-based products that have supported the development and growth of small- and medium-sized enterprises (SMEs) for women and youth.

A total of 25 public seed enterprises, 2 large and 117 SME seed companies, and 545 farm-based seed businesses have been established that were able to supply more than 42,000 t of improved bean seeds in 2021. This seed, in turn, has allowed farmers to adopt new varieties, increase variety turnover, and improve bean productivity.

PABRA now has more than 934 **partners** in 31 sub-Saharan Africa countries, which includes 432 farmer organizations. These partnerships are critical to supporting the adoption of innovations throughout the value chain, from new varieties to SME start-ups through to international export opportunities. These partnerships are also critical to identifying and addressing relevant bottlenecks throughout the value chain.

PABRA realizes that the legacy of interventions is often through **capacity and institutional development** that is built to ensure sustainable impact. This development also ensures that bottlenecks can continue to be addressed and ongoing growth of the sector be supported. As an indication of the efforts to build capacity, PABRA and the Alliance of Bioversity International and CIAT have been directly involved in the training of 4,000 national research partners, more than 100 postgraduates, and more than 460,000 (48% women) smallholders and other value chain actors to ensure the effective use of innovations and continue the ability to address context-specific challenges.

Outcomes: changing farming behaviors and adopting new varieties

Key outcomes include changing farmers' practices to achieve higher yield and increased productivity; greater economic returns for smallholders and other value chain actors; increased export earnings; improved nutrition for consumers, including farming households; and inclusion of women and youth in various aspects of the value chain to deliver livelihood benefits.

The adoption of new varieties and improved farm management practices have meant that approximately 37 million smallholder farmers in Africa (58% women) have seen **bean yield increasing**, with some yields doubling. Average bean yield of 560 kg/ha in 2003 increased to more than 980 kg per ha in 2016 (https://bit.ly/3pTKKHp). As yield and productivity have increased, and greater market opportunities have been used through maturing value chains, the sector has also grown in Africa, with more than 6 million hectares now under improved-variety bean cultivation.

Improved productivity and growing markets have delivered improved **economic returns to smallholder farmers and households**, nationally and regionally. At the farm level, the introduction of new bean varieties and improved farm management in Zimbabwe has led to increased income of US$500–800/ha in unirrigated farming systems and up to US$1,000/ha in irrigated systems and increased demand for improved seed.[10]

10 Katungi E, Kalemera S, Mutua M, Maereka E, Chirwa R, Chimboza D, et al. 2020. Bean technology adoption and its impact on smallholder farmers' productivity, bean consumption; and food security: Evidence from Zimbabwe. https://hdl.handle.net/10568/109122

SUCCESS STORY

Bean grain processor in Tanzania – G2L Company Ltd.

G2L is working with more than 7,500 smallholder farmers in four regions in Tanzania to benefit all those in the value chain. Beans now provide 25% of G2L's grain business revenue with 6,000 t annually. G2L is partnering with research institutions, local government, and lending institutions to support the development of the whole bean value chain in Tanzania. Focusing on building farmer capacity and enabling access to new bean varieties and access to suitable finance, G2L has developed an approach that benefits all those involved in the value chain.

JC Rubyogo (CIAT)

Another important outcome is the ability for smallholder farmers to adapt early-maturing varieties, climate-smart agricultural technologies and practices, as well as climate information services. PABRA developed and deployed a Digital AgroClimate Advisory (DACA) tool to enhance bean value chain actors' ability to respond to climate challenges.

A key outcome for PABRA is the significant contribution that improved bean varieties make to **better nutrition**. More than 37 million smallholder farmers accessed, farmed, and consumed beans with improved quality from 2004 to 2021. In Rwanda, high-iron beans (RWR2245) improved yields, increased own consumption, and provided an additional 4.7 mg of iron per day (https://bit.ly/3crNN6H), more than a quarter of the recommended daily requirement of 18 mg/day for women.

More than 277 SME start-ups (69 led by women) have taken advantage of new **commercial opportunities** and played a significant role in linking more than 3.5 million smallholder farmers (51% women) to growing market opportunities. These SMEs provide significant opportunities for women and youth to engage in commercial activities, such as providing farm services and processed bean product development that enhance the overall performance of the value chain.

