IBP October 2021
Newsletter

Dr Jean-Marcel Ribaut, Director of the IBP

Q&A People and Partnerships: a Perfect Fit for the IBP

Formed in 2014, the IBP is a not-for-profit entity whose mission is to help accelerate the delivery of new crop varieties in the context of an increasing global demand for food and unprecedented environmental challenges such as climate change. The IBP provides tools, technologies and support to plant breeders, particularly in developing countries, in the bid to achieve food security.

Director, Jean-Marcel Ribaut, reflects on what has made the IBP a 'go-to' organisation for plant breeders in their quest for innovative tools and knowledge. "With the right people encouraged by the right will and intent and in a collaborative spirit it is possible to achieve much with very little; conversely, excess funding in the wrong environment will not deliver expected results", says Ribaut.

Excerpts:

How are modern breeding methods key to boosting crop improvement in Africa?

Modernising breeding in Africa is a 'must have' to deliver improved cultivars more effectively and there is a clear need to better understand the local demand and a need to breed with a commercial perspective in mind. Therefore, demand-led validated product profiles and well-defined breeding objectives contribute significantly to breeding effectiveness, helping to define the desired commercial values critical for local markets. Such product profiles should ensure that the selection strategies deployed for each trait will deliver varieties with significantly improved performance—meeting or exceeding demand—and, as such, with a high probability of being adopted by growers and downstream stakeholders.

At a more technical level, several modern approaches are also impacting breeding efficiency;

molecular breeding and the digitisation of breeding programs are two that immediately come to my mind. Technology, such as molecular markers, reduces the time taken to develop new crop cultivars; for certain target traits it enables plant breeding to progress faster and at less cost. Marker composition of elite germplasm is also very useful in predictive approaches and can be used for quality control during selection, to be sure that the seed in the bag corresponds to what is on the label. Attempting to modernise breeding without a reliable data management system in place is a very risky endeavor. The digitisation of breeding increases the effectiveness of seed management, data capture, quality control, documentation and analysis. It enables cumulative learning and more accurate selection decisions at all stages of the breeding process. Digital tools such as the BMS are a 'must-have' for proper documentation and to create institutional memory, addressing the major issue, especially in Africa, of staff turnover. Collectively, modern breeding methods contribute efficiency and improved monitoring and evaluation and better returns on investment.

How do we make research and development more effective?

It comes to working with the right people to empower partnerships, building on existing initiatives; working with the right people and sharing the same philosophy is key for effective research and development. This includes engaging with the end-users of research and jointly defining priorities and activities with the aim to empower 'local' ownership of research outputs and outcomes. Last, but not least, developing capacity on-the-ground is important, as is working with young people who will be amenable to new technologies, who will recognise the opportunities afforded by the use of these new technologies and who will have carriage of modernised systems moving forward.

How can the application of biotechnology tools enhance crop breeding and agricultural productivity in Africa?

I will be provocative here, we should not be technology driven! Too often we believe that technology will be the 'silver bullet'. I have been in so many meetings that advocate genomic selection will save Africa and then an African plant breeder stands up and says sorry, but right now I need a cold room to store seed. We need to take on-the-ground reality into account and walk before we run. Often, plant breeding programs will benefit most from an investment in basic necessities such as cold rooms or irrigation facilities to produce reliable phenotyping data. That said, there is scope for more advanced interventions. For example, we have generated >250,000 genotyping data points to implement molecular breeding in an IFAD-supported project, coordinated and implemented by the IBP in close collaboration with national agricultural research system (NARS) partners who define and lead the research agenda. Therefore, one size does not fit all and the technologies that are deployed must be 'fit-for-purpose' i.e. they should be proven technologies for the environment into which they will be deployed. Trying to deploy or validate sophisticated technologies, however trendy and attractive for funding they might be, into an unreceptive setting, is a recipe for disaster.

Demand-led plant breeding will promote sustainable and resilient food production

The West Africa Breeding Networks and Extension Empowerment (ABEE) project launched in March 2020 is fostering a more coordinated regional and national approach to plant breeding. The ABEE Project is part of the European Union's "Developing Intelligent Innovation through Research in Agriculture (DeSIRA)" initiative and aims to strengthen the resilience of rural communities in the Sahel to climate change through the establishment of modern equipment and infrastructure for the breeding of varieties of five climate-sensitive crops. It seeks to reach over 40,000 direct beneficiaries in five years (2020-2024). A consortium of actors with a track record of developing crop breeding in the Sahel and West Africa is involved including CORAF, AfricaRice/IBP, and the national programs of Burkina Faso (INERA), Niger (INRAN) and Senegal (ISRA) while Mali (IER) is engaged through a companion project. The philosophy of the project is to place plant breeders at the forefront in driving change and modernisation of crop improvement.

