Demand-led Breeding

FOR EMERGING MARKETS IN AFRICA

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www.demandledbreeding.org

ANNUAL REPORT

2022

VISION STATEMENT

Transforming African agriculture by enabling small scale farmers to better participate in local and regional markets, by increasing the availability and adoption of high performing plant varieties that meet market demands and are resilient to the challenges of climate change and extreme weather events.

PURPOSE STATEMENT

The DLB project seeks to understand and learn from best practices in plant variety design worldwide. The project tests the thesis that market-led product development by public and private sector research agencies will lead to increased availability and higher levels of uptake of new, high performing crop varieties that enhance productivity and profitability of target crops.

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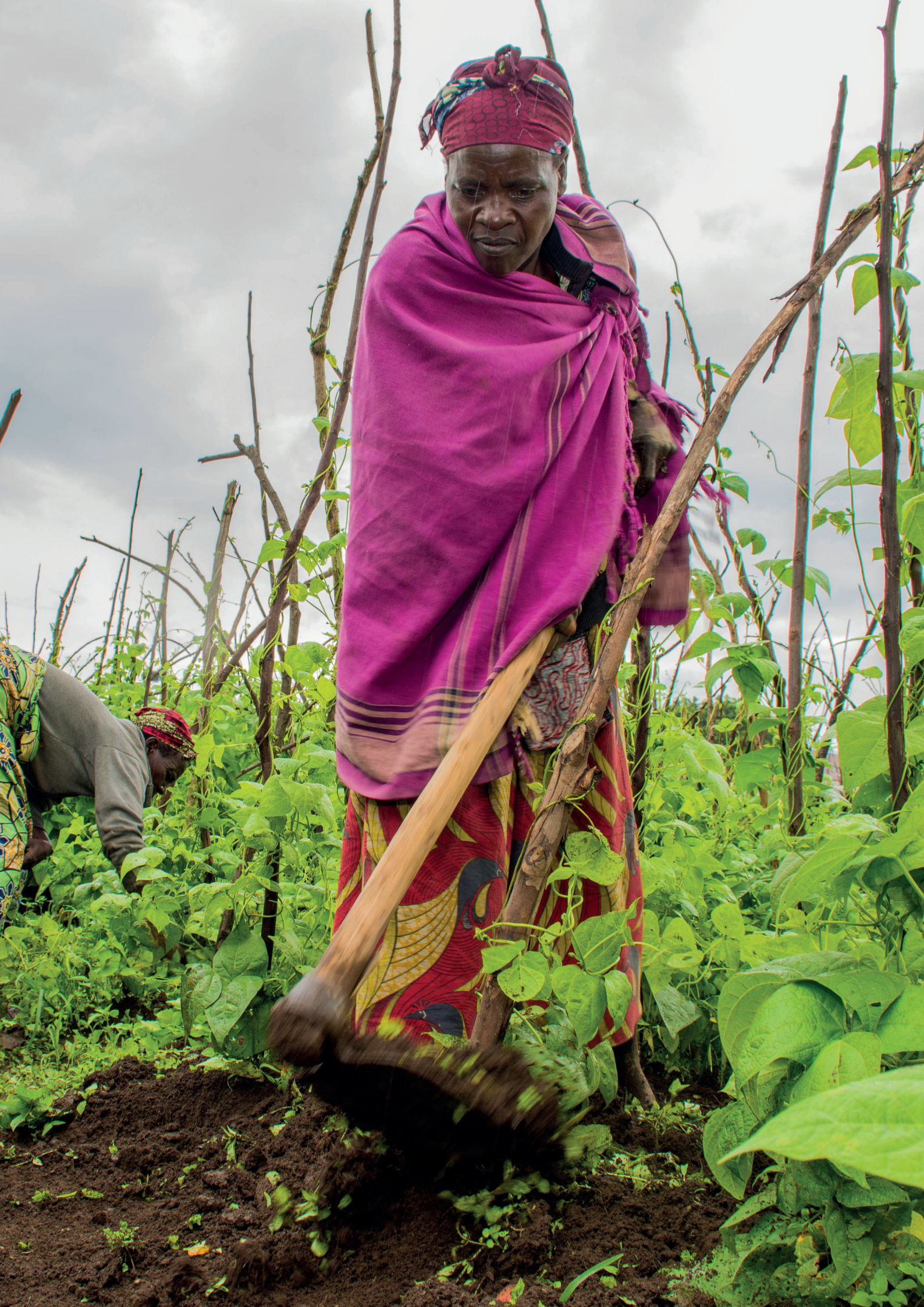

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1 SUMMARY OF ACHIEVEMENTS

PROJECT GOAL

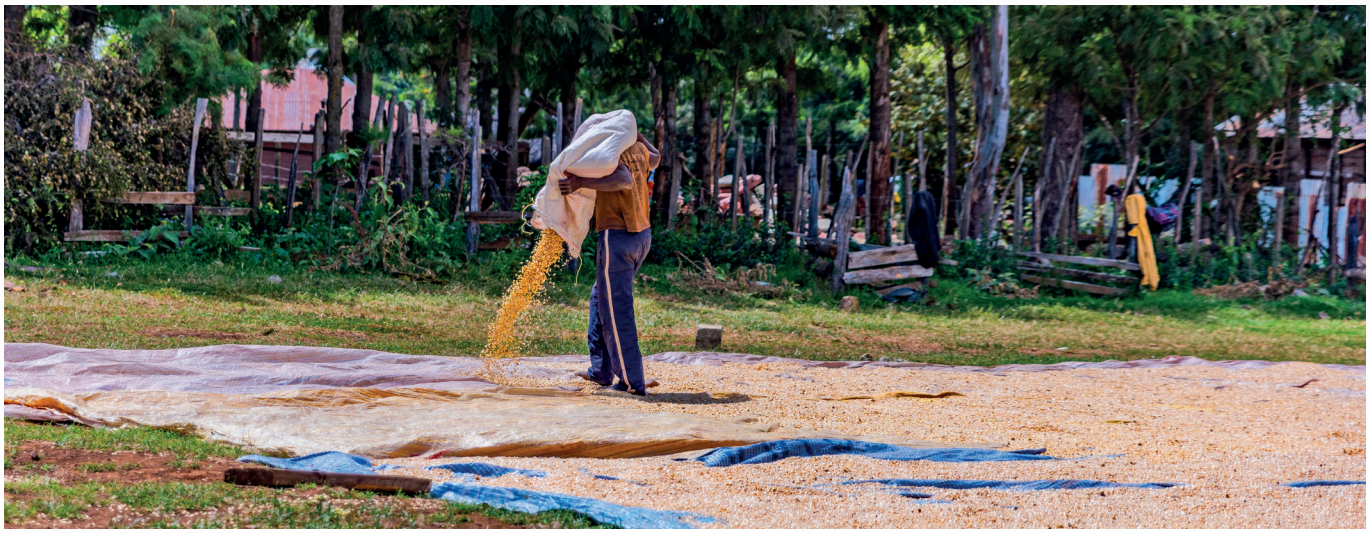
The goal of the project on "**Demand led plant variety design for emerging markets in Africa**" is to contribute to the transformation of African agriculture by enabling small scale farmers to participate in local and regional markets, by increasing the availability and adoption of high performing plant varieties that meet market demands. The intended research outcome is that plant breeders in Africa will adopt more demand-led approaches to plant breeding to respond to the preferences of farmers, consumers, and others along the value chain.

The demand led breeding (DLB) project is supported by an Alliance for Food Security, formed in 2014 by Australian Centre for International Agricultural Research (ACIAR) and the Crawford Fund, Australia, and the Syngenta Foundation for Sustainable Agriculture (SFSA), Switzerland. The project is managed by the University of Queensland, on behalf of its three co-sponsors and the partners in Africa. News on project activities and access to educational resource materials and professional development opportunities can be found on the project website: **https://www.demandledbreeding.org**

The progress towards achieving the project goal and the three project objectives, through the activities and outputs achieved since the project commenced in 2015 are summarised in this Annual Report 2022. The highlights include:

Forging New Partnerships in Africa, Australia and Internationally

The project's key research and educational institutional partners in Africa, with whom the DLB team have worked closely over several years are: the African Centre for Crop Improvement (ACCI) at the University of KwaZulu Natal South Africa; the Alliance of Bioversity International and the International Centre for Tropical Agriculture (CIAT), and the Pan African Bean Research Alliance (PABRA); the West Africa Centre for Crop Improvement (WACCI) at the University of Ghana; the Ethiopian Institute of Agricultural Research (EIAR), and Haramaya University, Ethiopia; the Ugandan National Agricultural Research Organization (NARO) and Makerere University, Uganda; and the University of Nairobi, Kenya.