"PABRA has been a major contributor to the CGIAR impact areas"

G.Smith (CIAT)

Impacts: changing lives

Impressive impacts have been achieved by PABRA, with significant contributions to the Sustainable Development Goals (SDGs). The focus to understand impacts continues, with recently commissioned impact assessments that will determine economic benefits through cost-benefit analysis in Zimbabwe and Burundi. The analysis will consider investment and operational costs and benefits derived primarily through increased revenue and income for farmers and value chain actors.

Nutrition, Health and Food Security

Common bean is a major component of the diet of the urban and rural populations of Eastern, Central, and Southern Africa. Beans provide iron and zinc, which are essential to the health and well-being of African women and children, and also protein, which is essential for the entire household of women, men, and children.

The release of 657 new bean varieties, which have reached 37 million farmers, along with good farm management has more than doubled yield in many cases. In Ethiopia, beans are grown by more than 3 million smallholders on more than 290,000 hectares of land and account for 3% of the land planted to grain crops, with yield increasing at more than 6% per year, since 2003. A total of 65% of the area allocated to beans has improved varieties grown by 57% of the farms. From 2003 to 2021, in Uganda, yield improved from 0.7 to 1.5 t/ha; in Ethiopia, yield has expanded from 0.7 to 1.8 t/ha; and in Tanzania, yield increased

from 0.5 to 1.3 t/ha. In conjunction with this yield increase, there has been an 86% increase in bean production area throughout Africa. In Rwanda, farmers who adopted improved high-iron variety RWR2245 increased yield by 20% and increased the length of time beans are consumed from own production by 19–20 days and decreased the length of time beans are purchased for consumption by 22–23 days (https://bit.ly/3crNN6H).

This increase in yield and area of production has contributed to providing dietary protein to more than 400 million people in Africa, especially women and children living in rural areas and poor urban consumers. To determine additional nutritional effects, studies of high-iron beans versus normal beans were conducted with young women in Rwanda, most of whom were iron deficient or anaemic. After four and a half months, the group eating high-iron beans showed a statistically greater increase in haemoglobin (3.8 g/L), log serum ferritin (0.1 log µg/L), and total body iron (0.5 mg/kg).[11] Furthermore, other studies revealed that consumers of high-iron bean demonstrated superior cognitive ability, increased neuron activity, and superior work capacity. More than 37 million smallholder farmers accessed, cultivated, and consumed improved-quality beans from 2004 to 2021.

With the bean yield increase, there has been an 86% increase in bean production areas throughout Africa.

11 Murray-Kolb LE, Wenger MJ, Scott SP, Rhoten SE, Lung'aho MG, Haas JD. 2017. Consumption of Iron-Biofortified Beans Positively Affects Cognitive Performance in 18- to 27-Year-Old Rwandan Female College Students in an 18-Week Randomized Controlled Efficacy Trial. *The Journal of Nutrition*, 147(11):2109-2117. https://doi.org/10.3945/jn.117.255356

SUCCESS STORY

Working with smallholder farmers in central Uganda

More than 800 t of seed of improved bean varieties are now being sold to smallholder farmers for production in central Uganda. Productivity has increased up to fourfold with improved varieties and good farm management. The increased production provides more nutritious diets for households in the community as well as increasing income. The success comes from working with and building capacity of the entire value chain. The approach of linking institutions, public and private, around a common goal with both farmers and consumers plays a key role in delivering impacts in Uganda.

G.Smith (CIAT)

Poverty Reduction, Livelihoods, and Jobs

The PABRA partnership has seen a 30% increase in household income for 5 million households in 10 African countries. For example, from 2003 to 2021, smallholder farmers who adopted improved bean varieties in Zimbabwe saw seasonal income gains of US$500–800 per hectare under rainfed conditions and US$1,000 per hectare under irrigation. In addition to the income increases, analysis shows that, when 10 kg of additional improved-variety bean are planted, this raises per capita consumption expenditure by 9% and increases the probability that a household is food secure by 6% while decreasing the likelihood of being poor by 6%.

A total of 277 SMEs (69 women-owned) commercializing bean have also been supported by PABRA, which has enabled more than 1.4 million farmers (51% women) to have new market opportunities. This improved market engagement has also provided employment for more than 300,000 men and women throughout the value chains.