Continued investment in modernizing plant breeding is essential if national programmes are to respond to market signals and to take advantage of advances in plant breeding that will enable them to be more effective and efficient in developing resilient crops suited to local environments and changing climates. The ABEE project is targeting breeding for millet, sorghum, fonio, groundnut and cowpea. Based on the experience of the World Bank WAAPP initiative and other projects, we know that further improvements in crop productivity in the Sahel will be dependent upon inclusive value-chain development within commodities and across ecologies and countries. As such, demand-led plant breeding that fulfils farmer needs and responds to market signals is essential for the target countries – through their national programmes – to sustainably increase agricultural productivity in the face of population growth and climate change.

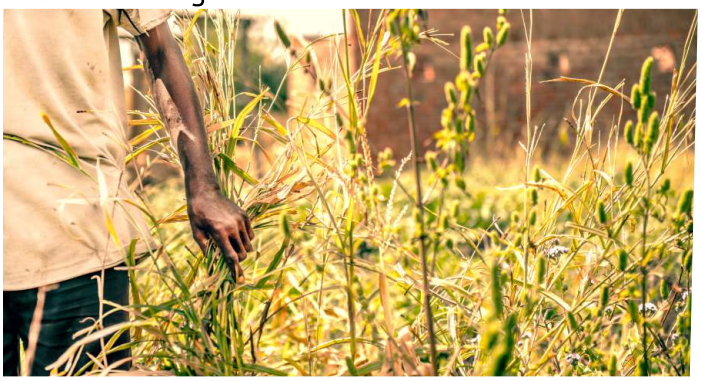
Project highlights – the role of the IBP

In the ABEE project, the IBP is working with different partners and breeding programs on the knowledge and data management activities, in order to document research results and promote the digitization of breeding pipelines. The IBP works with all stakeholders to better understand knowledge needs in the breeding programs and along the value chain and to optimize the development of a knowledge platform that stores and contributes seed information.

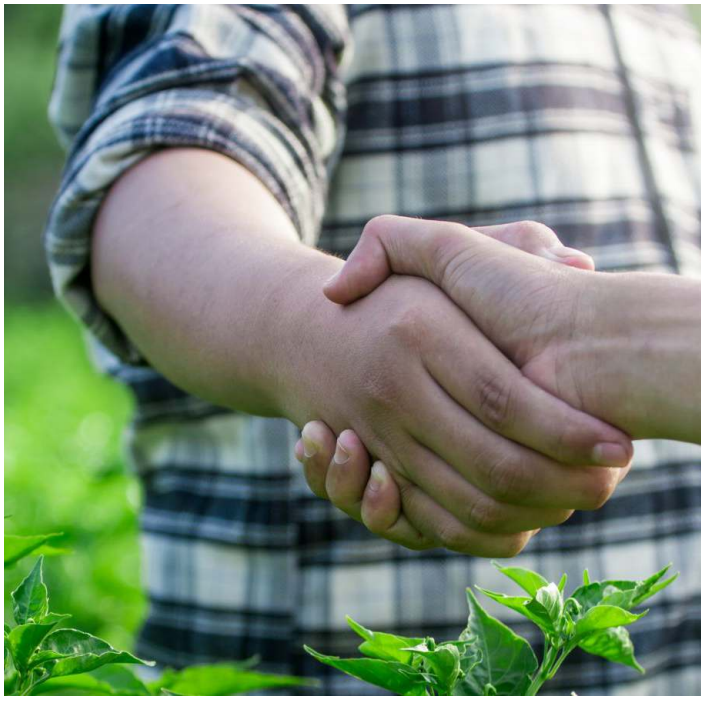
In addition to the knowledge platform activities the IBP is managing the roll-out of the BMS and advising partners on IT infrastructure requirements and the need for institutional data management policies and practice.

A strength of the BMS is its ability to capture, store and analyse data across a range of crops across the Sahel region and, uniquely, the BMS has the capacity to synchronize data across different BMS instances. The federation of BMS instances- a major objective of the project- is invaluable for regional projects and it enables national programs to curate and analyse data for similar projects with different donors in their respective institutional BMS instance, while sharing selected data with partners from different countries on a regional instance.

