

Annual Report 2021

Invigorate • Innovate • Integrate



Foreword



Dr Jacqueline Hughes Director General

ICRISAT is delighted to have won the Africa Food Prize 2021 for our work, that has markedly improved food security across 13 countries in sub-Saharan Africa. We are proud to have led a consortium of partners to implement the Tropical Legumes project with the International Center for Tropical Agriculture (CIAT) and International Institute of Tropical Agriculture (IITA). The project resulted in improved legume varieties and close to half a million tons of seed for a variety of legume crops, including cowpea, pigeonpea, chickpea, common bean, groundnut, and soybean.

These new varieties have contributed to over twenty-five million smallholder farmers to become more resilient to climate change, in addition to disease and pest outbreaks. We are especially grateful to the Africa Food Prize Committee and AGRA for this prize which exemplifies our deep and ongoing commitment to the drylands, especially in sub-Saharan Africa.

While the sciences can deliver these outcomes at the farm level, we are mindful that the relatively poor performance of agriculture in low-income regions has often been due to the prioritization of the urban industrial economy over the rural sector. In response, ICRISAT works closely to inform good public policy based on our evidence-based research to address the social, institutional and structural requirements of smallholder dryland farming. The results contained in this report are not exhaustive but highlight our firm commitment to delivering on the Sustainable Development Goals. It is through our valued partnerships that we will continue to see, new advances being made to improve the lives of those in the drylands of Asia, Africa and beyond.



Professor Prabhu Pingali Governing Board Chair

On behalf of the ICRISAT Governing Board, I am pleased to present our Annual Report for 2021. The collective impacts of our work derived from our collaboration with government institutions, partners, donors, and others continue to improve agri-dryland farming systems across Asia and Africa and with it, a better quality of life for those who call the drylands home.

ICRISAT's mandate crops – millets, sorghum, and grain legumes, and their cropping systems – are increasingly important in a global narrative on how to best overcome persistent malnutrition among marginalized populations across the drylands, while contributing to better diets and agricultural production that is more resilient to climate change.

The state of the drylands demands of us, new and more innovative approaches to addressing the progressively complex challenges and latent opportunities present in these regions. To this end, we are proud to be implementing our new strategic plan 2021 – 2025 to advance our mission.

We are heartened that our endeavours, which include world firsts, continue to deliver the transformative impacts and pragmatic development outcomes being sought by Governments, donors and partners, and which was most recently affirmed by the Institute being awarded the Africa Food Prize 2021.

As we look forward, we thank our international, national, and regional donors and partners that remain so crucial to the generation of our high-quality transformative research.



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ICRISAT thanks our donors, partners and supporters for enabling us to keep delivering the innovations that overcome hunger, malnutrition, poverty and environmental degradation for the 2.1 billion people who reside in the drylands of Asia, sub-Saharan Africa and beyond.

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Key Achievements

ICRISAT's key achievements in 2021 range from being awarded the prestigious Africa Food Prize to being acknowledged for our innovative work in water conservation and soil health, developing varieties and seed systems to winning a corporate social responsibility award for our partners in watershed management.



2021 Africa Food Prize

ICRISAT has been awarded the 2021 Africa Food Prize for work that has improved food security across 13 countries in sub-Saharan Africa. Between 2007 and 2019, ICRISAT led the Tropical Legumes Project in collaboration with the International Center for Tropical Agriculture (CIAT), International Institute of Tropical Agriculture (IITA), and other partners and developed 266 improved legume varieties and almost half a million tons of seed for a range of legume crops, including cowpea, pigeonpea, chickpea, common bean, groundnut, and soybean.

"ICRISAT's leadership in developing seeds that not only end malnutrition but also survive in semi-arid areas is inspiring other agricultural organisations to rethink seed development and farming practices that suit and solve Africa's agricultural challenges."

