Taking legumes from Science of Discovery to Science of Delivery

The journey from Project Tropical Legumes to Project AVISA

“It’s not the end, it’s a new beginning.”

Developing genetic resources for legume crops, innovative and sustainable seed platforms, strengthening national agricultural research systems’ (NARS) breeding programs, releasing over 307 improved varieties of focus legume crops and training 52 young scientists to be the torchbearers of agricultural science in Sub-Saharan Africa and Asia were some key achievements of the Tropical Legumes project. These were reflected upon at the end-of-project workshop held in Tanzania. The project, supported by the Bill & Melinda Gates Foundation, brought together partners from 15 countries over a period of 12 years.

The Tropical Legumes project (phases I, II and III), together with associated development projects in the regions, contributed to production of about 498,034 tons of certified seeds across six legume crops (chickpea, common bean, cowpea, pigeonpea, groundnut and soybean) in the project focus countries (Mali, Burkina Faso, Ghana, Nigeria, Ethiopia, Uganda, Tanzania and India - Uttar Pradesh State).

These regions now have stronger seed systems in place – with produced certified seeds planted in an estimated 5.0 million ha by over 25 million smallholder farmers in 15 countries and beyond, producing about 6.1 million tons of grain worth US$ 3.2 billion.

The third phase of the Tropical Legumes (TL III) project was led by ICRISAT and jointly implemented by the International Center for Tropical Agriculture (CIAT) and the International Institute of Tropical Agriculture (IITA) in close collaboration with 15 NARS across eight countries in sub-Saharan Africa and South Asia. With the end of this project, some of the work done in this field will be carried forward into the project AVISA – Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa.

What they said...

Dr Jeff Ehlers, Senior Program Officer, Bill & Melinda Gates Foundation, congratulated everyone involved in the projects, saying, “It is satisfying to note that together we have been able to meet the productivity increase target of about 25% in some crops, as intended by the project, and got many improved varieties into the farmers’ fields.”

“With a total investment of US$ 67 million together with partners, we have been able to achieve so much on ground,” said Dr Geoffrey Mkamilo, Director General, Tanzania Agricultural Research Institute (TARI),
appreciating the Gates Foundation’s backing over the years.

Dr KK Sharma, Deputy Director General – Research, ICRISAT, said, “One of the best things about this project is the huge number of partnerships it has created. I call upon the NARS partners and all our other partners to carry forward the excellent work done during the past years into the AVISA project.”

Dr Hamidou Traore, Director General, Institut de l’Environnement et Recherches Agricoles (INERA), Burkina Faso, noted the great political goodwill and support from the government whereas Dr David Chikoye, Regional Director (Southern Africa Hub), IITA, said, “We have made great progress in capacity building, releasing improved varieties and strengthening our partnerships across regions.”

Dr Robin Buruchara, Director, Pan-Africa Bean Research Alliance (PABRA), while presenting CIAT’s perspective, said, “The TL project, through PABRA, has benefited not just the focus countries but more than 30 other countries by way of germplasm sharing and capacity building.”

“We have had an ROI of >US$ 25 in this project,” said Dr Rajeev Varshney, Research Program Director, Genetic Gains, ICRISAT, and Principal Investigator of the TLIII project. “From being orphan crops once, these crops now enjoy the status of genomics resource rich crops. In addition to developing 307 varieties, molecular breeding products have also reached farmers’ field in sub-Saharan Africa and Asia. We have documented the achievements, lessons, challenges and gaps from this project to be published as a special issue in Plant Breeding journal.”

Gender integration, adoption of digital data collection, and institutional capacity building were some of the key challenges pointed out by Dr Chris Ojiewo, Global Coordinator, Tropical Legumes III project.

Dr Moses Siambi, Outgoing Research Program Director – Eastern and Southern Africa, ICRISAT, said, “The dilemma we have is between commercialization of new technology and ensuring that it reaches the farmer. We need a hybrid system under which seed companies can make money while keeping the technology affordable.”

Key impacts of the Tropical Legumes project
- Groundnut crop interventions demonstrated 32.35% increase in income, 6.72% households lifted out of poverty and 14% out of food insecurity
- Ten groundnut varieties, including six high-yielding, drought-tolerant ones and four ELS, released in Mali
- Seven groundnut varieties with traits such as aflatoxin tolerance, early maturing, drought tolerance etc. released
- In India, chickpea national program on developing improved varieties resulted in area enhancement up to 68%.
- Chickpea program in Ethiopia won a national award in 2013 for science and innovation
- Seven-fold increase in number of improved common bean variety releases from 2011 to 2018.

Participants of the workshop.

Photo: ICRISAT

Dr Ramadjita Tabo, Research Program Director – West and Central Africa (WCA) in his remarks highlighted: "We thank the Gates Foundation for TL I, II, III, HOPE I, II and now AVISA, I request the national partners and their leadership to invest more in strengthening their research ecosystem in the country to have a sustainable impact in the long run".

Remembering his long-term association with the Tropical Legumes project, Dr Pooran Gaur, Research Program Director - Asia, said, “In my 18 years at ICRISAT, this was one project that I enjoyed the most. We, partners, are like one community. This project had a long-term vision and addressed the major challenges of the regions.”

Special mentions were made of the value provided by Mr Satish Nagaraji, Sr Manager, Digital Agriculture, ICRISAT, and Dr Abhishek Rathore, Principal Scientist, Data Management. These key contributors spoke about the need to modernize breeding programs, so as to use research data to maximum efficiency.
First ever high-yielding chickpea variety developed using marker-assisted backcrossing (MABC) released in Ethiopia

Ethiopia has become the first country in the world to release such a chickpea variety

In a first, the National Variety Release Committee (NVRC) of Ethiopia, announced the release of a high-yielding chickpea variety developed in collaboration with ICRISAT using marker assisted backcrossing (MABC).