The COVID-19 pandemic has necessitated some adjustments to work schedules; in particular, field activities have been impacted. However, the constraints on travel and movements have also prompted the use of alternate measures such as online meetings.



The IBP and CGIAR: A complementary partnership



Over the last two years the IBP and the Excellence in Breeding (EiB) platform of the CGIAR have been working together to maintain momentum, to secure the hard-won gains in digitizing breeding programs in the CGIAR Centre and national partner programs, and to set the scene for adoption of the Enterprise Breeding System (EBS), the crop information system of the EiB under development. The BMS will continue to be an important tool for the CGIAR Centres during the transition phase to the EBS.

The IBP has a well-established deployment model that includes locally deployed support staff, a key element in transitioning institutions to a more structured approach to data management. The amount of time and effort that must be devoted to supporting institutions as they adopt more sophisticated data management systems should not be under-estimated and we look forward to the IBP deployment team playing an important role in helping the EiB achieve its targets over the next 3-5 years, in the context on the One CGIAR reform process.

Currently, there are two main areas of collaboration with the EiB: a) ongoing development and maintenance of the BMS, including management of the software development process and support to deployment efforts at CGIAR Centres and at a few key NARS; and b) support for the digitisation of national programs in Africa engaged in the maize and rice CGIAR networks. The IBP is maintaining a regular schedule for developing and deploying new versions of the BMS on a trimester basis and the updates of the BMS system have been deployed at CGIAR centres and with NARS partners. New functionality and major improvements to the software code have resulted in a very robust BMS that has become less expensive to maintain.

Through the support of the Bill and Melinda Gates Foundation the IBP, with the Boyce Thompson Institute at Cornell, have been instigators of the BrAPI initiative and, as such, both the BMS and BreedBase systems are BrAPI compliant. The EBS development team has recently adopted the same approach; the complementary roles of the different systems to digitize breeding in developing countries naturally leads to a joint effort across the different development teams to develop new applications for transferring data between BrAPI compliant breeding data management systems. Such applications will be key to enable: a) migration of data across systems, and b) support for collaborative breeding efforts involving One CGIAR programs, NARS and SME partners.

Under the NARS digitisation collaboration, the BMS has been deployed in the Cloud in Ghana (CSIR), Kenya (KALRO), and Uganda (NARO) and deployment has been expanded to include Tanzania (TARI) and Zimbabwe (DRSS). Breeding programs have been supported in the loading and curation of historical data and training sessions have been held to support the use of the BMS and peripherals such as bar code readers, hand-held devices for field data and seed counters.

Integrated Breeding Platform (IBP)

CGIAR Excellence in Breeding Platform

IBP-EiB collaboration

Our experience to date has demonstrated the utility of the BMS for NARS, particularly the robustness and flexibility that it brings to a wide range of plant breeding programs across both key commodities and secondary crops. It is a low-maintenance system from an IT perspective that is readily supported by a dedicated institutional focal staff member. Similarly, the BMS offers NARS with a level of data protection that allows for both internal ownership and management together with data sharing at a broader level, including with CGIAR Centres and across regional project initiatives.

The IBP has long experience in working with key NARS (under the aegis of the GCP) and more recently we have worked with the national programs of Ghana and Uganda as part of the EBCA project (see companion news). Collaboration with the EiB enables consolidation of different initiatives on an existing foundation while enabling the addition of new programs. Create synergies across initiatives is fundamental to adding value to our efforts, a concept that is fully endorsed by Liz Jones (EiB Lead, Adoption and Outreach) and Biswanath (Bish) Das (EiB NARS Coordinator), both of whom are deeply engaged in our BMS deployment activities in Africa. As a result of this approach the BMS instances in Ghana, Kenya, Uganda, and Tanzania (soon) will host data from the CGIAR breeding networks, the USAID Innovation Labs (Peanut-Georgia University, Crop Improvement- Cornell University), and the EBCA project. For example, NARO in Uganda is hosting data from all four initiatives.

Right now the BMS is the tool of choice in a dozen countries in Africa and we foresee the demand for the BMS to continue, playing a critical role in the medium- to long-term in supporting institutional efforts at the national level, in parallel with the efforts of the One CGIAR to roll-out the EBS with its CGIAR Centre

Enhancing institutional breeding capacity in Ghana, Senegal and Uganda to develop climate resilient crops for African smallholder farmers

The EBCA project on 'Enhancing institutional breeding capacity in Ghana, Senegal and Uganda to develop climate resilient crops for African smallholder farmers' focuses on demand-driven crop improvement. The project has a total budget of $4.3M over 2018-21 with $2.5M funded by the International Fund for Agricultural Development (IFAD) and has been implemented by the Integrated Breeding Platform (IBP) and AfricaRice, in close collaboration with national agricultural research system (NARS) partners.