Environmental Health and Biodiversity

The scaling of good agricultural practices (GAP) has had significant impact on environmental health and biodiversity. Smallholder farmers are using chemical inputs more efficiently and effectively, thus diminishing environmental impact. Improved bean yield through efficient use of inputs and GAP also means less land clearing, contributing to improved environmental health. Consumers are becoming more interested in the environmental impacts of food consumption patterns and are providing incentives to continue and improve agricultural practices. Increased yield also contributes to environmental health benefits. The environmental impact of shorter cooking time for beans is potentially large through decreased demand for fuel for cooking, hence less destruction of forests for wood and charcoal. The growing of beans contributes to increased nitrogen in the soil through atmospheric nitrogen fixation and provides organic nitrogen sources for companion crops or subsequent crops in rotation. Straw left behind after the grain harvest is valuable for soil fertility and animal feeding.

Gender Equality, Youth, and Social Inclusion

Women and youth have been a key focus of PABRA. Of the more than 37 million households that have gained access to improved seed, 58% are represented by women. Of the 3.5 million farmers that have improved their market access, 50% are women. Of the more than 10 million Africans who have consumed high-iron beans in 15 SSA countries, 53% are women. And, of the 501,716 bean value chain actors who have been trained by PABRA, 73% are women.

Climate Adaptation and Greenhouse Gas Reduction

The use of improved varieties has bean crops maturing early in 65–95 days, thus avoiding climatic stress conditions, such as drought. In Rwanda, when smallholder farmers have access to and use climate information, they achieve significantly higher yield than those that do not use the available climate information. In Ethiopia, access to higher-yield beans that are resilient to pests, diseases, and drought enabled more than 2 million farmers to triple production from 117,750 t in 2004 to 378,802 t in 2021, with yield rising from 0.75 to 1.6 t/ha from 2004 to 2021 (https://bit.ly/3TqOaPf).

Managing climate extremes for smallholder farmers

Rising temperatures will decrease the area suitable for bean production by 30% to 50% in Eastern Africa in the 21st century if adaptation does not occur. New varieties are a key part of an effective adaptation strategy. Of the new varieties released, 52 are early maturing, 38 are drought tolerant, 180 are multiple stress tolerant, and 412 are pest and disease tolerant. These traits are used to address the challenges of climate extremes.

The 2016 drought in Malawi caused maize crops to fail. Improved climate-resilient bean varieties developed and distributed by PABRA and its partners in Malawi were able to be successfully grown and harvested, thus delivering nutritional security and income for farming families. Following the benefits of beans to address climate extremes, Malawi partners are now evaluating the effects of maize intercropping and fertilizer application on bean productivity.

Adapting to climate extremes with the support of new varieties can also improve productivity. In Uganda, farmers who adopted two climate strategies (using drought-tolerant/early-maturing varieties in conjunction with adjusting planting times based on weather information) harvested double the amount of beans compared with those farmers who did not use the climate adaptation strategies.

N.Polmer (CIAT)

From farm to household, community, country, and continent

1

657 new varieties reaching 37 million farmers have improved incomes and livelihoods

2

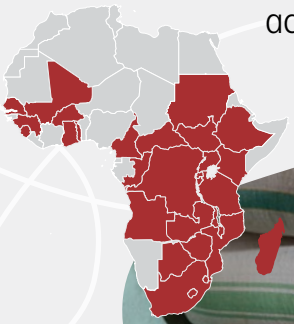
13 million households increased non-food expenditure by 54% due to selling improved beans

3

Release of biofortified beans now means that over **10 million Africans (53% women)** are consuming high-iron beans in 15 countries

5

Exports of beans through African bean corridors and also into international markets **are growing significantly, providing revenue** but also enabling more consumers access to beans



PABRA 25
Beans for impact and nutrition in Africa

4

More than
3.5 million farmers,
half women, have
improved market access
as a result of PABRA

6

400 million people, especially women and children,
in Africa benefit from increased dietary protein,
carbohydrates, and micronutrients from beans

"PABRA has delivered impact across the SDGs, in particular SDGs 1, 2, 5, 8, 13, and 17"

N.Palmer (CIAT)

PABRA's contribution to the SDGs

1 NO POVERTY

10 kg of improved varieties decreasing the likelihood of being poor by 6%. Shifting one hectare to improved beans increases per capita consumption expenditure by 23%

17 PARTNERSHIPS FOR THE GOALS

More than 934 partnerships in over 31 countries through 8 bean corridors of Africa; 59 private seed companies, 11 large-scale grain traders, and 432 farmer organizations; 19 public seed enterprises, 68 SME seed companies, and 399 farm-based seed businesses supplying 37 million farmers