The variety, ‘Geletu’, was named after the eminent pulses scientist Dr Geletu Bejiga from the Ethiopian Institute of Agricultural Research (EIAR). The variety was officially released for commercial production and recommended for wider adoption in the dry semi-arid tropics to moist agro-ecological zones.

The variety delivered the highest grain yield of 3822 kg/ha at Arsi Robe, Ethiopia, which translates into an yield advantage of 15% over the check variety ‘Teketay’ and 78% more than the local check. Geletu with medium seed size and 100-seed weight ranging over 28.0 – 39.9 grams has compound leaves. Under Ethiopian conditions, the variety exhibited resistance to fusarium wilt and root rot with a rating of 3 and 2 respectively on a 1-9 scale (Where 1= free from disease, 9= killed by the disease).

Debre Zeit Agricultural Research Center (DZARC), EIAR received MABC3F international nursery/line from ICRISAT and evaluated it in Ethiopia as part of the partnership in the Tropical Legumes I project, funded by Bill & Melinda Gates Foundation through CGIAR Generation Challenge Program in 2011-2012 cropping season and later evaluated it along with other lines for four seasons in Ethiopia.

The new variety’s performance was superior to the local and national check during the final evaluations of multilocation national trials conducted at seven divergent agro-ecology locations: Akaki, Ambo, Arsi Robe, Chefe Donsa, Debre Zeit, Hosanna and Jari (Sirinka) over a period of two years (2015-2017).

Researchers from DZARC, EIAR and ICRISAT, conducted the multilocation trials. The breeders’ team included Drs Assefa Funga, Nigussie Girma, Million Eshete, Lijalem Korbu, Asnake Fikre, Dagnachew Bekele, Ridwan Mohamed, Fasil Hailu, Amin Fedlu, Genet Mengistu and Mekasha Chichaybelu.

Dr Peter Carberry, Director General, ICRISAT, commended the collaborative effort of ICRISAT- EIAR under the Tropical Legumes projects: “The role of national partners like EIAR is key in translating research results into molecular breeding products on the ground, and this is one great example of creating that impact.”

“We look forward to have such collaborations with ICRISAT to take Ethiopian agriculture to the next level,” said Dr Mandefro Nigussie, Director General, EIAR.

“The identification of a molecular marker (QTL hotspot) for drought tolerance by ICRISAT in itself is a significant scientific contribution, but to see the Ethiopian national program utilize modern breeding approaches and successfully translate the technology in the form of a drought-tolerant locally adapted variety is a first. And this also represents a substantial contribution for smallholders in the country”, said Dr Jeff Ehlers, Senior Program Officer, Bill & Melinda Gates Foundation.

Dr Jean-Marcel Ribaut, the then Director of the CGIAR Generation Challenge Program that funded the Tropical Legumes I project for ICRISAT and EIAR through investment of the Gates Foundation said, “ICRISAT and EIAR fulfilled their promise to take genomics from laboratories to the fields”.

Dr Asnake Fikre, Regional Chickpea Breeder, ICRISAT, Ethiopia, said, “It feels good to be the first generation
adopter of molecular breeding in the chickpea improvement program which made Ethiopia the first country to release the molecular breeding chickpea variety.” Tanzania may also release a molecular breeding variety as some MABC lines have shown good performance in the country.

Dr Chris Ojiewo, former Regional Chickpea Breeder collaborated with EIAR researchers on evaluation of MABC lines.

Development of the released MABC line was possible due to the efforts of a multi-disciplinary team of scientists representing genomics, breeding and crop physiology at the ICRISAT headquarters. For instance, the genomics team led by Dr Rajeev Varshney, Research Program Director- Genetic Gains and Principal Investigator of Tropical Legumes project, did the identification of markers, foreground marker selection and background marker selection. The marker-assisted backcrossing, generation breeding team led by Dr Pooran Gaur, Research Program Director- Asia and Chickpea Objective Coordinator in Tropical Legumes Project did advancement and field evaluation work; and Dr L Krishnamurthy and Dr Junichi Kashiwagi, former crop physiologists at ICRISAT, conducted crop physiology work.

Speaking of the success of molecular breeding, Dr Gaur said, “I am excited to see that the first chickpea molecular breeding variety was developed from the parent lines JG 11 developed together by ICRISAT and JNKVV and ICC 4958 coming from the ICRISAT germplasm collection. We hope to have wider adoption of this new variety and will continue to work towards enhancing chickpea yields in Ethiopia”.

“Integration of molecular technologies in breeding programs is the need of the hour for enhancing yield, nutrition and addressing global challenges like climate change,” said Dr Varshney.

Geletu was developed from the cross $JG\ 11 \times ICC\ 4958$ with pedigree $[(JG\ 11 \times ICC\ 4958) \times 3*JG\ 11] – 29$ after introducing a QTL-hotspot for drought tolerance related traits using marker-assisted backcrossing identified by ICRISAT researchers and its collaborators (published in The Plant Genome 6 doi: 10.3835/plantgenome2013.07.0022).

**Project:** National Chickpea and Lentil Research Program, Ethiopia and Tropical Legumes projects

**Investor:** Bill & Melinda Gates Foundation, CGIAR Generation Challenge Program, Government of Ethiopia

**Partners:** EIAR and ICRISAT

**CGIAR Research Program:** Grain Legumes and Dryland Cereals
Terraced mountainsides growing a range of crops – cereals, forage and vegetables like carrot and garlic that the people had never seen before; and a wide variety of trees (even apples!) – are a common sight in Yewol today.

While that’s how the fields look like, the homesteads too have gone for a change and new breeds of livestock can be spotted. Surplus fodder and crop produce from this region making its way to nearby markets is beginning to catch up.