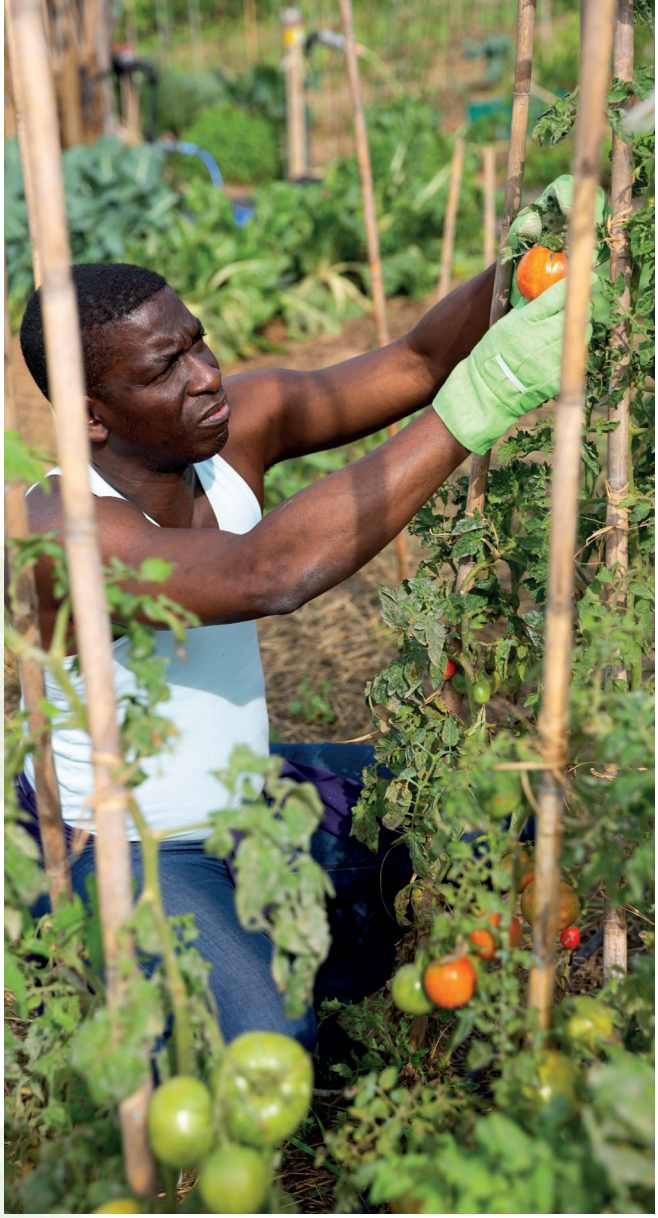


During 2021-22, the DLB team in Africa has been approached to expand its partnerships in West and Central Africa (e.g., in Cote d'Ivoire, Democratic Republic of the Congo (DRC) and Nigeria), and with the regional body, the West and Central African Council for Agricultural Research and Development (CORAF/WECARD), especially for sharing DLB approaches with plant breeders in francophone Africa.

In addition, the DLB team is collaborating with the international Breeding Program Assessment Tool (BPAT) program, also based at the University of Queensland. BPAT and DLB co-sponsored an international symposium on plant breeding in low- and middle-income countries, at the Australasian Plant Breeders Congress (APBC) in Queensland, in May 2022, with over 100 participants, including speakers from Africa, Australia, Europe and USA, contributing in-person or by video link.

Demand led breeding community of practice developed with plant breeders in Africa: The DLB project has developed a demand-led breeding "community of practice", composed of more than 400 plant breeders working within African national agricultural research systems (NARS) and universities in eastern, southern and West Africa. The members of the DLB community of practice are primarily African plant breeders who first participated in the DLB sponsored education and training workshops, some 25 of which were held in eastern, southern and West Africa between 2015-2019.

These DLB workshops, the majority of which were conducted during DLB Phase 1 (2015-2019), introduced to the African plant breeding community the principles of demand led plant breeding and its applications to crops important for food security and increasing incomes in farming communities throughout Africa. These plant breeders now constitute a "community of practice" with whom the DLB project team is working to mainstream demand led breeding approaches within national plant breeding programs for a range of crops in the countries of Africa. The DLB team supports the



community of practice through 8 crop-oriented working groups, and by developing educational resources, including two new technical modules completed in 2022 on Gender, diversity and inclusivity in plant breeding; and preparing product profiles, which are publicly available to download via the dlb website at **https://www.demandledbreeding.org/education-modules**

The DLB Pan African Coordinator, Dr Nasser Yao, who is based in Nairobi Kenya, is primarily responsible for developing and supporting the DLB community of practice of plant breeders, by developing and making new education resources widely available; and by establishing a variety of communication channels and new distance learning opportunities. These virtual educational and professional development activities were initiated in 2019 and have become increasingly important, due to the impact of the COVID pandemic throughout 2020-22.

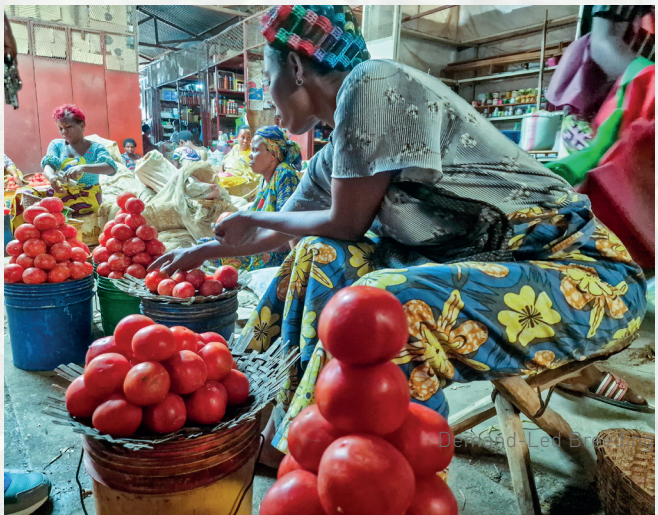
HIGHLIGHTS of achievements during 2021-2022, for each of the three project objectives, are:

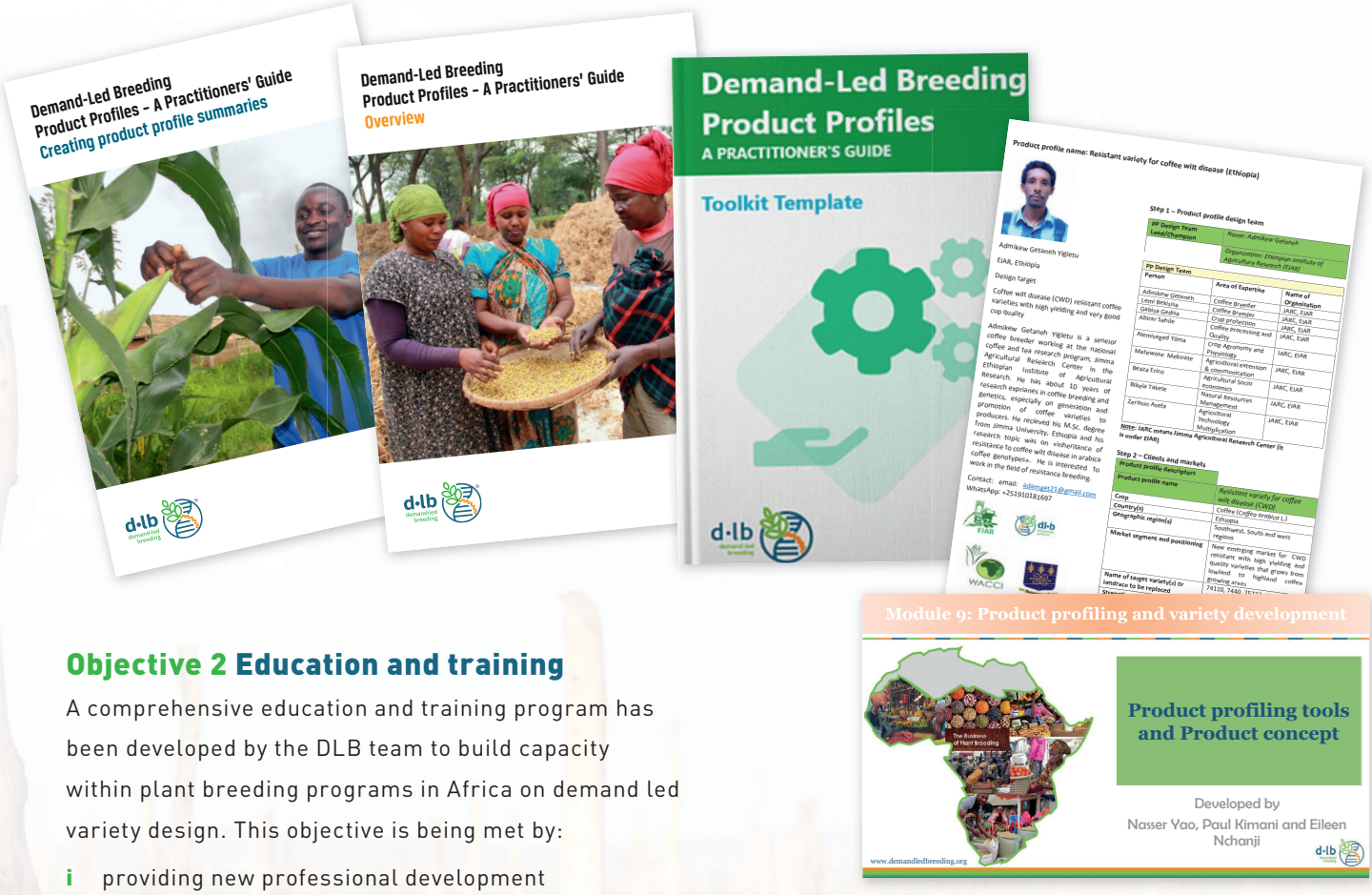
Objective 1 Best practices in plant variety design