2 ZERO HUNGER

Good farm management and improved varieties more than doubled yields from 0.4 to 1.0 t/ha and provided dietary protein to more than 400 million people in Africa, especially women and children living in rural areas and poor urban consumers

From 2017 to 2021, more than 953,823 hectares of African land were occupied by climate-resilient beans, with 15% of households using bean technologies to manage environmental stress in 8 countries. In Ethiopia more than 2 million smallholder farmers were able to triple production, with yield rising from 0.75 to 1.6 t/ha through access to higher-yield beans that are resilient to pests, diseases, and drought

13 CLIMATE ACTION

More than 37 million households (58% represented by women) have gained access to improved varieties from 2017 to 2022; 11.3 million Africans (53% women) have accessed or consumed high-iron beans in 15 SSA countries; 501,716 bean value chain actors (73% women) gained skills and knowledge

5 GENDER EQUALITY

In Zimbabwe, farmers adopting improved bean varieties have seen seasonal income gains of US$500–800 per hectare under rainfed conditions and US$1,000 per ha under irrigation. The development of the bean sector has provided income and employment for 295,208 men and women smallholder farmers. 300 traders in Tanzania trade over 200,000 t p.a. valued at over US$100 million with even the smallest trader generating approximately US$10,000 p.a. 277 SMEs commercializing bean business opportunities providing 4 million farmers (51% women) with new market opportunities

8 DECENT WORK AND ECONOMIC GROWTH

"PABRA is powered by science, innovation, and partnerships across 31 countries to deliver better beans for Africa"

G.Smith (CIAT)

Key success factors

The key success factors for PABRA follow:

Supporting institutional and individual development

The most important success factor for PABRA is its approach to working with partners and supporting the institutional and individual development of those partners. The direct training of 4,000 national research partners, more than 100 postgraduates, and more than 460,000 smallholder farmers and other value chain actors is a small indication of the dedication to institutional development. However, the approach is much deeper. PABRA works with all actors in the value chain, the research bodies that develop innovations to scale, and the policy agencies that develop an enabling environment. PABRA strengthens the capacities of its members for the benefit of the African bean sector. The other important institutional development approach is to enable the connection across countries, through regional networks, value chains, and bean corridors, and throughout the continent to learn and develop from tested experience, supporting each other in the ongoing development of the bean sector.

- Developing consumer- and farmer-preferred varieties: the demand that PABRA has successfully responded to has come from markets. Value chains have been established to take advantage of arising trade opportunities and market demand. Demand also comes from national governments and development partners, for whom livelihood improvements through economic growth and social outcomes, particularly for women and youth, are critical. PABRA has also been able to respond to the increasing demand for improved nutrition – a critical factor for investors – and to the demand from new opportunities, such as for new processing enterprises as value chains mature and consumers continue to demand innovative products. Importantly, PABRA has been able to respond to demand for the development of new tools and approaches, such as demand-led breeding and mechanisms and approaches to improve scaling.

Finding solutions to specific bottlenecks through a multi-disciplinary approach

PABRA has focused on the right bottlenecks and solved those problems along the value chain. This approach ensures impact for smallholder farmers and consumers. A key part of this success is the ability to use a multi-disciplinary approach, in partnership with other organizations, to invest in and implement innovations that enable the whole value chain to improve in a sustainable manner.

Building sustainable partnerships

Founded in the evidence derived through research, over 25 years, PABRA has always built partnerships that enhance value and deliver benefits for key stakeholders. Partnerships with research institutes within and beyond Africa have been important. Engaging with value chain actors throughout the bean corridors of Africa, which has been supported by African regional bodies and economic communities, has enhanced the impact of PABRA. These partnerships have benefited PABRA through engagement in prioritization, dissemination, scaling, adoption, and co-investment to deliver benefits in a complementary manner.

Recovering from economic shocks through access to innovation

The ability to respond to economic shocks rapidly is a key feature of more resilient agri-food systems. One way in which PABRA is ensuring improved capacity to respond to economic shocks is to get improved seeds into the hands of smallholder farmers faster. This enables improved productivity and income generation in a shorter period of time.

A unique private-sector partnership was formed to enable this to happen in Kenya. PABRA worked with a Kenyan business, Bubayi, to identify customers for new bean varieties. The partnership was able to produce certified seed in 4 years, a process that usually takes 10 to 12 years.