How it used to be

Five years ago, the scenario was totally different. The agro-pastoral communities found it difficult to grow even their staple crops – barley, wheat, teff, lentils, faba bean and peas. When it rained, which most often is heavy during the months of July to September, rainwater gushed down the slopes carrying with it great amounts of soil and vegetation. Soil erosion coupled with free grazing of animals and long spells of ‘unexpected’ drought degraded the land so much that their crops began to dwindle along with their livestock. Migration was the only way out for some of them. Food shortage stalked the residents and it still is a reality for some all year through and for some during the dry season.

What was done

At a time when the people were struggling with the situation, an initiative was started by concerned local researchers with the support of the government. The project brought in the needed change among communities to join hands and work together to replenish the dwindling resources of their homeland, Yewol, which in Amharic means ‘for all of us’!

Continued on pages 2 & 3...

*United Nations Convention to Combat Desertification 14th session of the Conference of Parties

ICRISAT is participating on September 2nd in a side event – Applying the Research in Development Approach to Scale Land Restoration and achieve the LDN targets
How communities joined hands to replenish the ecosystem that belongs to them

1. Saving the soil
Terracing and contour ditches prevented soil erosion and increased recharge of groundwater

7,500 hectares
i.e. the entire watershed area was terraced by the community as part of the government’s Safety Net Program with technical support from ICRISAT

2. Mobilizing the community
Scientifically tested solutions ensured effectiveness and sustainability. Local byelaws were framed to support solutions

60 days
of work was contributed by each farmer for building terraces and other structures

3. Growing new crops
Crop diversity increased by growing new and profitable crops

4. Livestock innovations
The project distributed crossbreed bulls and rams, and recruited artificial insemination experts

5. Market access
Forming farmer cooperatives improved farmers’ bargaining power

6. Mechanism to save livestock from the effect of drought (% of households)

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<thead>
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<th>Control group</th>
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<tr>
<td>Sold the Animals</td>
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<td>Destocking</td>
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<tr>
<td>Bought Feed</td>
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<td>from other place</td>
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<td>Gave them to someone on profit sharing</td>
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<tr>
<td>Did Nothing</td>
<td>61</td>
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<td>Took Other Measures</td>
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*1 birr = 0.035 US$

7,500 birr
was the average income of young farmers in the potato cooperative.

5,140 birr
per annum earned from agroforestry products

>17 new crop varieties were introduced including potatoes, garlic, carrots, apples, etc

Project: Enhancing Communities’ adaptive capacity to climate change in drought-prone hotspots of the Blue Nile Basin in Ethiopia

Funder: CRP Water, Land and Ecosystems
Partners: Wollo University, Ministry of Agriculture and Natural Resources - Ethiopia and ICRISAT

Shift towards market-oriented crops
Rising adoption of high-value crops: Apple, carrot, chickpea and spices.
Food security crops: Potatoes
How communities joined hands to replenish the ecosystem that belongs to them

Capturing rainwater
Dug wells and farm ponds upstream for harvesting rainwater. Increased river flow downstream.

5 fold increase in irrigable land

Revitalizing the soil
Best agronomic practices and access to quality seed helped conserve the soil and get more yields.

Grass pea cultivation decreases with increased water availability and cultivation of market-oriented crops.

Climate resilience and improved livelihoods
Better adaptive capacity results in better incomes.

Change in 5 years

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<tr>
<td>82%</td>
<td>51%</td>
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<td>Improved food security</td>
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<td>53%</td>
<td>92%</td>
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<td>Reliance on food aid</td>
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Upscaling avenues
Influence on policy makers
Project success caught the attention of higher officials, decision makers and regional administrators including the president of Amhara regional state. Concrete actions taken by concerned institutions include:

- Allocated additional budget for further scaling up/out
- Started interventions of the same kind and showed interest to scale-up/out
- Incorporated it into the Productivity Safety Net program (PSNP)

The Way the Project empowered Female and Male Farmers

For printable version please click here
A series of initiatives, including increasing rainfed fodder production and rapid livestock pregnancy diagnosis, have been taken this monsoon in India’s Uttar Pradesh to prevent cattle from turning into pests.

Fodder shortage in the rain-scarce region of Bundelkhand in the north Indian state forces farmers to let their cattle loose to graze on what is available in the fields, starting April. This practice is called Anna Pratha. Bountiful rains can ensure availability of water for fodder cultivation but changing climate is unlikely to allow such guarantees. This kharif (monsoon) the Doubling Farmers’ Income project in the region has put the spotlight on fodder production interventions in all the seven districts of Bundelkhand. Farmers are being encouraged to cultivate legumes, non-legumes and fodder trees in their fields to meet livestock nutritional requirements.

A similar partnership between the Indian Council of Agricultural Research (ICAR)-Central Agroforestry Research Institute (CAFRI) and ICRISAT in developing the watershed of Parasai-Sindh in Jhansi, which is in Bundelkhand, led to an increase of 93% in fodder production post 2016; in 2011 Bundelkhand needed 10,163,000 tons of dry fodder but had just over half of that. With improvements in livestock productivity, the buffalo population in Jhansi increased from 900 to 1300, with gains in milk yield of 2 liters per day per animal. The watershed was developed mainly through water harvesting, introduction of improved crops and improvement in agricultural practices.

Under the current efforts, ICRISAT, with ICAR-CAFRI, is stepping up rainwater harvesting efforts through the construction of check dams, farm ponds, renovation of traditional tanks, desilting of water harvesting bodies and large scale field bundings in all seven pilot sites of Bundelkhand region.

Farmers of the region usually leave their fields fallow during kharif and cultivate a rabi (winter) crop using residual moisture. Since landholdings are generally larger in Bundelkhand than in other parts of Uttar Pradesh, farmers make do with one crop, with the region losing ₹ 1,600 crore (Approximately US$ 220 Mn) per year from the lost opportunity, estimates Dr Prakash Rathod, Visiting Scientist, ICRISAT Development Center.

The cattle, straying until October, destroy up to a third of the rainfed crop the region produces. Poor yields imply insufficient crop residue. The animals often move too far away from home and die. The state’s breed improvement programs are affected as there is no control over mating of stray animals. The situation calls for measures to develop resilience in the farm-livestock systems, which account for nearly 96% of the farmers’ income in the region.