Product Profiles – A Practitioners' Guide: Preparing product profiles to promote new varieties that respond to farmer needs, consumer preferences, market demand and climate challenges

An important early step in demand led breeding is developing product profiles that identify the priority traits required by various actors along the value chain. During 2020-21, DLB convened a working group of African and international plant breeders to develop new guidelines for preparing and communicating product profiles of new plant varieties. These guidelines are applicable for a wide range of crops, environments, and markets. The product profile guidelines are part of a "toolbox" for plant breeders, containing the DLB publications on *Product Profiles – A Practitioners Guide* and templates for creating new product profiles. These are available at: **https://www.demandledbreeding.org/product-profiles**

During 2021-22, the DLB product profile guidelines were used by African plant breeders within the *community of practice* to develop some 20 new product profiles, for seven different crops (beans, cassava, Kersting groundnut, maize, pigeon pea, sorghum and tomato). These new product profiles serve to characterise promising and potential new crop varieties, with traits of value to farmers, traders, and consumers, to meet household needs, market demands and/or to identify traits important for climate resilience. The product profiles describe the desirable profile of new varieties for range of crops, countries, and environments. These product profiles will be used both to promote the benefits and value of new crop varieties; and to promote scaling up of already available, highly promising varieties though creating more demand for high quality seed, to enable their wider distribution and use by farmers for target markets and environments.





Objective 2 Education and training

A comprehensive education and training program has been developed by the DLB team to build capacity within plant breeding programs in Africa on demand led variety design. This objective is being met by:

i providing new professional development opportunities for plant breeders in Africa; and

ii producing and disseminating new education and training materials related to the implementation of demand-led breeding programs.

Professional development resources and opportunities for plant breeders in Africa

The DLD project continues to develop and make available educational resources and other professional development materials for use by plant breeders in Africa. New resource materials developed in 2021-22 expand the resources already available online at **www.demandledbreeding.org**. These resources include a CABI-published textbook on "The Business of Plant Breeding" and its seven teaching modules. The textbook and its associated research and educational resource materials are available to download as open access on the CABI web site at: **https://www.cabi.org/products-and-services/about-cabi-books/open-resources/the-business-of-plant-breeding/**

A new DLB Module 8, on "Gender, Diversity and Inclusivity in Plant Breeding" is now completed and available at **https://www.demandledbreeding.org/education-modules**. This new Module 8 describes the principles and practices of taking account of gender and diversity when determining the traits important to distinct groups of farmers and consumers, and how to accommodate their preferences in designing new plant varieties. A new DLB Module 9, on preparing new product profiles, based on the DLB publications and toolbox on Product Profiles: A Practitioners Guide, has also been completed during 2021-22 and is available at: **https://www.demandledbreeding.org/education-modules**

Several African universities have incorporated the demand led breeding approaches, developed through the DLB project, into their formal post graduate teaching programs on plant breeding. These participating universities include the post graduate plant breeding courses taught by ACCI at the University of KwaZulu Natal, South Africa; WACCI at the University of Ghana; Makerere University, Uganda and the University of Nairobi, Kenya.

Objective 3 Policy and advocacy

Communications strategy

A communications strategy has been developed to guide DLB communications activities. The communications channels include new social media channels, as well as ensuring that the DLB website is a key source to enable plant breeders in Africa ready access to new publications, research and teaching resources, and identifying other professional development opportunities for plant breeders in Africa and internationally.

Policy and advocacy

The DLB community of practice members have identified two priority areas where they would value DLB team's professional support and new resource materials, on:

i Making the *business cases* for sustainable investments in demand led breeding, for targeted crops and countries; and

ii Identifying *innovative financing mechanisms* and *encouraging agri-entrepreneurship* amongst the breeding and seed system communities, for the development, promotion and scaling up of new plant varieties in Africa.

The DLB team is developing additional educational resources in these areas. These new resources are being made available progressively to the DLB community, through communications and dissemination activities, including DLB workshops with partner countries, regional and international seminars, and online resources. Policy and advocacy consultations initiated by the DLB team in these priority areas during 2021-22 include:

ii Two webinars organized by ACCI in South Africa on *"Making the case for demand led breeding in southern Africa*;

ii A workshop in Ethiopia to prepare the business case for strengthening investments in breeding beans and other crops, in Ethiopia, sponsored by the Ethiopian Institute of Agricultural Research (EIAR), CIAT/ PABRA and the DLB program; and

iii Presentations by DLB team members on a framework for preparing business cases for innovative investments in demand led plant breeding and encouraging agri-entrepreneurship in Africa, at a DLB-led international session during the Australasian Plant Breeding Congress in Australia in May 2022.

Future opportunities

These, and other, initiatives on promoting innovative financing mechanisms for sustainable support for demand led plant breeding in Africa and encouraging entrepreneurship amongst plant breeders in Africa are being further developed by the DLB team and its partners in Africa and internationally during 2022-23, as part of advocating the *business of plant breeding in Africa*, not as a cost to the public purse for governments, but as an investment in the future of African agriculture, and the farmers, traders, processors and consumers who drive this dynamic and critically important sector.

2 IMPACTS

SCIENTIFIC IMPACTS

The intended scientific impact is to ensure greater availability of new, high performing crop varieties that respond to customer needs, market demand, and climate challenges, and that this will lead to increased adoption of new high performing varieties by farmers in Africa, thus contributing to food and nutritional security and income generation.

The DLB project seeks to understand and learn from best practices in plant variety design worldwide. The project examines the thesis that market-led product development by public and private sector research agencies will lead to increased availability and higher levels of uptake of new, high performing crop varieties that enhance productivity and profitability of target crops.

Success in demand-led plant breeding will depend on the development, dissemination, and communication of new decision support tools to the plant breeding community. This will enable R&D programs in Africa to obtain and evaluate information about market demands and use this information to set targets and product specifications within plant breeding programs.

The scientific impacts of this project will be to better integrate all aspects of market demand into the design of new plant varieties. This involves the systematic use of product profiles to define the priority traits identified through consultation with the value chain participants for each crop and country. This approach also includes incorporating demand from farmers (primarily addressing biological constraints), as well as demands from consumers (e.g., taste, colour, nutritional quality) and demand from suppliers (e.g., storage quality). Developing new varieties that are resilient to climate change, including more frequent extreme weather events, is also increasingly important.

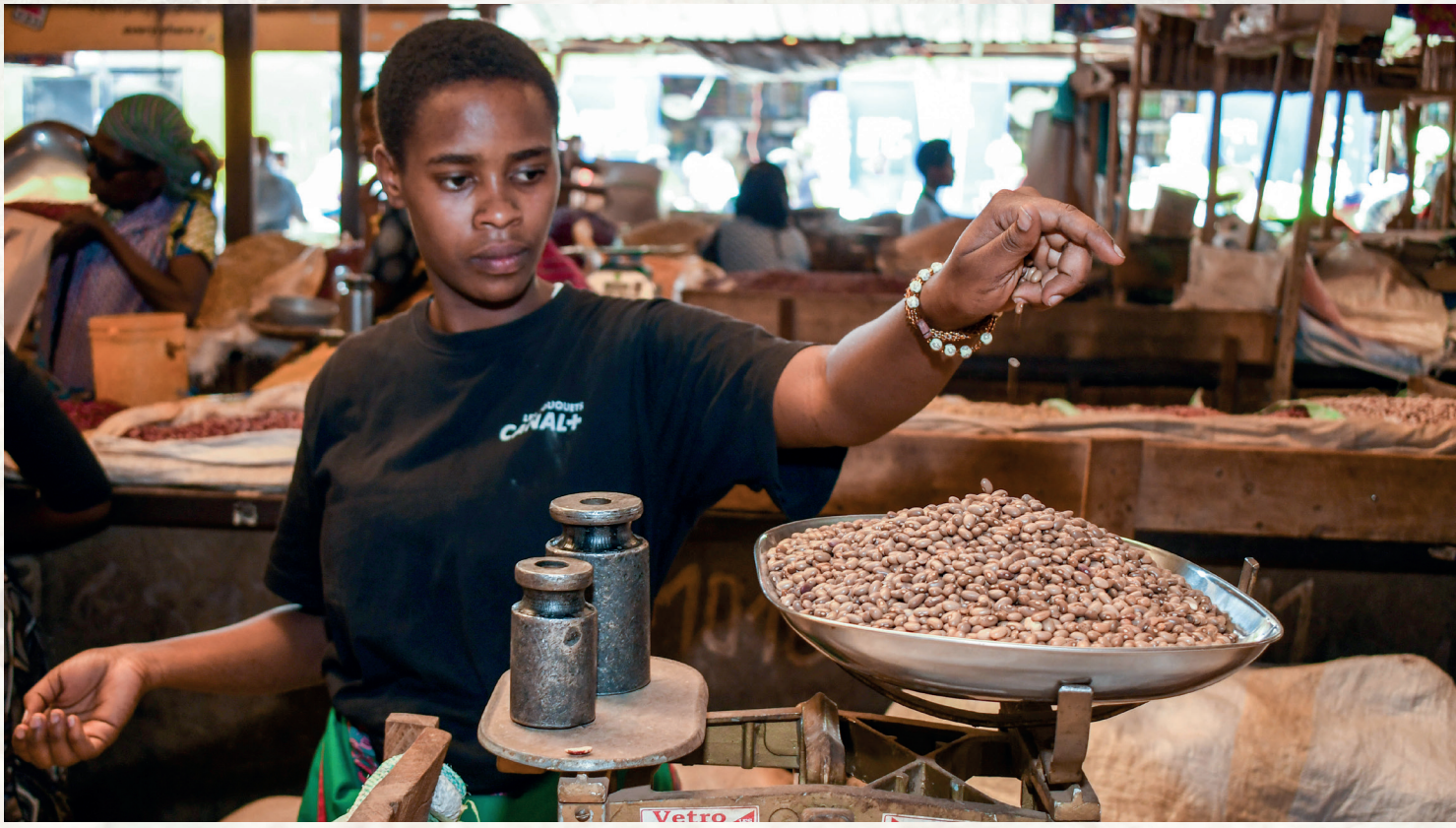
Demand-led approaches to plant breeding are being introduced progressively into regional and national

plant breeding programs in Africa by plant breeders who have participated in the DLB project since 2015. For example, demand led approaches to plant variety design are being successfully implemented by project partners for the following crops:

- *Beans* in eastern Africa, through the PABRA/CIAT regional bean breeding networks and national bean breeding programs in Ethiopia, Tanzania and Uganda;
- *Tomato* in West Africa, through WACCI at the University of Ghana and the Ghanaian national tomato breeding program, and the World Vegetable Centre regional tomato breeding program in Benin;
- *Rice* in Nigeria through the University of Port Harcourt; and
- *Kersting's groundnut* in Benin through the University of Aborney Calavi, Benin.

Demand led breeding in beans: In the case of the three PABRA-sponsored bean breeding networks in eastern, southern and West Africa, four years after the first exposure of PABRA bean breeders to DLB principles during phase 1 of the DLB project, many of these DLB participants are bean breeders working within national bean breeding programs and who are integrating DLB practices into their breeding programs. This includes, for example, understanding market segmentation and its roles in defining the breeding objectives and engagement of the value chain actors in various stages of germplasm evaluation. Product profile concepts are being mainstreamed by PABRA members at national institutes in their home countries, as well as within CIAT's international bean breeding program.

In addition, the results from the *market research study on rapid bean cooking time*, commissioned by the DLB project with national and international partners from the PABRA/CIAT team in Uganda are being shared with bean breeders through the PABRA regional networks in eastern, southern and West Africa, to support their



utilisation in developing product profiles tailored to their various environments and markets. This data is being used also to develop an investment case for breeding for rapid bean cooking time and other priority traits for farmers and consumers in Uganda.

The importance of the demand led approaches that have been adopted for bean breeding in Africa was widely recognized during the African Plant Breeding Association meeting in Rwanda in 2021, with the results of DLB applications in their breeding programs presented by several members of the DLB community of practice. These testimonials on the practical applications of DLB approaches by early career plant breeders in Africa are available at **https://www.demandledbreeding.org**

New scientific partnerships to increase adoption of demand led breeding principles and practice in national and international breeding programs

Africa-Australia research collaboration on rapid bean cooking time: The DLB team is working closely with the University of Western Australia and its ACIAR - funded project on rapid bean cooking time, led by Professor Wallace Cowling at the University of Western Australia. The DLB team's role is to support this related ACIAR project by facilitating the development of product profiles to target breeding new bean varieties for rapid cooking times in the six project partner countries, and to provide training in DLB approaches to scientists in these countries. Six new product profiles for bean varieties with rapid cooking time, suitable for each of the participating countries, have now been completed during 2021-22, with the DLB Pan African Coordinator working with breeders in each participating country to prepare the new product profiles suitable for their environments. These profiles are available at: **https://www.demandledbreeding.org/product-profiles**

International collaborations: The DLB Pan African coordinator (Dr Nasser Yao) participated in several international meetings during 2021-22, on behalf of the DLB team, and shared the *DLB Product Profiles* suite of publications, including guidelines and a toolkit for preparing product profiles, and examples for use by breeders in preparing product profiles of their target crops, markets, and environments.

These international collaborations also included sharing the DLB product profiles tool kit and examples with the SFSA Seeds2B team, for their use in related international programs that SFSA is supporting, particularly *The Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa (AVISA)* project.

Other international programs with whom the DLB team is sharing its educational resources and expertise include the OneCGIAR initiatives, such as the Accelerated Breeding Initiative (ABI), including *Excellence in Breeding (EiB) and Crops to End Hunger (CtEH)*, as well the international breeding programs being implemented by several international agricultural researchcentres in Africa. These international crop breeding programs are all giving increasing emphasis to using product profiles as a means to set targets and determine priorities within and between the crop breeding programs, they are supporting.

The DLB approach is to enable crop improvement teams in Africa, including plant breeders and their social science colleagues to work with all actors across the value chain for specific crops, to better understand farmer needs and market opportunities. This knowledge can then be organized into "product profiles", which set targets for plant breeding programs to develop new varieties that have a higher chance of adoption by farmers. The new varieties are designed to reflect farmers' needs, by meeting the biological imperatives of the environments where the crops are to be grown, as well as responding to new market opportunities, especially for consumer preferred traits.

CAPACITY IMPACTS

A comprehensive education and training program has been developed to build capacity within plant breeding programs in Africa on demand led variety design. This objective is being met by: (i) Providing new professional development opportunities for plant breeders in Africa; and (ii) Producing and disseminating new education and training materials related to the implementation of demand-led breeding programs.

Capacity impacts are coming from the project partners working with the teaching and research faculty in African universities and with research scientists and private sector expertise to develop and disseminate new educational materials for introducing new demand led approaches to plant breeding.

In addition, there has been a new and innovative educational nexus established between faculty at universities in Africa and Australia on training of the next generation plant breeders in Africa on demand-led plant breeding approaches.

DLB educational materials incorporated into African university curricula

Several African universities have now incorporated the demand led breeding approaches, developed through the DLB project, into their formal post graduate teaching programs on plant breeding. These post graduate teaching programs which include a component on demand led breeding include ACCI at the University of KwaZulu Natal, South Africa, WACCI at the University of Ghana, the University of Nairobi, Kenya, and Makarere University, Uganda.

Demand led breeding community of practice developed with plant breeders in Africa

The DLB project has developed a demand-led breeding "community of practice", composed of more than 400 plant breeders (120 of whom are women) working within African national agricultural research systems (NARS) and universities in eastern, southern and West Africa. These professionals are working on thirty-one crops within 28 countries of Africa.

The members of the DLB community of practice are primarily African plant breeders who first participated in the DLB sponsored education and training workshops, some 25 of which have been held between 2015-2019. These DLB workshops introduced to the African plant breeding community the principles of demand led plant breeding and its applications to crops important for food security and increasing incomes in farming communities throughout Africa. These African plant breeders now constitute a "community of practice" with whom the DLB project is working to mainstream demand led breeding approaches within national plant breeding programs for a range of crops in the countries of Africa.

Demand Led Breeding

3 COMMUNICATION AND DISSEMINATION ACTIVITIES

COMMUNICATIONS

An active communications, policy and advocacy program is a key component of the Demand led breeding project, in order to disseminate project results to research leaders, policy makers, and potential investors in both the public and private sectors

The DLB project team and partners in Africa are expanding the DLB communications and advocacy program. A communications strategy has been developed to guide future communications activities during 2021-22 and beyond. This strategy included refreshing the DLB web site, as well as using a wider range of communication channels, including social media (e.g. twitter, facebook, utube, flikr). Expanding these new communications channels was particularly important, when most countries in Africa, as elsewhere, continued to have had restrictions on movement within and between countries, as part of their COVID-19 control measures during 2021-22.

The DLB web site has educational and training materials available as open sourced materials at **www.demandledbreeding.org**. A refresh of the DLB website was completed during 2021-22. The dlb website was initially designed and managed by the Syngenta Foundation for Sustainable Agriculture (SFSA), as part of SFSA's contributions towards program management. This was very helpful and much appreciated by the DLB team during the first phase of the DLB program. During 2021-22, the refresh of the dlb website was completed, and the management of the site transferred from SFSA to the DLB team in Africa, led by the Pan African Coordinator, based in Nairobi. This transfer of communications responsibility to African based partners strengthens the capability of African partners to update the website on a regular basis with news and add new educational materials as they are finalized, and to host the eight community of practice working groups on specific crops.

The communications channels include new social media channels, as well as ensuring that the DLB website is a key site to enable plant breeders in Africa ready access to new publications, research and teaching resources, and identifying other professional development opportunities for plant breeders in Africa and internationally.

The DLB community of practice members have identified two priority areas where they would value DLB team's professional support and new resource materials, on **(i)** *Making the business case for sustainable investments in demand led breeding*, for targeted crops

and countries; and **(ii)** Identifying *innovative financing mechanisms and encouraging agri-entrepreneurship* amongst the breeding communities and formal and informal seed systems, to promote the development, promotion and scaling up of new plant varieties in Africa. The DLB team is developing new resources in these areas, which are being made available progressively to the DLB community of practice, through the communications program, including as online resources, DLB workshops with partner countries, and by participation of DLB team members in regional and international seminars.