Excellent and stable leadership and responsible governance

Initiated by CIAT (now the Alliance of Bioversity International and CIAT), who formed a consortium with key regional bean bodies and 31 NARS, the approach of PABRA has benefited from insightful and committed leadership at several levels. Governance arrangements have also been able to respond to new partnerships and continue to resolve emerging challenges, through regional steering committees and an overall PABRA steering committee with authority and responsibility for setting priorities. The stability of committed leadership is also an important factor, with only three directors leading PABRA over its 25 years. Important leadership and governance roles have been played by national governments and more recently by the private sector, with the approach developing into a shared leadership model. This shared leadership supports shared decision-making and the ability to engage with emerging opportunities and investments.

Using multiple impact pathways

The motivation of PABRA has always been to have beneficial impact on smallholder farmers and consumers through the more effective use of beans. To this end, PABRA has taken an open approach to the most effective delivery mechanisms to achieve this benefit at scale. PABRA has used informal and formal approaches, government-based systems, the private sector, and NGOs to ensure that impact is maximized. PABRA has also been willing to engage in innovation, such as digital platforms, to ensure that this impact continues, and is tailored to the needs and context of different countries and communities.

Bundling of innovations

Bundling innovations in various ways has been a constant approach for PABRA. Breeders have bundled multi-stress genes into new varieties. As these new varieties emerge, these technological innovations have been bundled with financial and policy innovations to ensure that enabling environments are in place to maximize impact. Research partnerships have also been bundled effectively together with CGIAR and the NARS of both developing and developed countries, and various research disciplines have been bundled together to maximize the likelihood of impact. As these research approaches have been effectively bundled, PABRA has also ensured the bundling of research, extension, adoption, and capacity building to ensure that innovations reach scale effectively.

Constantly evolving to meet new challenges

PABRA has shown a constant ability to evolve with a long-term commitment, which is essential for impact. PABRA has demonstrated adaptive management of all resources, responding to demand and evolving methodologies to improve impact. This has been demonstrated in the development of seed systems that have improved farmers' access and evolved approaches to ensure the maximization of benefits for women and youth. PABRA has also evolved to address emerging challenges, such as the need for improved nutrition, the empowerment of women in all aspects of the value chain, and breeding work and capacity to respond to climate change.

Ensuring orientation to inclusive impact

All of PABRA's efforts have been focused on delivering impact, particularly for smallholder farmers and consumers. With this focus, PABRA has always ensured an inclusive approach, enabling women and youth to gain significant benefit through their engagement with growing opportunities within bean value chains and throughout bean corridors.

