

ICRISAT

Building relationships and regional leadership for better plant breeding

Context

The [International Crops Research Institute for the Semi-Arid Tropics \(ICRISAT\)](#) is an international organization that conducts agricultural research for rural development. It works to reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics across South Asia and sub-Saharan Africa. With its focus on the drylands, it specializes in crops that thrive in these harsh climates: chickpea, groundnut, finger millet, pearl millet, pigeonpea and sorghum.

As a close collaborator and user from the start, ICRISAT has a long relationship with the IBP. It played a key part in the development of the IBP and of its core product, the Breeding Management System (BMS), and now uses it in all its breeding programs. ICRISAT has taken on the role of leader, supporting not only its own BMS users but also many of their partners and other organizations in Africa and the South Asian region.

Challenges

ICRISAT is in no doubt about the need for effective breeding informatics and data management. The institute has sophisticated needs, with numerous teams, locations and crops – making good data management all the more crucial, while also complicating the task of achieving full uptake. The first challenge was to get everyone on board: for busy breeders investing time in learning to use a tool such as the BMS can feel like an unwelcome chore. As in any large organization, users were coming to the BMS with widely varying levels of interest and prior knowledge, so while some only needed introductory training and occasional troubleshooting, others required more in-depth, ongoing help. It will also remain important for users to keep up to date as tools and best practices evolve rapidly.

“The IBP has always made us feel that we are making this journey together. They listen to and value us, and we work together on problem solving. It is a very good relationship and a win-win situation for both organizations. — Dr Abhishek Rathore, Theme Leader, Statistics, Bioinformatics and Data Management, ICRISAT”

Solution

ICRISAT came on board in the very early days, before waiting for the perfect solution, willing to test, use and provide feedback on beta versions of the BMS, as an active actor in BMS development. The ICRISAT Statistics, Bioinformatics and Data Management team, headed by Theme Leader Dr Abhishek Rathore, now has a strong focus on providing support for the BMS, both to their own breeders and to partners and regional users, whenever and to whatever extent it is needed. This helps to make adoption and ongoing use as easy as possible, guiding researchers past teething troubles and cutting down on resistance. Rather than letting breeders go it alone, they act as in-house experts, supplying in-depth knowledge that complements the other members of breeding teams. This specialization means that they keep up with all the latest on how breeders can get the most out of their data using informatics, as well as the technical side of things such as the latest BMS updates or functionalities. Relationship between breeders and data scientists were built up through BMS implementation, bringing them closer together.

Says Dr Rathore: “People tell me, ‘we thought that the BMS would be a burden, but now you have simplified our lives. We don’t need spreadsheets – we can create field books through the BMS in one click. It is so much faster.’ This is coming from the technicians and junior breeders, those who spend a lot of time doing this tedious work.”

Another advantage for ICRISAT is compatibility with other tools. ICRISAT and the IBP both collaborate on the [Breeding Application Programming Interface \(BrAPI\)](#) project to allow different plant breeding applications to talk seamlessly through a common interface. For example, work is underway to have the BMS connect – through BrAPI – with the database of the [Genomic Open-source Breeding Informatics Initiative \(GOBii\)](#) to pull in its high-throughput and high-density genomic datasets.

Concretely, this will mean that breeders will be able run a genomic selection exercise, extracting and using data from both the BMS and GOBII. As such, the BMS does not isolate or lock in users, but rather connects them with a wide community pulling together, and fits as a powerful tool within a wider strategy for effective data management and better breeding.

Finally, a big selling point for scientist to use the BMS is that users retain total control of their data. It is possible to export data and analyse it externally if desired, including if anyone decided to stop using the BMS for any reason. No other breeding management tool offers so much to users, and has done much in securing trust and buy-in at ICRISAT.

A regional role

The close collaboration between IBP and ICRISAT helps reaching wider impact, as ICRISAT supports partners in using the BMS. For example, in major research-for-development initiatives like [Tropical Legumes III](#) and [Sorghum & Millets HOPE projects](#), seed production roadmaps are better monitored as ICRISAT and partners can share data in real-time with BMS. This serves a more global vision for breeding informatics driving major improvements in crop breeding in the coming years, with ICRISAT taking a leading role in its regions of focus in South Asia and sub-Saharan Africa. As an IBP Regional Hub, they also provide support and training to many research institutes, including those that have not traditionally been ICRISAT partners, creating a wider network of users and an interconnected research community across South Asia. “Many of our NARS (national agricultural research) partners are on board with us, using the BMS via the cloud,” says Dr Rathore. “So we are not just *talking about* taking partners with us, we *are* taking them with us. If we have a problem, they have the same problem; if we have a solution they get the same solution. It has brought lots of synergy and confidence.”

Looking forward

The BMS is bringing clear improvements to the research itself. Researchers are freed from time-consuming, repetitive tasks such as preparing field books and labels, giving them more time for scientific activities. Costs and time are saved, and data quality is improved, by replacing hand notes and excel with electronic data capture. In fact, using the BMS for each step of the breeding process drastically cuts human errors caused by data recording, processing and transfer between formats. This greater efficiency helps avoid delays or poor decisions at critical moments such as planting time. “I anticipate that we will soon be substantially augmenting our genetic gains – in other words, breeding better crops, and much faster, for dryland farmers,” says Dr Rathore. “Nowadays breeding programs generate and use a huge amount of data, and anyone without effective management will find themselves really lagging behind. There is no escape: using a breeding management system is the future, and the BMS will emerge as champion in my opinion. There are plenty of things still to work on, and we are collaborating with the IBP to make improvements all the time. I see it getting more and more integrated; I think ours users already cannot imagine working without it.”



I am Hingane Anupama, pigeonpea breeder at ICRISAT. I work on developing varieties and hybrids, resistant to various biotic and abiotic stresses, in short and medium maturity group.

The BMS has become a necessity for my team and me since we started using it in the last couple of years. I use it to make breeding decisions based on data captured electronically, to review traits of interest, select parents, make crosses, develop experimental designs etc. It is also very useful to identify and generate plot IDs and genotyping samples.

We have migrated most of our historic data for pigeonpea breeding into the BMS, and are now maintaining a seed inventory. This makes my job easier in developing multi-location trials based on the availability of seed. The major concern in upscaling pigeonpea is the potential unavailability of genetically pure hybrid seed. With the availability of SNPs markers, I can confirm hybridity, and thus make genetically pure hybrid seed available to stakeholders. The overall process is now faster and more accurate.

Without a doubt, modern breeding tools and approaches have increased the operational efficiency of my breeding program. Above all, my research technicians are enjoying working with these modern technologies, more than any earlier traditional way of recording data in notebooks! Together with them, and with the right technology in hand, I will strive to enhance the rate of genetic gain in pigeonpea. I am looking forward to future additional features and services that would help us achieve this greater goal.



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