Policy and advocacy consultations initiated in these two priority areas during 2021-22 also include: two webinars organised by ACCI in South Africa on *"Making the case for demand led breeding in southern Africa*; a workshop to prepare a business case for investments in breeding beans and other crops, held in Ethiopia and sponsored by the Ethiopian Institute of Agriculture (EIAR) and CIAT/PABRA; and presentations by DLB team members on a framework for preparing business cases for innovative investments in demand led plant breeding and encouraging agri-entrepreneurship in Africa, at a DLB led international session at the Australasian Plant Breeding Congress held in Queensland in May 2022.

Publications

DLB publications are available at www.demandledbreeding.org

In 2021-22, new project publications include the following:

- ***Market Study on Consumer preferences in bean cooking time in Uganda*—Report and PowerPoint presentation**
- ***DLB Education Module 8: Gender, diversity and Inclusivity in demand led plant variety design***
- ***DLB Education Module 9: Product profiling and variety development***
- **20 new Product Profiles, on 7 crops, prepared by African plant breeders working on these crops in several countries in eastern, southern and West Africa**

The new product profiles, published on the dlb website, include illustrative profiles for 7 crops:

- ***New bean varieties*: Six new product profiles completed with bean breeders to guide breeding of new bean varieties with shortened cooking time, for varieties suitable for *Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda*. A new product profile for a bean variety suitable for *Zimbabwe* was also developed, with high iron and zinc content and disease resistance. (These PPs were developed with breeders participating in an ACIAR/UWA project on breeding beans with faster cooking time for 8 countries in eastern Africa).**
- ***Kersting groundnut*: Product profile prepared for a new variety targeting short cooking time for urban markets in *Benin* and other countries in West Africa.**
- **New product profiles were also prepared as examples for varieties of cassava, maize, pigeon pea, sorghum, and tomato.**

DISSEMINATION ACTIVITIES 2021-22

DLB Virtual Seminars and Presentations during 2021-22

DLB team members participated in several African and international meetings during 2021-22, either in person or virtually, and made presentations on various aspects of implementing demand led breeding approaches into national and international breeding programs in Africa. These included:

1 October 24-29, 2021
2nd African Plant Breeders Association (APBA2) meeting, Kigali Rwanda

The DLB Pan Africa Coordinator (Dr Nasser Yao) represented DLB at the 2nd African Plant Breeders Association (APBA2) meeting held in Kigali, Rwanda in October 2021 and delivered a talk titled *"Understanding Africa's plant breeders and their variety portfolio: Challenges and Opportunities for emerging markets"*. Dr Yao also led a DLB sponsored side event at APBA2, held on October 29 2021, on the theme of: *"Market-led approaches to plant breeding in Sub-Sahara Africa: Insights and benefits from changing practices"*. The aim of the DLB event was to demonstrate progress in implementing demand led approaches to plant breeding in several countries in Africa, based on the experiences of several early career plant breeders working in African national breeding programs and universities.

These experiences were shared as testimonies by DLB alumni, who are members of the DLB community of practice. The event was attended by more than sixty participants, who joined virtually from various countries in Africa and internationally. These presentations highlighted the business opportunities available through the African plant breeders' variety portfolio as well as the avenue for transforming African agriculture through new varieties. More details about the event, including videos of the individual testimonies on the use of DLB approaches within several NARS breeding programs can be found at: **https://www.demandledbreeding.org/eventresources**

2 May 9-15, 2022
Australasian Plant Breeding Conference (APBC), Queensland Australia

Several DLB team members participated in person or virtually in the Australasian Plant Breeding Conference (APBC) in May 2022. The APBC conference program included an international symposium, co-sponsored by the Demand led breeding (DLB) and the Breeding Program Assessment Tool (BPAT) programs, both programs being hosted by the School of Agriculture and Food Sciences (SFSA) at the University of Queensland. The joint symposium was attended by some 50 participants in person and more than 100 participants online, including the DLB virtual presenters joining from eastern and southern Africa.

The DLB virtual presenters in the symposium were Prof Hussein Shimelis (ACCI, University of KwaZulu Natal, South Africa); Dr Jean Claude Rubyogo and Dr Clare Mukankusi (Alliance of Bioversity and CIAT and the Pan Africa Bean Research and Development Alliance; and Dr Vivienne Anthony (SFSA, Switzerland). Dr Nasser Yao (Pan Africa Coordinator) and Professor Gabrielle Persley (University of Queensland) participated in person. The DLB team members made presentations on various topics related to DLB and its applications, including:

- Market driven breeding for sustainable development, and climate-resilient traits
- Educational and professional development needs and opportunities for plant breeders in Africa
- Innovative financing mechanisms for plant breeding in Africa, and
- The value of a well-defined product profile: Role and content definition.

3 May 25th, 2022
2nd Nigerian plant breeders' association (PBAN) webinar series

Two members of the DLB team participated in the 2nd Nigerian plant breeders' association webinar series on *"Breeding Crops to Feed 2.5 billion Africans by 2050"* in May 2022. Professor Shimelis Hussein from ACCI, South Africa made a presentation on: *"Demand-led breeding: a business approach"*. The Pan Africa Coordinator (Dr Yao) made a presentation on *"The value of Smart breeding in Demand-Led Breeding"*. Details can be found at **https://www.demandledbreeding.org/news/** (2nd Plant Breeders Association of Nigeria (PBAN*) Webinar Series.

The PBAN meeting was attended by more than 400 participants including 120 through Zoom and 300 on Facebook. The participants included public and private sector plant breeders, educators, DLB alumni, and policymakers. The key message delivered during the webinar was that DLB is a business model and the channel through which investment required by the practice of SMART Breeding can effectively and efficiently impact the value chain actors including farmers, breeders, and consumers. Subsequently, the Nigerian plant breeders' association secretariat requested copies of DLB publications to share with their members, and several Nigerian plant breeders have now joined the DLB "Community of practice".

4 New Partnership Meetings 2021-22

Accelerated Varietal Improvement and Seed Systems in Africa (AVISA) program

Two meetings were held by the PAC with the AVISA program leadership in Nairobi on December 21st 2021 and in early February 2022 to discuss areas of collaboration. The main conclusion was a request from AVISA for the DLB team to support the AVISA project in building the capacity of partners across crops on:

- The overall principles of Demand-led breeding, including sharing DLB educational resources
- Product profiling for market targeting and promotion of released varieties (seed systems)
- Variety business case development to demonstrate value of new varieties
- Gender inclusion in variety targeting for promotion (market targeting)
- Demand analysis (current and foresight)
- Customer profiling (current and foresight)
- Commodity value chain analysis and development

West Africa Virus Epidemiology (WAVE) Centre, University of Abidjan, Cote d Ivoire

Two online meetings were held with the Director of Research and the Director of WAVE during 2021-22 to update each program on progress made and pave the way forward regarding a future partnership. The WAVE leadership welcomed a potential partnership with DLB in West Africa. It was therefore agreed for the PAC to visit WAVE to meet in person with the WAVE connections/partners in West Africa and directly introduce DLB and its concepts to the potential partners. The discussions with WAVE highlighted the need of deploying DLB extensively in West Africa with a focus on francophone African Universities and national research institutions along with initiating additional key strategic partners in the West African region.

4 EDUCATION AND TRAINING ACTIVITIES 2021-22

A comprehensive education and training program has been developed to build capacity within plant breeding programs in Africa on demand led variety design. This objective will be met by: .

i providing new professional development opportunities for plant breeders in Africa; and

ii producing and disseminating new education and training materials related to the implementation of demand-led breeding programs. There are two target audiences:

- Next generation plant breeders who are undertaking formal post graduate programs.
- Early to mid-career plant breeders working in crop improvement programs in Africa.

A total of 529 participants participated in 4 DLB sponsored webinars and seminars during 2021-22. There were also 37 participants in three DLB formal post graduate training workshops, at MSc and PhD level, held at 3 universities in eastern, southern and West Africa. A summary of the DLB-led seminars, webinars, education, and training workshops that were organised by the DLB team and their partners in Africa during 2020-21 is given in Table 1.

Post graduate curriculum development

Several African universities have now formally incorporated the demand led breeding approaches, developed through the DLB project, into their formal post graduate teaching programs on plant breeding. Four African universities included a DLB module within their post graduate teaching programs during 2021-22: University of Ghana; University of KwaZulu Natal, South Africa, University of Nairobi, Kenya, and Makarere University Uganda.