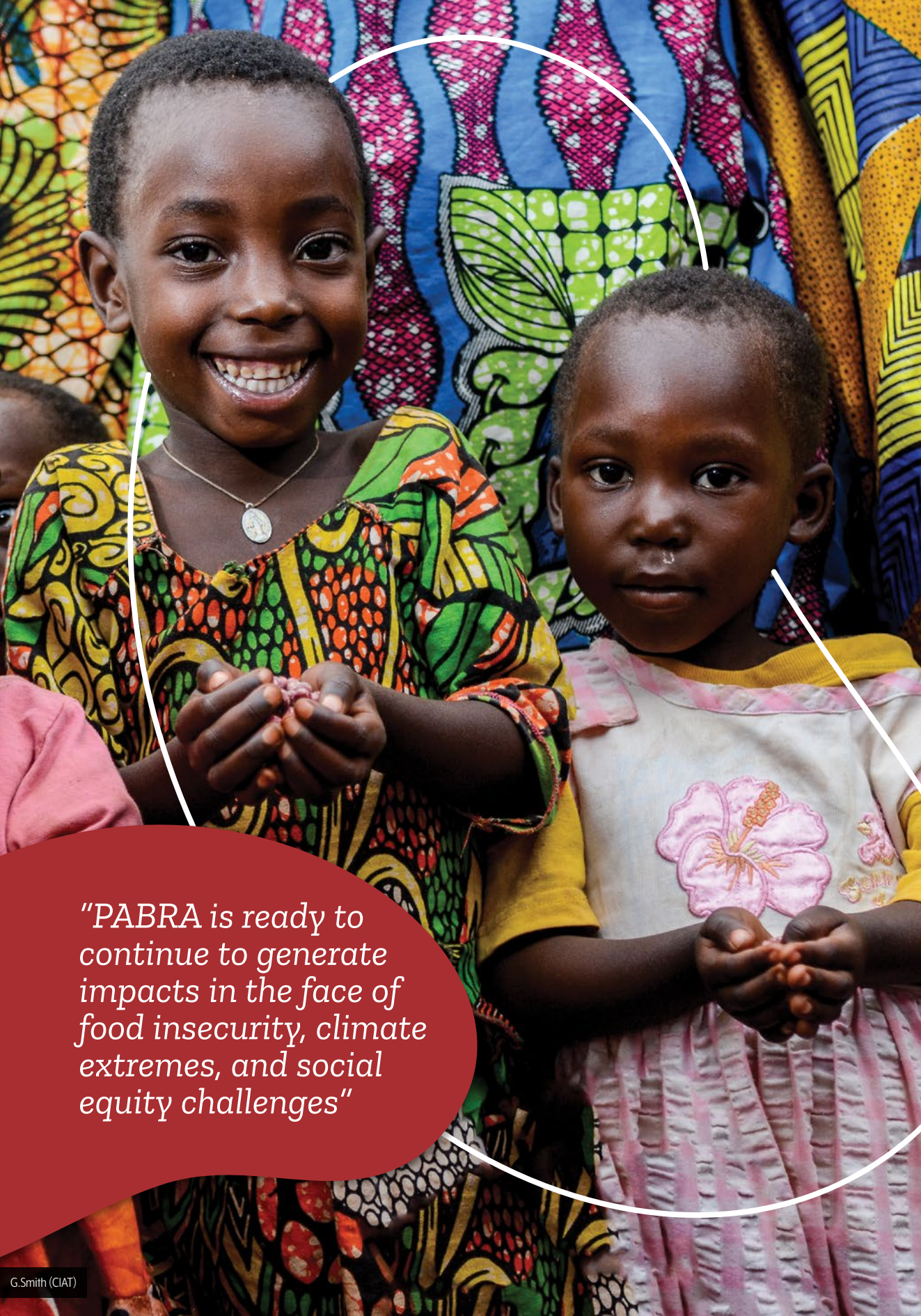
Solving inequalities through beans

As agricultural systems move from subsistence to market engaged, men often take greater advantage of the opportunities to improve income. PABRA has been instrumental in supporting women and youth entrepreneurs to engage in employment and commercial activities as markets provide greater livelihood opportunities. In addition, PABRA's efforts to decrease bean cooking time and develop processed bean products have been highly beneficial for women.

Ensuring continuous funders' support

PABRA is a multi-donor and investment platform. Since inception, PABRA has benefited from the long-term commitment of three founding external investors through the international development agencies of Canada, Switzerland and the USA. They have also provided important stability of external funding to which additional bilateral projects can be added at the country level to support specific outputs, while contributing to the overall outcomes and impact of PABRA. The long-term commitment of CIAT (now part of the Alliance of Bioversity International and CIAT) and the funders of CGIAR has also provided stability in staffing and institutional support. In addition, the founding external funders have provided an investment framework for other donors, governments, and private-sector investments. The continuous funding has allowed PABRA to have a long-term vision and program planning and to take innovation to scale sustainably.

E.Birachi (CIAT)



"PABRA is ready to continue to generate impacts in the face of food insecurity, climate extremes, and social equity challenges"

G.Smith (CIAT)

The future

Climate, security, resilience, crisis, nutrition, women

Africa's food security is being challenged by climate extremes, social crises, and economic shocks. PABRA will continue to take on such challenges by enabling the bean sector to thrive. PABRA will expand its role as an investment platform for both the public and private sector. Working with a broad array of these partners will assure our future success.

PABRA is a key part of the agri-food transformation in Africa, with a proven track record of developing regenerative and resilient agri-food systems that deliver lower-cost nutritious foods enjoyed by many.

PABRA, an ever-evolving investment platform

PABRA's future focus will:

- Expand the power of demand-led bean breeding with both increased farmer and consumer priorities, using innovative financial models, and by regional and international partners
- Assure greater smallholder profits from improved bean varieties that produce larger harvests and earn higher return on their investments
- Build resilience to climate change and the regenerative capacities of farming systems
- Foster women and youth entrepreneurship and generate new jobs
- Advance gender-transformative research and development for inclusive future agri-food systems
- Share the PABRA bean corridor model and insights into value chain performance with a range of private-sector investors having national, regional, and international perspectives
- Influence national policies to create an enabling environment that attracts greater public and private investments in bean value chains
- Embrace efficiencies generated by information and communications technologies (ICT) that scale out innovations in the value chains and change livelihoods
- Assist in expanding the PABRA model and experiences to other regenerative food crops, particularly legumes
- Ensure healthier dietary outcomes through the nutritional power of beans.