Against the backdrop of changes in the state’s livestock marketing policies, the government has initiated solutions including setting up shelters for wandering animals. Research organizations like ICRISAT, engaged to realize the greater objective of doubling farmers’ income, are striving for a change.

ICAR’s Indian Grassland and Fodder Research Institute is helping in fodder management in three districts while Bharatiya Agro-Industrial Foundation is undertaking sorted sexed insemination programs in the region. These inseminations increase the likelihood of female births to increase the value perception of an animal to the farmer.

Farmers are also being provided rapid pregnancy diagnosis facilities, which makes pregnancy detection possible in 21 days as compared to the three or four months it normally takes. This gives the farmer another reason to keep the animal. Further, biogas plants are also being established for effective utilization of urine and dung in the project villages.

Such in-situ and ex-situ water harvesting measures will facilitate groundwater recharge and increase blue and green water availability in project villages. Increased freshwater availability would not only enhance crop intensification but also ensure fodder availability, thereby improving livestock productivity as was seen post the development of Parasai-Sindh watershed project, which was recognized by NITI Aayog as a model worth emulating.

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**Project:** Doubling farmers’ income in Bundelkhand Region, Uttar Pradesh  
**Funder:** Government of Uttar Pradesh  
**Partners:** ICAR-IGFRI, BUAT, BAIF, Bharat Agriculture, Lakshya Seva Samiti, Lakshya Seva Samiti, Gram Unnati, Samarpan Jan Kalyan Samiti, Samarth Foundation, Gram Unmesh Sansthan Gramin Vikas Kendra, Upman Mahila Samstan
To combat a noxious weed like the Parthenium *hysterophorus*, a multipronged strategy that includes preventive measures, manual uprooting, herbicides and biological control agents is essential, said Dr AN Rao, Consultant, ICRISAT Development Center (IDC), at a recent seminar on “The menace and management of *Parthenium hysterophorus*”.

*P. hysterophorus*, a flowering plant in the aster family, *Asteraceae*, is a highly invasive and aggressive weed. “A single seed of Parthenium can give rise to up to 25,000 seeds, creating an enormous seed bank in the soil,” Dr Rao said. “The seeds can survive for up to six years in the soil. As many as 54 countries worldwide are infected by this weed.” Parthenium inhibits growth of other vegetation in its proximity by producing ‘allelochemicals’. It is highly allergenic to humans and also toxic to animals. Therefore, it is extremely essential to get rid of the weed, especially from agricultural land.

During the seminar at the ICRISAT headquarters on 27 August, Dr Rao listed several approaches to tackling the menace:

▪ Prevent spread of the Parthenium seeds by maintaining strict hygiene in fields
▪ If seeds are present in the soil, deep plough to bury them under 7 cm or more of soil and keep them buried for 6 years – till they lose their viability
▪ Destroy seedlings manually before flowering
▪ Growing competing plants like *Cassia* spp around Parthenium
▪ Herbicide spraying before seeds are set. Repeated spraying may be required.
▪ Glyphosate seems to be the most effective herbicide when used at the appropriate time, e.g. at onset of monsoon, when seeds germinate and seedlings emerge. However, adequate care – including use of protective clothing and gear - should be taken while using this herbicide.
▪ Biocontrol agents such as the *Zygogramma bicolorata* leaf-feeding beetle.

Considering the aggressively proliferating nature of the weed, Dr Rao suggested that a concerted effort – integrated weed management – employing all or most of the above strategies were needed for eradication of the plant.

Photo: ICRISAT

*P. hysterophorus*, a flowering plant in the aster family, *Asteraceae*, is a highly invasive and aggressive weed.
Malawi has prioritized improving food security for its people through maize-oriented policies and investments. This has, however, come at a cost of losing agricultural diversity and the nutrition benefits from diversified diets. Today, with undernutrition remaining unresolved, integrating agriculture, nutrition policies and institutional frameworks are more critical than ever.

Against this background, the CLIM2 Policy Dialog event, under the EU-funded CLIM2 project (https://clim.icrisat.org), brought together policy makers, researchers, district-level agricultural extension and nutrition coordinators, food industry representatives, and small-scale producers to examine the various dynamic linkages between agri-food value chains and nutrition. The purpose was to explore how diversification and integration of crops and livestock could contribute to higher incomes for small-scale producers and other agri-food value chain actors, while enhancing nutrition for rural communities in Malawi. More than 50 participants attended the two-day meeting in Blantyre, Southern Malawi, from 23 to 24 July 2019.

“Effective policies need to support agri-food systems to have collaborations at national and community levels to empower smallholder farmers and reduce the dependency syndrome”, emphasized Dr Yanira Ntupanyama, Chief Director, Agriculture, Irrigation and Water Development, in her opening speech.

“Southern Malawi, despite land shortage as the elephant in the room, has potential for farmers to gain more from better structured agri-food value chains. We are good at working on agricultural productivity; yet we must also work on the value chain constraints and institutional issues that restrict market interventions for agri-food value chains to respond to nutrition challenges,” said Dr Andre van Rooyen, Principal Scientist, ICRISAT.

Investing in high potential agri-food value chains

The CLIM2 project fast-tracks the release of the Kuroiler chicken breed and a new business model for communities to take advantage of the increasing demand for village chickens, while reducing Malawi’s import of the same. The objective is to verify if the improved performance of the Kuroiler, viz. efficient feed conversion, higher egg and meat production etc., holds true as a dual-purpose breed, along with its business model and value chain development. The new business model involves the registration of farmers as companies, with farmers contributing to infrastructure and owning shares in the companies. In all, 5,000 birds were evaluated on Mikolongwe Research Station in comparison to semi-commercial conditions on Luzu Quarantine Station, and on-farm production with 100 small-scale farmers in Balaka, Chiradzulu and Thyolo Districts. According to Donald Kaonga, PhD student, International Livestock Research Institute (ILRI), “Preliminary cost comparison suggests that farmers can raise these chickens free-range with supplementary homemade feeds at half the cost of commercial feeds.”