The overall goal of the project is to contribute to enhanced food security and poverty alleviation by increasing smallholder productivity and income. It seeks to achieve this by enabling the development and dissemination of 'fit-for-purpose' improved crop varieties that meet the needs and wants of both farmers and consumers along the crop value chain, as well as being resilient in the face of challenges such as disease and climate change.

The project works directly in three low-income African countries (Ghana, Senegal and Uganda) where agriculture is key to rural livelihoods, although benefits have spilled over into additional counties through partnership networks. It is focused on two staple crops, groundnut and rice, with some additional activities in bean, cowpea and sorghum.

The EBCA project is deeply rooted in a 'people first' philosophy, inherited from the Generation Challenge program (GCP), under-pinned by partnerships based on trust. Project activities are focused on strengthening the capacity of national crop breeding programmes, facilitating their

leadership, priority-setting and adoption of best practices. The project also seeks to help train the next generation of plant breeders and scientists in modern plant breeding through supporting MSc and PhD students. It is projected that up to 30,000 smallholder farmers in the three project countries will benefit directly from better crop varieties. In the longer term, EBCA will leave behind stronger research capabilities in the participating breeding programmes, as well as greater linkages between researchers and other stakeholders along the value chain, such as farmer associations and seed businesses.

The EBCA approach

Project philosophy

The EBCA project has adopted an approach that aims to leverage and build upon existing networks and initiatives with an emphasis on NARS leadership and ownership to establish a foundation for ongoing sustainability of the outcomes generated. This approach, with clear objectives and outputs defined, has enabled the NARS partners to identify gaps in their plant breeding programmes and to apply EBCA project resources to areas where they are most needed and where they will be most effective. The project has therefore been able to rapidly achieve significant impact over a short timeframe, providing a return on investment substantially beyond that which would normally be expected with a modest budget and limited timescale.

The role of the IBP and AfricaRice as project implementers has therefore been one of catalysing activities, fostering synergies between partners, and maintaining project momentum and direction. The EBCA project puts NARS partners in the driving seat, while providing support, expertise and guidance in areas such as planning, coordination, access to services, digitisation and analysis. A key aspect of this approach has been the engagement of external breeding experts as advisors, supporting, when needed, NARS partners at every stage from planning to troubleshooting breeding activities to analysing results. Early in the EBCA project, each NARS breeding programme developed their respective workplans, providing a conscious opportunity to examine, set and pursue their priorities. They then received more than half of the total project budget to implement those workplans.

Project structure

EBCA project activities are organised around four components, which we consider to be the four pillars in building a sustainable and demand-led crop improvement program. These are: i) connecting the dots between breeders, extension workers, farmers, businesses and consumers along crop value chains; ii) improving data management and digitising breeding; iii) integrating modern approaches into plant breeding, such as the use of genetic information; and iv) enhancing both human capacity and infrastructure.

This approach has been embraced by IFAD as an exemplary model for future, similar projects. The EBCA project is already a case in point; the CORAF-led EU-DeSIRA project ABEE is taking advantage of methodologies, partnerships and networks formed by the IBP (and CIRAD) during implementation of the EBCA project as well as an existing regional network (IAVAO).

EBCA outcomes: the numbers

The EBCA project, by taking a cross-cutting, NARS-led approach, connecting to other initiatives, and filling the gaps in breeding programme needs, has provided a substantial return on investment. It has achieved, or contributed to, outcomes well beyond those that could be obtained alone with a traditional 'vertical' approach, within its modest budget and limited timeframe. The EBCA project has created significant impact across a range of indicators as may be seen in the attached "EBCA in numbers: A measure of impact".

Data management and modernisation of breeding: partners have added data on 15,000 breeding lines to the IBP Breeding Management System (BMS) and uploaded > 350,000 field data points. All partner institutions have developed an institutional data management policy.

Programmes deploying molecular breeding techniques have generated over 250,000 genotypic data points so far, an astounding amount of new information contributing to better and faster breeding decisions.
Improved varieties: Contributed at different levels to the development of 90 improved lines across five crops.
Training the next generation: The project has partnered with leading universities to support 7 PhD and 16 MSc students and 165 MSc students have been trained in the use of the BMS.
Farmer participation: More than 200 participatory varietal selection (PVS) trials have been conducted along with > 300 participatory rural appraisals to understand farmer needs and challenges. The participation of women in these trials and appraisals has been significant (45%). In total, the project has engaged directly with more than 11,000 farmers and indirectly has reached 190,000.
Private-sector involvement: The project has engaged 22 seed companies and 110 seed producer associations to produce > 6,000 tons of certified seed.