Meeting the SDGs by 2030

This approach has delivered significant impact. With support and the right growth strategies, PABRA will continue making significant contributions to the SDGs by 2030.

SDG	Current impact	Growth strategy	Planned impact
1 NO POVERTY 	30% increase in incomes for 5 million households in 10 countries using improved beans	Deepen and broaden adoption and market engagement to reduce poverty	15 million farmers increasing income by 30% through the adoption and marketing of improved beans
2 ZERO HUNGER 	40% of households using improved bean varieties in 10 countries with 10% showing increase in diet diversity	Broaden household access to and availability of high-iron beans to improve diet diversity	60 million Africans diversifying their diet through the consumption of high-nutrient beans
5 GENDER EQUALITY 	1.4 million farmers (50% women) have gained improved market access	Increase opportunities for women's engagement with growing markets	2 million women through the bean value chain engaging with profitable market opportunities
8 DECENT WORK AND ECONOMIC GROWTH 	Bean sector has provided income and employment for 295,208 men and women smallholder farmers	Create employment for youth and women along the value chain from farm inputs to processing and marketing	1,000 SMEs take-up bean business opportunities providing 10 million farmers (60% women) with new market opportunities
13 CLIMATE ACTION 	37 million farmers accessed improved varieties	Ensuring farmers have access to varieties and knowledge to manage climate extremes	60 million farmers accessing climate-smart varieties that are pest, disease, and drought tolerant
17 PARTNERSHIPS FOR THE GOALS 	934 partnerships in 31 countries	Effective partnerships throughout entire value chain and policy environment	1,000 partnerships: including 600 farmer organizations, 230 public and private seed enterprises, 50 grain trading organizations, 20 bean processing businesses, 20 support service providers

Achieving these results

Importantly, the focus will continue to strengthen bean corridors and optimize the entire value chain, thus enhancing the performance and capacity of each value chain component for the benefit of women, men, and youth bean farmers, traders, and consumers.

Corridor hub	Value chain actors	Current focus	Medium-term focus	Longer term focus
Production	Variety development. Seed and other input providers	Genetics, technology, soil, human resources	Strengthen demand-led breeding and systems. Catalyze investments in the value chain, support robust partnership with financial services	Optimization of small-, medium-, and large-farm management
	Smallholder farmers	Small-scale but market-oriented production, storage	Market engagement, certified seeds, SMEs offering various services, medium-sized farms	Ecosystem services
Distribution	Aggregators, grain traders, and warehousing	Postharvest storage and aggregation efficiency, equity	Grain quality and volume, financing	Bundling services
	Distributors/Marketers	Open-air market	Supermarkets, exports	ESG information
Consumption	Processors	Dry bulk and initial stage of processing of beans	Dry packaged, flour, porridge, cooked wet/dry	Ready-to-eat meals (soups, crackers, chips)
	Consumers	Rural and urban market	Schools, urban and rural, international	Restaurants, fast food, specialty food stores

Investor portfolio

The development of PABRA over 25 years has been gratefully underpinned by investment by a group of bilateral and multilateral donors, the philanthropic sector, and PABRA member country governments. This investment support will remain critical to PABRA and the bean sector in Africa as PABRA continues to generate significant impact.

PABRA also recognizes the importance of engaging the private sector (conventional financial service providers and impact investors). These newer investors will likely focus on medium- and long-term issues that have an impact on the transformation of the bean sector in Africa. Private-sector investors will look for opportunities to derive economic outcomes within a shorter time through a focus on areas that engage a growing market, such as seed supply, alternative packaging, and cooked products. Environmental, social, and governance (ESG) investors will be willing to engage in a longer timeframe and look at more undefined areas of investment, such as the provision of ecosystem services through the smallholder bean sector.

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PABRA

Beans for impact and nutrition in Africa

www.pabra-africa.org

Alliance

Bioversity International

CIAT

International Center for Tropical Agriculture

Since 1967 Science to cultivate change

CGIAR

The Pan-Africa Bean Research Alliance is facilitated by the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), part of CGIAR

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