Workshop participants visited the evaluation sites and experienced the opportunity and potential for Malawi to capitalize on the Kuroiler experience.

More at: https://www.icrisat.org/the-nexus-between-agri-food-value-chains-and-nutrition/

About the author:

Dr Sabine Homann Kee Tui
Senior Scientist, Markets, Institutions, Nutrition & Diversity, ICRISAT
Improved sorghum varieties are finding new champions in Burkina Faso

The Provincial Union of Agricultural Professionals Bemba Nayala supported by the HOPE II project, recently won a contract to supply 200 tons of sorghum to the World Food Program (WFP). This was made possible due to the activities of the Harnessing Opportunities for Productivity Enhancement (HOPE II) for Sorghum and Millets in sub-Saharan Africa project, says Dr Drabo Inoussa, millet breeder at the Institut de l’Environnement et Recherches Agricoles (INERA).

The project funded by the Bill & Melinda Gates Foundation has been helping farmer organizations such as the union to work together with other key stakeholders in the fight against hunger and to improve the living conditions of small producers. The union also manages and distributes state-subsidized inputs (seeds and fertilizers) throughout the province, a mission entrusted by the Ministry of Agriculture of Burkina Faso.

The contract was awarded to the union at a recent fair on certified seeds organized by the Federation of Agricultural Professionals of Burkina Faso. The event helped small producers understand the importance of using certified improved seeds. Participants of the fair were briefed on seed production, and were provided guided tours to certified seed plots with popular improved varieties such as Kapelga (sorghum) and MISARI 1 (millet) throughout the province of Nayala.

The HOPE project spanning 11 countries focused on developing improved varieties and crop management practices to help smallholder farmers increase productivity under harsh, dry production environments in many parts of sub-Saharan Africa and South Asia. Sorghum and millet production is helping communities in areas like Nayala in Burkina Faso achieve food self-sufficiency and beyond.

Project: Harnessing Opportunities for Productivity Enhancement (HOPE II) for Sorghum and Millets in sub-Saharan Africa

Funder: Bill & Melinda Gates Foundation

Partners: Institut de l’Environnement et Recherches Agricoles (INERA), Burkina Faso; Institut d’Economie Rurale (IER), Mali; Institute for Agricultural Research (IAR) of Ahmadu Bello University (ABU) and Usmanu Danfodiyo University of Sokoto (UDUS), Nigeria; Ethiopian Institute of Agricultural Research (EIAR), Ethiopia; Department of Research and Development (DRD), Tanzania; National Semi-Arid Resources Research Institute (NaSARRI) of the National Agricultural Research Organization (NARO), Uganda.
Investing in nutrition is investing in people

More than 400 policy makers, experts, and researchers endorsed the need for a better inclusion of millet, sorghum and groundnut in the food and nutrition system at the Mali National Nutrition Forum in Bamako.

The forum served as an effective platform for sharing and capitalizing on experiences and lessons learnt, and to explore new ways for impactful and sustainable sectoral governance on food and nutritional security in Mali. ICRISAT, in a special session, highlighted the Smart Food Initiative with exhibits at the venue.

The forum also brought together technical and financial partners, regional and local rural development technicians, actors of industrial food processing, consumer associations, representatives of NGOs and civil society organizations involved in the fight against food and nutrition insecurity.

Organized in July, the opening ceremony of the Forum was chaired by Dr Boubou Cissé, Prime Minister of Mali - Minister of Economy and Finances, with Mr Daniel Kablan Duncan, Vice-President of Côte d’Ivoire, Ms Gerda Verburg, UN Assistant Secretary-General and SUN Movement coordinator, Mr Jakaya Kikwete, former President of Tanzania, and Dr Purnima Kashyap, REACH, Coordinator.

The forum concluded with a call for strong engagement of the government to double investments in nutrition. It also called for increased funding from the domestic private sector.

Interventions on nutrition were also identified and prioritized by the participants.
Eight months of the year was the most farmer Seydou Yolo’s harvest would last to feed his family of two wives and fifteen children. From then on, cattle would have to be sold to feed the family for the following four months.

No amount of hard work could raise the yield from the farm of this farmer from Doundé village in Mopti region, Mali, beyond 4 tons, i.e., 3 tons from millet, 300 kg from sorghum, and 700 kg from groundnut, cowpea and fonio millet.

“I joined the ARDT_SMS project in 2014 through Catholic Relief Services (CRS). First, I joined a Farmer Field School which conducted several training sessions on best agricultural practices in millet and sorghum. The training focused on composting, seed treatment with Apron star 42 WS, intercropping (millet and cowpea), conservation of cowpea grains against pest attacks, microdosing, and improved seed production and conservation techniques,” explains Seydou.

What turned the tide in his production fortunes was the training on biological control of the millet head miner. “The module was taught at a workshop in 2016. Following many other training sessions, my skills and knowledge of the right practices for millet and sorghum production technologies improved,” says Seydou.

Today, he is a Farmer Field School facilitator, seed producer and resource person, all rolled into one, spreading the knowledge he has gained and teaching other farmers how to ward off deadly pest attacks that can decimate their millet and sorghum crops. He has supported many NGOs and the district agricultural extension services during the trainings.

Benefits of FFS trainings facilitated by Seydou

Training on best farming practices, 2015

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<tr>
<th>Village</th>
<th>Participants</th>
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<td>Doundé</td>
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<td>Ségué</td>
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<td>Bandiagara</td>
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Training on biological pest control, 2018

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Though Seydou has reduced the extent of sowing on his farm given the physical effort it required, his yields have risen. The use of quality seeds and improved agronomic practices in millet and sorghum gave him a harvest of 7 tons (6 tons of millet and 1 ton of sorghum). “I could sell 480 kg out of the 680 kg of cowpea produced, earning about CFA 170,000 (about US$ 400) for household expenses. In addition, the fodder from cowpea as a result of intercropping, is being use for livestock fattening,” he says.