Developing new education and training materials on demand led breeding

The DLB project is developing additional educational materials to add to the seven DLB educational units currently available online and in the textbook on *The Business of Plant Breeding*, which were developed as teaching resources during phase 1 of the DLB project. The new educational materials completed or under development during 2021-22 are:

- *Gender, Diversity, and Inclusivity in plant variety design* (Module 8, completed and online)

- *Product Profiling and Variety Development* (Module 9, completed and online)
- *Making the Case for Investing in Demand led Plant Breeding (*in preparation)

DLB education and training workshops 2021-2022

Several DLB education workshops or training events were held during 2021-2022, each led by one of the partner institutions in Africa. Some were face to face learning, while other were a hybrid of face to face interaction and online learning. They included the following:

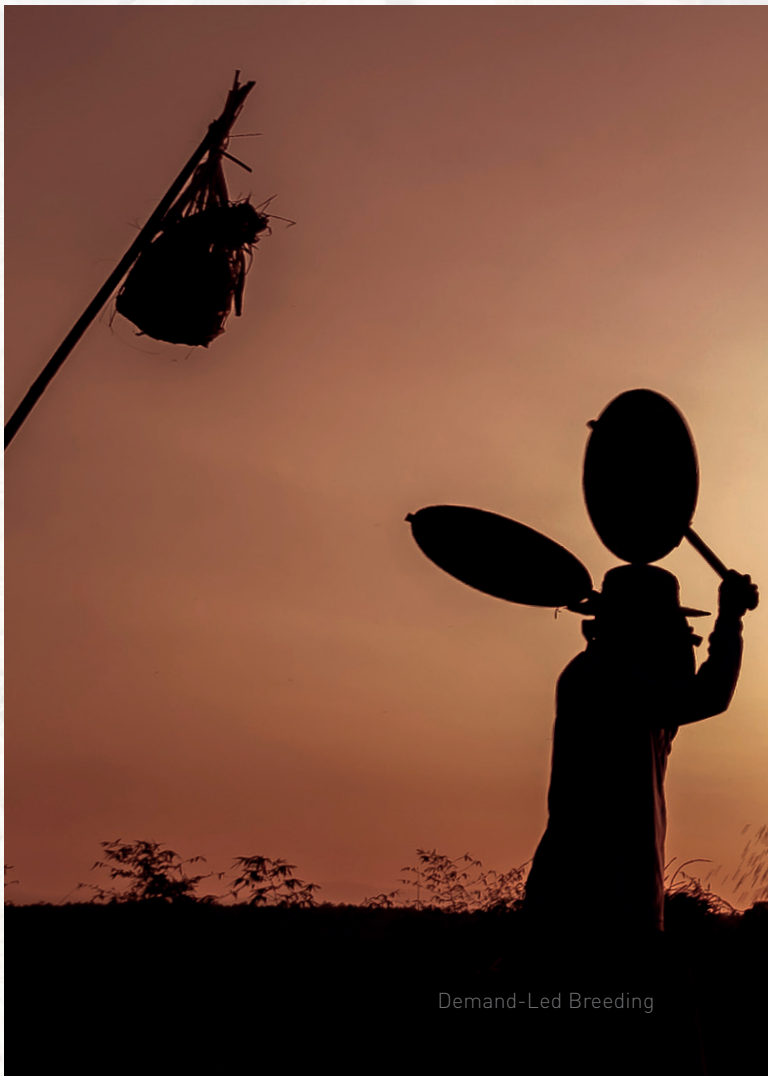
- ***ACCI, University of KwaZulu Natal, southern Africa***: In July 2021 Professor Shimelis Hussein at ACCI in South Africa provided a training workshop for six postgraduate students at the University of KwaZulu-Natal on demand-led plant breeding as part of the module on Advanced Plant Breeding.

- **University of Nairobi, Kenya:** The DLB course was taught by Professor Paul Kimani to 10 MSc plant breeding students during the first Semester of the 2021/2022 academic year.

- **Africa Plant Breeders Association (APBA2) meeting, Rwanda October 2021**: At the APBA2 Conference, the Demand-led Breeding (DLB) team hosted an online workshop on October 29, 2021. The purpose of the webinar was to report on progress, practicability, and success of the demand-led breeding approach and practice by several early career plant breeders. The webinar was attended by more than 60 participants, who joined from various countries in Africa and internationally.

- ***WACCI, West Africa, December 2021:*** WACCI organized a high-level policy meeting held from 29th November to 1st December 2021 in Ghana. The meeting brought together Chief executive officers from research and education institutions in Ghana (Crop Research Institute, Savanah Agricultural Research Institute, University of Development Study, Kwame Nkrumah University of Science and technology, Cocoa Board, Plant Genetic Resources and University of Cape Coast.

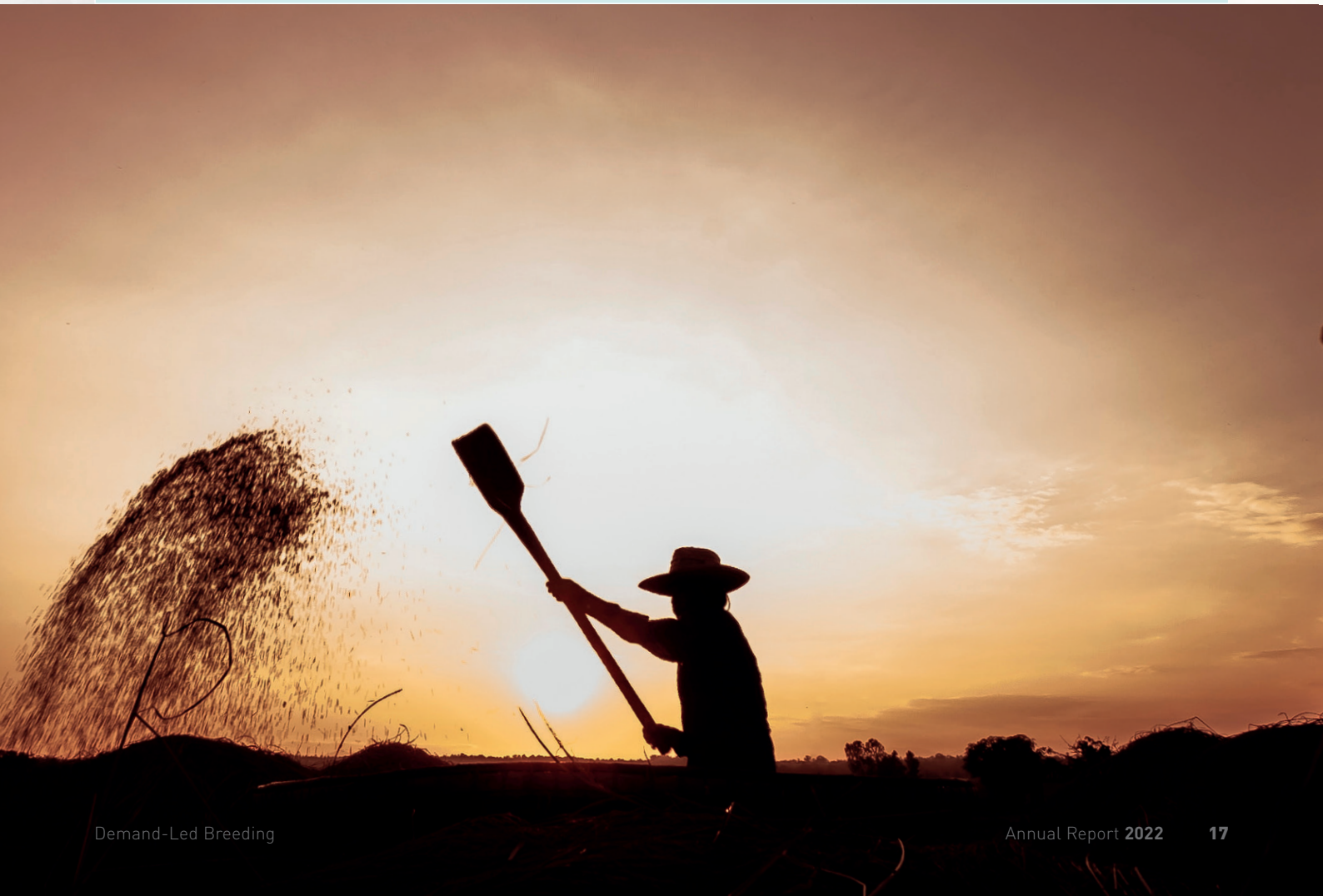
- **WACCI, West Africa, February 2022**: WACCI also conducted a training workshop on developing product profiles in February 2022 at the University of Ghana, for 21 post graduate students, as part of its post graduate program for plant breeding in West Africa.



Demand-Led Breeding

Table 1. Summary of DLB and partner organised seminars, webinars and education workshops 2021-22

Date	DLB lead host organisation	Topic	Location	Participants
DLB sponsored seminars and webinars 2021-22				
October 2021	DLB team, Nairobi	2nd African plant breeder association meeting	Kigali, Rwanda	60 (online)
May 2022	DLB team/UQ	DLB/BPAT session at the 16th Australasian plant breeding conference	Australia, (Gold coast, Qld)	50 (in person) 100 (online)
DLB Policy webinars: making the case for investments in demand led plant breeding (DLB)				
December 2021	WACCI, Univ. Ghana	High level policy meeting	University of Ghana, Legon	9 (in person)
May 2022	Nigerian plant breeders' association	*Breeding crops to feed 2.5 billion Africans by 2050*	Online	420 (online)
A. Total participants in DLB sponsored seminars, webinars 2021-22				**529**
DLB Training workshops with post-graduates and "trainers of trainers" in DLB for plant breeders				
July 2021	ACCI	DLB Training course	University of KwaZulu-Natal, S. Africa	6 post graduates
1st semester 2021-2022	UoN	DLB training course	University of Nairobi	10 MSc post graduates
February 2022	WACCI	DLB training course on product profiling	University of Ghana	21 post graduates
B. Total participants in DLB education and training workshops 2021-22				**38**



5 CONSTRAINTS AND OPPORTUNITIES

Pandemic induced constraints

COVID-19 has continued to impact project activities due to restrictions on travel within partner countries and internationally and limitations on in person meetings during 2021-2022. The DLB team have become more adept at organising and participating in webinars and making presentations virtually, as reflected in the summary of Communications and Dissemination, and Training activities as described in this Annual Report.