Elements of impact

Partnerships

The IBP has used its extensive experience in technology transfer and network animation to facilitate the development and revision of breeding objectives, both within national programmes and across the regions. This 'bigger picture' lens adopted by the IBP has been supplemented by a close working relationship with the CGIAR Excellence in Breeding (EiB) platform through engagement with their NARS outreach program, through the modernisation of breeding pipelines in Ghana and Uganda and through the coordination of genotyping analyses by Intertek. The EBCA project has leveraged existing networks and enabled the development of new collaboration, not only within West Africa (Ghana, English speaking, Senegal, French speaking) but also between West and East Africa. The IBP was an active participant in the formation of the African Plant Breeders Association in 2019 and it is this kind of forum, together with the networks that are gaining momentum, that will assure the future of plant breeding in Africa. This groundswell of activity is perhaps best summarized by the following quotes:

"EBCA was part of a long process, and without the history of collaboration in the region we would not have had the success we did," says Dr Fonceka, CIRAD scientists posted at CERAAS in Senegal.

"Sharing – our material, data, time and ideas – is all a mark of trust, and trust is a function of time and of ongoing partnership building." IBP Management.

Private sector engagement

Complementing the impressive research achievements at NARS institutions EBCA, via local partners, has engaged actively and extensively with the private sector, particularly farmer organisations and seed companies, as an essential component of the project. Such linkages with the private sector are crucial to scaling out research outcomes for impact and, ultimately, to long-term sustainability. A viable, thriving seed industry creates valuable jobs and wealth, particularly for rural young people, as well as being good news for farmers. Ultimately, the EBCA model promotes a research for sustainable investment approach, whereby research products meet real needs and have a value beyond the life of the project.

Digitisation

Modernising breeding programmes not only includes the incorporation of genetic information and molecular breeding techniques, but also the use of the BMS to facilitate all stages of breeding and data management, and the integration of appropriate ICT tools for day-to-day-use to male breeding more efficient and effective. These are connected to a project knowledge base (knowledge module- KM), allowing easy storage of, access to, and analysis of information and for this to be shared extensively along the seed value chain. Applications (Apps) for farmers and seed management are currently under development and will be important in exchanging information and data between breeders, seed dealers, extension agents and

farmers. Digitisation enables increased quality control and product traceability and this has been achieved through the introduction of electronic tablets to collect data in the field, eliminating the risk of losing paper field books, the need for time-consuming data entry and the potential to introduce errors. Similarly, bar code printers and scanners to label every seed sample, make the work of tracking and tracing much easier and more efficient, cutting down on mistakes and connecting the physical steps of the breeding cycle with information in the BMS.

Gender

Gender is an overarching concern for the EBCA project, and it is considered by all partners in planning their activities. Gender representation is particularly important for successful and equitable demand-led breeding, since women often tend to carry out specific farming and household tasks, which means they may have very different wants and needs to men when it comes to agronomic, storage, cooking and eating qualities. The project has committed to a goal of at least 40% women participants and this target has been exceeded; of the more than 11,000 farmers engaged in rural appraisals, participatory varietal selection, seed distribution for farmer testing, training, and field demonstrations and similar activities, 43% have been women.

Nutrition

The five crops invested in by the EBCA project – bean, cowpea, groundnut, rice and sorghum – offer the opportunity for diversified household diets and improved nutrition. Moreover, one of the key traits for groundnut breeders is oleic acid content since higher content results in a longer shelf life for groundnut products and better health outcomes for consumers.

Conclusions

The EBCA project has achieved impacts and a return on investment far greater than expected within its modest budget and limited three-year timeframe. It has done so by emphasising partnership and NARS leadership, creating a cross-cutting, gap-filling approach that generates synergies and magnifies outputs. Demand-led crop improvement draws on private-sector engagement to understand what the market needs and it delivers varieties that seed dealers want to sell and farmers want to grow. EBCA has helped breeding programmes set priorities and reach targets faster due to improved data management, digitisation using ICT tools and modernisation of breeding processes. The project is also nurturing the next generation of breeders through supporting students and building partnerships with universities.

This project has highlighted the potential for genetic gain to amplify in farmers' fields through a digitised seed value chain that is highly scalable.