Lessons learnt

“Farmers in the community are open to testing new technologies. Once the benefits of greater yields became visible, they were more receptive to applying compost, adopting microdosing, using improved seed and treating them with Apron star 42 WS, intercropping (millet and cowpea) and the biological control of the millet head miner,” says Seydou. “Without USAID, ICRISAT and the project partners who exposed us to new technologies, neither would I have become a useful member of the community nor have the strong conviction that together we can make food insecurity a thing of the past with such interventions.”

For more success stories of the USAID Africa RISING’s Large-scale Diffusion of Technologies for Millet and Sorghum Systems (ARDT_SMS), please click here.
Closer to delivering more produce and income to smallholder farmers

Farmers’ preferences, high yields, and resistance to drought, pests and diseases will be the priority for scientists. Partners of the project Delivering more produce and income to farmers through enhancing genetic gains for chickpea and pigeonpea, recommended this as they reviewed the progress and defined its future strategies at a planning meeting in July 2019.

Session Chair Dr NP Singh, Director, ICAR-Indian Institute of Pulses Research (IIPR), recommended targeting ‘low-hanging fruits’ – outputs of earlier projects – to accelerate rate of delivery in farmers’ fields and using off-season locations to advance crossing in different stages. He emphasized use of genomics tools in crop improvement to step up crop productivity.

Dr Peter Carberry, Director General, ICRISAT, said, “India leads the world in chickpea production. Collaboration with our partners – the Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs) – is vital to ensure that farmers’ incomes get a boost with high-yielding varieties tolerant to drought, pests and diseases.”

Describing that the project was carrying out trait mapping, molecular breeding, farmers’ participatory varietal selection and adoption trials, Dr Rajeev Varshney, Research Program Director, Genetic Gains, ICRISAT, said, “Many improved chickpea and pigeonpea varieties/hybrids have reached over 600 farmers in 152 villages of 25 districts across six Indian states. I was very impressed to see high-yielding, drought-tolerant and Fusarium wilt-resistant chickpea varieties in farmers’ fields of Kurnool District in Andhra Pradesh, when I visited.”

Around 30 researchers from nine institutes participated in this meeting to present the project progress on the ground, highlights of which are as follows:

1. Improved lines under varietal release pipeline
   - Pigeonpea: 1 notified and 1 pre-released and 6 in AVT/IVT
   - Chickpea: AVT 2: Four molecular breeding lines for drought tolerance; one molecular breeding line for Fusarium wilt resistance
   - 16 varieties/hybrids each in chickpea and pigeonpea tested in FPVS trials

2. 16 varieties/hybrids each in chickpea and pigeonpea tested in FPVS trials

3. A set of ~200 improved lines (100 each in chickpea and pigeonpea) evaluated for higher yield and desirable traits in multi-location trials

4. Molecular breeding to enhance drought-tolerance and fusarium wilt resistance in elite lines of chickpea and fusarium wilt and sterility mosaic disease resistances in pigeonpea

5. High-density genotyping, genetic maps and marker trait associations

6. NAM and MAGIC populations advanced in pigeonpea

7. Around 10 research articles in peer-reviewed journals including Nature Genetics, Scientific Reports, BMC Genomics, Theoretical and Applied Genetics, Plant Biotechnology Journal etc.

Dr Pooran Gaur, Research Program Director - Asia, ICRISAT, said importance must be given to farmers’ ranking of varieties tested in FPVS trials to ensure development of demand-driven varieties. He said, it was important that no variety older than 10 years be grown by farmers.

Activity leads were encouraged to accelerate MABC crosses so as to have a complete product ready for testing in fields soon. Phenotyping data analysis of the 100 lines’ multi-location evaluation was suggested to identify location-specific and/or overall better performing lines, so that some of them could be nominated for varietal release through appropriate channel.

The Review and Workplan meeting of the project, funded by the Department of Agriculture & Cooperation, Ministry of Agriculture & Farmers Welfare, Government of India, was held at Hyderabad.

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1. AVT/IVT: Advanced Varietal Trials/Independent Varietal Trials
2. FPVS: Farmer-Preferred Varietal Selection
3. NAM: Nested Association Mapping
4. MAGIC: Multi-parent Advanced Generation Inter-Cross
5. MABC: Marker-Assisted Back Crossing
China and CGIAR ramping up joint work in dryland agriculture

A Center of Excellence on Dryland Agriculture (CEDA) already established will now expand to a co-hosted China and CGIAR international conference on dryland agriculture in 2020 in China. Further discussions are underway for a web platform — eDAR for dryland ag research — which aims to be an e-network forum for the global research community in the drylands.

Increased collaboration between China’s research institutions and CGIAR institutes was seen as critical to drive sustainability in global agriculture, especially in improving soil health in drylands and increasing water-holding capacity of soils through measures like mouldboard ploughing, subsoil manuring and fertilizing subsoils.

The International Center for Agricultural Research in the Dry Areas (ICARDA), the Chinese Academy of Agricultural Sciences (CAAS) and ICRISAT have a joint MoU for CEDA located within the Institute of Environment and Sustainable Development in Agriculture (IEDA) under CAAS. Under CEDA, CAAS provides ICRISAT and ICARDA with annual funding to hold workshops and host CAAS staff. Under ICRISAT’s collaboration with CAAS, a joint laboratory for groundnut aflatoxin management has also been established.