Future Opportunities

Despite the challenges from COVID-19 pandemic, the project has been progressing well, as demonstrated by the DLB project team working together remotely throughout 2021-22, to finalise a series of twenty new DLB product profiles for seven crops, using the principles set out in the 2020 publication on *Product Profiles—A Practitioners' Guide*. Two new teaching modules have also been finalised: **(i)** *Product Profiling and Variety Development*, and **(ii)** *Gender, Diversity and Inclusivity in plant variety design*. These new education modules will be further disseminated to plant breeders in Africa during 2022-23.

Virtual meetings promoting the DLB approach have been extensively utilised with several webinars, training workshops and an annual project team meeting organised by the DLB dream team in Africa. This continued high level of activity by the DLB team in Africa throughout 2021-22 demonstrates the strong commitment of the DLB project partners in Africa, Australia, and Switzerland to continue their work together despite current challenges of communications and travel restrictions within countries and internationally.

The current phase 2 of the DLB project is due to be completed by March 31 2023, based on a one year extension approved by the three co-sponsoring agencies in December 2021. This one year extension of Phase 2 is enabling the wider scale dissemination of the project outputs, and the full implementation of the communications and dissemination strategy, so as to continue to support the DLB *Community of Practice*, which now numbers over 400 plant breeders in some 30 countries throughout eastern, southern and West Africa.

For example, in the area of policy and advocacy, the DLB community of practice members have identified two priority areas where they would value DLB team's professional support and new resource materials, on:

i Making the *business cases* for sustainable investments in demand led breeding, for targeted crops and countries; and

ii Identifying *innovative financing mechanisms* and *encouraging agri-entrepreneurship* amongst the breeding and seed system communities, for the development, promotion and scaling up of new plant varieties in Africa.

These, and other, initiatives on promoting innovative financing mechanisms for sustainable support for demand led plant breeding in Africa and encouraging entrepreneurship amongst plant breeders in Africa are being further developed by the DLB team and its partners in Africa and internationally during 2022-23, as part of advocating the *business of plant breeding in Africa*, not as a cost to the public purse for governments, but as an investment in the future of African agriculture, and the farmers, traders, processors and consumers who drive this dynamic and critically important sector.

During 2022, the demand led breeding team is also transiting towards full African leadership and management of future demand led breeding initiatives in Africa, from 2023 onwards. The DLB team in Africa is also exploring new opportunities, new partnerships within Africa and synergies with other like-minded programs in the area of demand led breeding, seed systems and market led varietal development throughout 2022, as part of planning for future activities in 2023 and beyond.

December 2022

APPENDIX 1

Appendix 1—Table 1 DLB project achievements July 1 2021-June 30 2022

Objective 1: Best practices in plant variety design

	Outputs	Activities	Delivery date	Responsibility	Status and comments
1.1	Implementing best practices for bean breeding in Ethiopia Develop at least 2 new PPs and 2 accompanying TDs for new bean varieties in target markets	Develop Product Profiles (PPs) and Technical Data sheets (TDs) for bean breeding program in Ethiopia in consultation with value chain participants and technical experts	Year 2 December 2020 Revised delivery date to December 2020	CIAT/PABRA (Dr J C Rubyogo)	Completed 2 PP and TDs for two new bean varieties in Ethiopia completed and available at: www.demandledbreeding.org Several additional PPs for new bean varieties suitable for mid to high altitudes in Ethiopia also prepared with EIAR breeders and posted on dlb website
1.2	Implementing best practices for bean breeding in Uganda Market research study conducted on reducing bean cooking time, to determine targets (specifications) for breeding new bean varieties	Conduct market research with consumers in Uganda on bean cooking time Final report on consumer preferences in bean cooking time	Year 2 December 2020 Revised delivery date Year 3 Dec 2021	CIAT/PABRA Dr Enid Katungi and Dr Clare Mukankusi	Completed Field work for market survey on bean cooking time in Uganda completed in 2021. Market research report prepared, peer reviewed and revised. Final report completed, April 2022. Slide set prepared as educational resource and posted at www.demandledbreeding.org Appendix 2a, 2b (Report and Slide set)
1.3	Implementing best practices for bean breeding in Uganda Develop at least 2 new PPs and 2 accompanying TDs for new bean varieties in target markets	Develop PPs and TDs for bean breeding programs in Uganda in consultation with value chain participants and technical specialists	Year 2 December 2020 Revised delivery date Year 3 Dec 2021	CIAT/PABRA (Dr Clare Mukankusi	Completed Product profiles of two bean varieties suitable for Uganda completed and included as examples in DLB publications on Product Profiles: A Practitioners Guide, and available at www.demandledbreeding.org Demand led breeding approaches now incorporated as standard operating practice within NARO national bean breeding program in Uganda; and within CIAT/PABRA regional bean breeding network in eastern Africa.
1.4	Implementing best practices in tomato breeding in Africa Develop at least 2 new PPs and 2 accompanying TDs for new tomato varieties in target markets	Develop PPs and TDs for the tomato breeding program in Ghana and other tomato breeding programs in Africa in consultation with value chain participants and technical experts	Year 2 December 2020. Revised delivery date June 2021	WACCI, University of Ghana (Prof P Tongoona)	Completed Two new PPs for tomato varieties in West Africa developed and included as examples in the DLB publication on Product Profiles: A Practitioners Guide, and available at www.demandledbreeding.org
1.5	Promoting best practices in DLB for other priority crops in Africa Develop PPs and TDs for 3 additional priority crops in target markets (at least 2 new PPs and 2 accompanying TDs per crop)	Develop PPs and TDs in conjunction with breeding programs, value chain participants and technical experts for at least 3 additional priority crops in Africa (e.g., cassava, sorghum and one other crop)	Year 2 December 2020 Revised March 2023	Pan African Project Coordinator - Dr Nasser Yao	Completed, and expanded, with additional work in progress with breeders to develop product profiles for a range of crops, to promote new varieties with farmer, consumer and/or market preferred traits. New product profiles are being developed with breeders working on range of crops in Africa, to introduce demand led breeding approaches to the DLB Community of Practice, through 8 CoP working groups. Some 20 new product profiles for varieties of 7 crops have been completed and published on the dlb web site; and a further 8 PPs for 8 other crops are in preparation during 2022. These product profiles include: New bean varieties: Six new product profiles completed with bean breeders to guide breeding of new bean varieties with shortened cooking time, for varieties suitable for Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. A new product profile for a bean variety suitable for Zimbabwe was also developed, with high iron and zinc content and disease resistance. (These PPs were developed with ACIAR project on breeding beans with faster cooking time for 8 countries in eastern Africa). Kersting groundnut: Product profile prepared for a new variety targeting short cooking time for urban markets in Benin and other countries in West Africa. Product profiles for cassava, maize, pigeon pea, sorghum, tomato also completed. Other product profiles for chickpea and lentil are in progress; and others are being planned for: Tree crops – cotton, coffee, coconut; Roots, tubers, banana: sweet potato, yam, and plantain.

Objective 2: Education and training

	Outputs	Activities	Delivery date	Responsibility	Status and comments
2.1	Introductory course on DLB – Gender related issues DLB Introductory Course Unit 8: Gender, Diversity and Inclusivity in Plant Breeding	Develop content of an additional unit on Gender, Diversity and Inclusivity in Demand led Plant Breeding	Year 2 Dec 2020 Revised to Dec 2021	CIAT/PABRA, (Drs Eileen Nchanji, Clare Mukankusi & Enid Katungi); and Prof. Paul Kimani (Uni. Nairobi); and Dr Nasser Yao (DLB)	Completed Gender, diversity and inclusivity module completed. DLB Module 8 Slide set as educational resource at: www.demandledbreeding.org Appendix 3- Module 8
2.2	DLB Advanced Module 1 "Creating Product Profiles and Technical Data Sheets"	Develop content of the new advanced module on "Creating PPs and TDs," in conjunction with Objective 1, including examples from implementing DLB in a range of crop breeding programs in Africa	Year 2 December 2020	Pan African Coordinator – Dr Nasser Yao	Completed Product Profiles Practitioners' Guide, templates and examples developed and launched via webinar in August 2020. Appendix 4 Module 9
2.3	DLB Advanced Module 2 "Making the case for investing in demand led breeding"	Develop content of new advanced module on investing in demand led breeding, in conjunction with Objective 3.	Year 3 December 2021 Revised March 2023	ACCI (Prof. Shimelis Hussein)	Ongoing ACCI is taking the lead in southern Africa, by hosting 2 webinars during 21/22, in conjunction with the DLB educators' group, to provide professional support to plant breeders and R&D leaders in making the case for increasing investments in plant breeding by African governments, private sector & funding agencies.
2.4	Professional development opportunities for plant breeders in Africa Analysis of DLB alumni views on their future professional development needs	Consult with DLB alumni on their future professional development needs	Year 2 December 2020 Revised March 2023	Pan African Coordinator– Dr Nasser Yao	On going DLB alumni and members of the DLB Community of Practice has identified two priority areas, where they would value DLB support and educational resources: (1) Developing business cases to justify future investments in plant breeding; and (2) Agri-entrepreneurship, including identifying innovative financing mechanisms for breeding, promotion of new varieties and seed systems.
2.5	A "Community of Practice" on DLB in Africa Strategy and operational plan for a "Community of Practice" on DLB in Africa	Develop a strategy and operational plan to communicate with and support the evolving "Community of Practice" on DLB in Africa	Year 2 December 2020 Revised to Dec 2021	Pan African Coordinator– Dr Nasser Yao	Completed, in operation Communication strategy completed and is being implemented by the DLB team, though various communications channels. CoP: Whatsapp group and social media platform created to expand discussion amongst COP members, through 8 crop specific working groups DLB team in Africa, led by Pan African Coordinator, now has responsibility for management of DLB website www.demandledbreeding.org
2.6	Promotion of promising new varieties developed by DLB alumni breeders "Africa Seeds" catalogue developed and published, including product profiles and supporting technical data, to promote promising new varieties of at least 5 crops	Consult with DLB alumni breeders to identify promising new varieties from their breeding programs that meet market demands	Year 3 December 2021 Revised to March 2023	Pan African Coordinator	Ongoing. Development of a seed catalogue was modified, on advice of DLB team in Africa in 2021, to focus on producing a Compendium of preferred varieties of key crops across several counties in Africa The first edition of the Compendium will be based on the completed Product profiles of preferred varieties, as identified by COP members, and for which further promotion and seed scaling would be beneficial to increase their availability and wider adoption by farmers.