An ICRISAT delegation led by Director General, Dr Peter S Carberry, toured facilities in China’s agricultural universities to cognize research capacities. The delegation also learnt the revolutionary impact of plastic mulching on agriculture in China. Mulching using biodegradable sources could help in enhancing the productivity and resilience of smallholder farming systems in Sub-Saharan Africa and South Asia. A visit to the Liaoning Academy of Agricultural Sciences (LAAS) helped the delegation explore opportunities for strengthening research collaborations. At the Gansu Agricultural University (GAU), Lanzhou, University President Prof Zhao Xingxu bestowed Adjunct Professorship on Dr Carberry.

GAU researches agriculture on the Loess Plateau, a landscape crafted by massive erosion along the Yellow River in central China. The delegation also visited GAU’s Rainfed research station in the town of Lijiabao, Gansu Province, and interacted with GAU post-grad students, including three from Ghana.

The ‘International Workshop on Dryland Agriculture Development’ organized at Shenyang, China, saw participation by multiple CGIAR centers, including ICRISAT, ICARDA and the International Water Management Institute (IWMI), besides institutions of CAAS.

Dr Carberry, along with Dr Pooran Gaur, Research Program Director-Asia; Dr Mamta Sharma, Theme Leader, Integrated Crop Management (ICM); Dr Hari Sudini, Principal Scientist (Groundnut Pathology); and Dr Shalander Kumar, Principal Scientist, Innovation Systems for the Drylands, presented ICRISAT’s work at the workshop.

Hosted by Prof Mei Xurong, Vice President, CAAS; Prof Zhang Yanqing, Director General, IEDA; and Prof Hao Weiping, Deputy-Director General, Department of International Cooperation, CAAS, the workshop featured a presentation on the revolutionary impact of plastic mulching on agriculture in China.

A working group was constituted for the 2020 conference’s planning in which ICRISAT’s Dr Shalander Kumar will represent ICRISAT.
The power of the positive – ICRISAT DG calls attention to agriculture’s narrative

Leaving doomsday predictions and grim pictures of the world behind is important to make a difference to agriculture research in the world, said Dr Peter S Carberry, Director General ICRISAT. Delivering the keynote address on agriculture ‘feeding the world or an environmental concern’ at a gathering of global researchers and practitioners, he emphasized that there had been significant contribution by research to farmers across the world.

However, the challenges remain. Dr Carberry quoted the study of a large farmer in Australia, who had access to all possible resources, but his farm income over 20 years still fluctuated, recording losses on several occasions. This was why research has to move beyond just providing solutions and assuming that they would help solve problems. He summarized that there is need to make the narrative of agriculture positive and focus on the immense potential of agriculture research.

These remarks were made during a keynote address in August at the conference on ‘Achieving Sustainable Development Goals and Strengthening Science of Climate Resilience’ at the 30th Foundation Day of the M S Swaminathan Research Foundation. Dr Soumya Swaminathan, Deputy Director General and Chief Scientist, World Health Organization, spoke of the need to focus on linkages between agriculture, nutrition and health. Dr Kundhavi Kadiresan, Assistant Director-General and Food and Agriculture Organization’s (FAO) Regional Representative for Asia, emphasized on more sustainable agricultural practices to preserve biodiversity along with enhancing food production.

Dr Trilochan Mohapatra, Director General, Indian Council of Agricultural Research and Vice-Chair, ICRISAT Governing Board, shared the scale of impact that agriculture research in India was having – both in terms of technologies developed as well as adoption.

Prof Bruce Alberts, University of California and former President, National Academy of Sciences, spoke of the need to bridge research and education for better agriculture practice. The event also celebrated the birthday of Prof M S Swaminathan, agriculture scientist, who noted the importance of conserving genetic resources, especially in the context of climate change.
Training an army of giants for the biological control of Fall Armyworm

Scouting for natural enemies of the fall armyworm (Spodoptera frugiperda) (FAW) in both Asia and Africa, and establishing mass-rearing facilities will aid the biological control program in the fight against the voracious pest.

A five-day workshop, organized by ICRISAT-Niger research station in July, trained 27 participants from 16 African and Asian countries on monitoring and management of FAW.

After receiving inputs on the biology, taxonomy, ecology, and distribution of FAW in their respective countries by experts, the participants were trained hands-on on preparing diets for rearing the pest and the rice moth. Fall armyworm eggs are used for producing the beneficial parasitoid Telenomus remus, and eggs of the rice moth for producing the beneficial parasitoid Trichogramma.

The fall armyworm, a pest native to the tropical and subtropical Americas, invaded Africa and Asia in 2016 and 2018, respectively. It is a serious pest that devours over 300 plant species, including maize and sorghum, which feed millions of people every day. Since, FAW has caused billions of dollars’ worth of damage in Africa and Asia. Biological control is one of the safe, effective, and socially acceptable options available for integration into the management of FAW.

In 2018, ICRISAT-Niger in collaboration with Institut National de la Recherche Agronomique du Niger (INRAN), University of Maradi, and the Feed the Future Innovation Lab for Integrated Pest Management found two natural enemies of the fall armyworm, Telenomus remus and Trichogramma, which attack its eggs. Telenomus remus and Trichogramma populations are low early in the season; hence, mass production and early release of the natural enemies will suppress the pest throughout the cropping season. The same team has used this approach known as augmentative biological control successfully for controlling the millet head miner in the Sahel.

The participants of the workshop learnt how to differentiate the males and females of different parasitoid species and different steps toward rearing them. The training also involved scouting eggs of the FAW for assessment of parasitism and collecting egg parasitoids to start a culture. Finally, participants learnt how to release the parasitoid once a culture is established.

Trainees for this workshop came from Bangladesh, Benin, Burkina Faso, Cambodia, Cameroon, Cape Verde, Cote d’Ivoire, Democratic Republic of Congo, Ghana, Mali, Nepal, Niger, Senegal, Sudan, Togo and Vietnam. The workshop was supported by INRAN and the Feed the Future Innovation Lab for Integrated Pest Management (IPM Innovation Lab), Food and Agriculture Organization (FAO), TAAT Sorghum and Millet Compact and the CGIAR Research Program on Grain Legumes and Dryland Cereals.
Partnerships to advance global peanut research

Highlighting the importance of partnerships to advance global groundnut research, a mini symposium organized at the Auburn University, Alabama, USA, explored new tools to empower breeding.

‘Synergies from US Global Research Partnership’ which was aimed at signifying the benefits of working with international partners, was held on the sidelines of the 51st Annual Meeting of the American Peanut Research Education Society (APRES). The Symposium was co-hosted by Dr Dave Hoisington, Director of the Feed-the-Future Innovation Lab for Peanut (FtFPIL) and Dr Rich Brandenburg, President, APRES.

Dr Nora Lapitan, Division Chief of Research in the Bureau for Food Security at the US Agency for International Development (USAID), illustrated past and current international collaborations and the agenda to modernize breeding programs under the Crops to End Hunger (CtEH) program. She noted the lead taken by the peanut breeding team at ICRISAT in moving forward with new tools to enhance efficiencies of the breeding program.

"The research collaboration with US researchers to use genomic tools resulted in the development of high oleic peanut varieties that were commercialized recently in India," said Dr Janila Pasupuleti, Principal Scientist - Groundnut Breeding, ICRISAT.

Dr David Jordan from the North Carolina State University, USA, discussed the benefits of international collaborations with the US researchers, and Mr Jeff Johnson, President emeritus, Birdsong Peanuts, detailed the potential of peanut to meet protein needs of the growing populations. Dr David Bertioli from the University of Georgia, USA, and Dr Daniel Fonceka from the CIRAD/ Centre d’études régional pour l’amélioration de l’adaptation à la sécheresse (CERAAS), Senegal, together with Dr Pasupuleti, detailed how sharing of germplasm contributed to the improvement of target traits, particularly resistance.
A deeper understanding of advanced trends in artificial intelligence (AI), machine learning (ML) and deep learning methods in genomic prediction models is critical to the success of smallholder agriculture. AI and ML algorithms are now being used to reduce risks in agriculture while also making it possible to forecast pest and disease outbreaks and alert farmers in advance.

The annual collaborative workshop for Bioinformatics & Biometrics Community of Practices (CoP) under Excellence in Breeding (EiB) Platform Module 5, held in July in Montpellier, France, discussed the untapped potential of deep learning methods to make a significant impact on farming.

With the theme: “Artificial Intelligence & Machine Learning with Genomic Selection Use Cases”, the workshop served as a platform for data scientists across CGIAR institutions to explore using advanced agricultural research ML algorithms for genomics including prediction of plant phenotype, image identification, disease identification, and annotation of DNA sequences.

“During the EiB Platform Module 5 meetings, a need to properly implement AI/ML algorithms in breeding programs was seen as a major opportunity to boost genetic gains in crops. It was further decided to have an EiB-supported CGIAR-wide collaborative workshop to share experiences, learn new methodologies and plan for the future,” said Dr Abhishek Rathore, EiB Platform Module 5 - Bioinformatics & Biometrics CoP Coordinator & Theme Leader, Statistics, Bioinformatics and Data Management, ICRISAT.

Dr Osval Antonio Montesinos López, Associate Professor from University of Colima, Mexico who served as the instructor for the workshop, detailed methodologies under the umbrella of machine learning. Participants were trained in algorithms of general elements of prediction and logistic regression, artificial neural networks and deep learning for different types of outcomes, support vector regression and support vector machines, linear mixed models for genomic prediction and functional regression.

Four women data scientists were among the group of 11 participants from CGIAR centers including AfricaRice, Bioversity International, International Center for Tropical Agriculture (CIAT), International Maize and Wheat Improvement Center (CIMMYT), International Potato Center (CIP), International Center for Agricultural Research in the Dry Areas (ICARDA), International Institute of Tropical Agriculture (IITA), International Livestock Research Institute (ILRI), International Rice Research Institute (IRRI) and ICRISAT.

EiB Platform Module 5 Leader, Dr Kelly Robbins supported and mentored the workshop planning and activities. The workshop was supported by the EiB Platform Module 5.
IPRs management key to capitalize on technology-supported businesses

A workshop on Intellectual Property Rights (IPRs) held at ICRISAT, equipped 85 participants with in-depth understanding on types of intellectual property, pre-filing scenarios, procedural timelines and statutory fees. The sessions also focussed on IP knowledge dissemination with examples from each domain/subject matter to cater to the diverse participant portfolio that included students, startups, innovators, incubation managers and entrepreneurs.

A better understanding of IPRs is key to boost innovation within both public and private institutions in the country, Dr Peter Carberry, Director General, ICRISAT, said. Speaking at a one-day workshop on IPRs at ICRISAT, Dr Carberry highlighted the importance of knowledge dissemination on patents, trademarks, designs and copyrights.

Dr Saikat Datta Mazumdar, Chief Operating Officer (COO)-NPK Program, AIP-ICRISAT addressed the participants on the criticality of IPRs management to capitalize on technology-supported businesses, while Dr Surya Mani Tripathi, Legal Counsel, ICRISAT, and Mr Diwaagar Radhakrishnan Sitaraman, Advocate and IP Attorney, Madras High Court, provided an overview of IPRs with various interactive exercises.

Ms Sravanti Vedula, Project Officer, Agribusiness and Innovation Platform (AIP) - ICRISAT, shared details on the Government of India initiatives that provide financial assistance for filing of IPRs in the form of reimbursement with special focus on assistance from the Ministry of MSME. With more than 40% of the attendees being women from diverse backgrounds, the event highlighted the increasing interest of women in the innovation ecosystem.

The activity was organized by the Intellectual Property Facilitation Cell and AIP - ICRISAT, in partnership with STARTUPBYTE and was supported by the Ministry of Micro, Small and Medium Enterprises (MSME), Government of India. ■

https://www.icrisat.org/iprs-management-key-to-capitalize-on-technology-supported-businesses/