Objective 3: Policy analysis and advocacy

	Outputs	Activities	Delivery date	Responsibility	Status and comments
3.1	Evidence-based methodology for creating business cases for increasing public and private investments in DLB	Develop new methodology and evidence base for creating business cases, in support of increasing public and private investments in DLB, when applied to individual crops and countries	Year 2 June 2020 Revised to March 2023	UQ (Prof Gabrielle Persley) CIAT/PABRA ACCI (link to Objective 2.3)	Ongoing Framework for "Making the Case for Investing in Demand led plant breeding" presented at Australian Plant Breeders Conference, May 2022;
3.2	Business case for investing in bean breeding in Ethiopia	Apply the new methodology and evidence base from Objective 3.1 to develop a business case for investing in beans in Ethiopia	Year 2 December 2020 Revised to March 2023	CIAT/PABRA (Dr J C Rubyogo)	Ongoing Bean Business case workshop held with Ethiopian Institute of Agricultural Research; Business case for Ethiopia being finalised in 2022
3.3	Business case for investing in bean breeding in Uganda	Apply the new methodology and evidence base from Objective 3.1 to develop a business case for investing in beans in east Africa (e.g. Burundi, Tanzania, Uganda)	Year 2 December 2020 Revised to March 2023	CIAT/PABRA (Dr J C Rubyogo)	Ongoing Bean business cases being prepared with CIAT /PABRA network member countries in eastern Africa
3.4	Business case for investing in tomato breeding in Ghana	Apply the new methodology and evidence base from Objective 3.1 to develop a business case for investing in tomato in Ghana	Year 2 December 2020 Revised to March 2023	WACCI at the University of Ghana (Prof P Tongoona)	Ongoing WAACI consulting with value chain participants in developing a business case for tomato breeding in Ghana
3.5	Policy brief on DLB-related policy issues identified by a policy round table in Ethiopia	Identify policy issues affecting the development and adoption of new high performing plant varieties in Ethiopia	Year 3 December 2021 Revised to March 2023	CIAT/PABRA (Dr JC Rubyogo)	Ongoing Policy dialogue initiated with EIAR during 2022 bean business case workshop in Ethiopia; EIAR plans to adopt DLB approaches for breeding of all crops.
3.6	Policy brief on DLB-related policy issues identified by a policy round table in Ghana	Identify policy issues affecting the development and adoption of new high performing plant varieties in Ghana	Year 3 December 2021 Revised to March 2023	WACCI at the University of Ghana (Prof P Tongoona)	Ongoing Policy dialogue initiated by WACCI, including conduct of a policy roundtable in Ghana in December 2021
3.7	Policy brief on DLB-related policy issues identified by a policy round table in Southern Africa	Identify policy issues affecting the development and adoption of new high performing plant varieties in Southern Africa	Year 3 December 2021 Revised to March 2023	ACCI (Prof Shimelis Hussain)	Ongoing First ACCI/DLB hosted policy webinar to identify key issues held on 29 June 2021. 2nd ACCI/DLB webinar held on Oct 10th 2021. Speakers Webinar presentations available on ACCI and DLB websites
3.8	Master Class on: "The Business of Plant Breeding in Africa"	Develop content, identify participants and conduct a Master Class on DLB in Africa Master Class course content published	Year 3 December 2021 Revised to March 2023	UQ and CF	Ongoing Master Class on investing in demand led breeding and encouraging agri-entrepreneurship to be conducted in Africa during Q1 2023, in conjunction with Crawford Fund Master Classes
3.9	Communications and advocacy	Promotion of DLB approaches in various national and international fora	Year 3 December 2021 Revised to March 2023	CF, SFSA and UQ Pan African Project Coordinator	Ongoing Promotion of DLB approaches were made at various national, regional and international fora, by several DLB partners in Africa. These opportunities included DLB-led sessions at African Plant Breeders Association (APBA), Rwanda Oct 2021; and presentations by DLB representatives at meetings in West Africa, including in Cote d'Ivoire and Nigeria; and a joint symposium at the Australian Plant Breeders Conference, May 2022, amongst others.

Acronyms

PPs	Product profiles
TDs	Technical data sheets
ACCI	African Centre for Crop Improvement, University of KwaZulu-Natal, South Africa
Alliance Bioversity/CIAT/PABRA	Alliance of Bioversity and the International Centre for Tropical Agriculture (CIAT), and Pan African Bean Research and Development Alliance (PABRA)
CORAF / WECARD	Conference des Responsables de Recherche Agronomique Africains/West and Central African Council for Agricultural Research and Development
EIAR	Ethiopian Institute of Agricultural Research
GREAT	Gender Related Plant Breeding Program, Cornell University, USA and Makerere University, Uganda
UoN	University of Nairobi
UWA	The University of Western Australia
WACCI	The West African Centre for Crop Improvement, University of Ghana, Accra, Ghana
ACIAR	Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia
CF	The Crawford Fund, Canberra, Australia
SFSA	Syngenta Foundation for Sustainable Agriculture
UQ	The University of Queensland School of Agriculture and Food Sciences, St Lucia, Brisbane, Australia

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DLB PROGRAM IMPLEMENTING PARTNERS IN AFRICA 2021-22

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Alliance of Bioversity-CIAT and PABRA: **Dr Jean Claude Rubyogo** (Kenya), **Dr Clare Mukankusi** (Uganda), **Dr Rowland Chirwa** (Malawi) and **Dr Teshale Assefa Mamo** (Tanzania), Alliance of Bioversity International, the International Centre for Tropical Agriculture (CIAT) and the Pan African Bean Research Alliance (PABRA)

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Haramaya University, **Ethiopia**: **Professor Firew Mekbib**

Makerere University, **Uganda**: **Professor Richard Edema** and **Professor Paul Gibson**, Kampala, Uganda

NARO, **Uganda**: **Dr Stanley Nkalubo**, National Agricultural Research Organization, Uganda

University of Nairobi, **Kenya**: **Professor Paul Kimani**, College of Agriculture and Veterinary Sciences

WACCI, Ghana: **Professor Eric Danquah**, **Prof Pangirayi Tongoona** and **Dr Agyemang Danquah**, West Africa Centre for Crop Improvement (WACCI) University of Ghana, Accra, Ghana

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DLB web design: **Sam Kamau**, Extend Communications, Nairobi, Kenya

Design: **Eric Ouma**, AfriqArt, Nairobi, Kenya.

d·lb
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breeding

Key African partners

The key project partners in Africa are three regional centres specialising in plant breeding, namely: African Centre for Crop Improvement (ACCI) at the University of KwaZulu Natal in southern Africa; West Africa Crop Improvement Centre (WACCI) at the University of Ghana; and the Alliance of Bioversity International and the International Centre for Tropical Agriculture and the Pan African Bean Research Alliance. In addition to the three centres, other DLB partners include; the Ethiopian Institute of Agricultural Research (EIAR) and Haramaya University, Ethiopia; the Ugandan National Agricultural Research organization (NARO) together with Makerere University, Uganda; and Kenya's University of Nairobi. The project team also works with an extensive Community of Practice of more than 400 plant breeders working in national agricultural research institutes and universities throughout Africa.

acci
African Centre for Crop Improvement

Alliance
Bioversity International
CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

PABRA 25
Beans for impact and nutrition in Africa
1996-2022

Ethiopian Institute of Agricultural Research (EIAR)

HARAMAYA UNIVERSITY
Haramaya University

Makerere University

National Agricultural Research organization (NARO)

University of Nairobi

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DLB sponsors

DLB is supported by an Alliance for Food Security formed by the Australian Centre for International Agricultural Research (ACIAR), the Crawford Fund and the Syngenta Foundation for Sustainable Agriculture (SFSA). The program is managed by the University of Queensland, Australia.

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