– H.E. Olusegun Obasanjo, the Chair of the Africa Food Prize Committee and former President, Federal Republic of Nigeria "Best Watershed Project in Agriculture" award to our CSR partner



The India CSR Network has awarded the "Best Watershed Project in Agriculture" to Mahindra & Mahindra Limited (M&M) for its ICRISAT-led watershed development efforts. The program involved creating 51 water harvesting structures in Buchinelli village in Telangana, India. The three year effort has led to the harvesting of 137,000 m³ rainwater every year, benefitting around 150 farmers.

World Vegetable Center photo of ICRISAT-led watershed management of "Odisha Livelihood Mission" wins a place in the top 5

This photo of a vegetable garden from a pilot site in India's Rayagada district under the ICRISAT Development Center (IDC) led Odisha Livelihood Mission project was judged one of top five photos from across the world by the World Vegetable Center.



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Research Highlights



With the shipment of **3700** accessions, **91%** of ICRISAT genebank collection has been **safety duplicated** at the Svalbard Global Seed Vault. The shipment included **2041** accessions of sorghum, **969** of pearl millet, **39** of pigeonpea, **221** of finger millet, **80** of groundnut and **350** of chickpea.



Led by ICRISAT, an international team of researchers from **41** organizations has **assembled chickpea's pan-genome** by sequencing the genomes of **3366** chickpea lines from **60** countries. The team **identified 29870 genes that includes 1582 previously unreported novel genes**.



ICRISAT sorghum lines demonstrated **high resistance to fungal disease**. Among **158** sorghum lines that were tested in Pennsylvania, USA for resistance to the fungal disease anthracnose leaf blight, ICRISAT lines, specifically ICSB94, showed the highest level of resistance in the field. These lines will be useful in breeding sorghum for north-eastern United States.



Launched **4CAST**, a digital seed variety catalog tool created by ICRISAT in partnership with public and private institutions. It is a user-friendly data driven platform that provides information about new improved varieties, quality and availability of seeds.



The National Seed Committee of Burkina Faso announced pearl millet hybrid **Nafagnon's** registration in the National Seed Catalog, making it the **country's first pearl millet hybrid to be approved** and the first single-cross hybrid to be approved for commercial use in West and Central Africa.



A new groundnut variety **'Kalinga Groundnut-101'** was released in Odisha (India) as an alternative to 'Devi', the popular variety. Both the varieties are of ICRISAT origin. Kalinga Groundnut-101 (ICGV 02266) was released by the Odisha University of Agriculture and Technology (OUAT) at the State Varietal Release Committee (SVRC) in Aug 2021.



ICRISAT researchers **zeroed in on little millet germplasm** with high nutrient content, high yield and biomass potential following analysis of **200 landraces** conserved in our Genebank in India. The study found **10** accessions with promising seed weight, **15 with high grain yield potential**, **15 with high biomass yield potential and 30 with consistently high grain nutrient content**.





1. Invigorate: For greater efficiency

1.1. A new research organizational structure to drive greater efficiency



ICRISAT underwent a structural reorganization in 2021 to reposition ourself as an effective global partner to help deliver on the Sustainable Development Goals. As the global knowledge leader in dryland agricultural science, our mandate as an Institute dictates that we remain ultra-responsive to the challenges faced by the 2.1 billion people who reside in the drylands of Asia, sub-Saharan Africa and beyond. Our approach, much like the approach of dryland farmers, is grounded in pragmatism and solutions that simply work. For fifty years, this has been and will continue to be our approach to the calling from the world's poorest, for hardier, more nutritious and now, more climate-resilient crops, on which they depend. No longer can the developmental space rely solely on traditional approaches, for progress, is often too slow in coming to those left behind. Our new revitalized institutional research structure has been seamlessly integrated for enhanced interdepartmental cooperation, agility, responsiveness, and new ways of working with and not just on behalf of smallholder farmers.

Aligning with the global agricultural research agenda, our renewed approach will leverage:

1) Foundational research: Research to address existing knowledge gaps and innovations to address critical needs.

2) Translational research: Application of knowledge and discoveries from foundational research to develop innovations (products/technologies) to achieve on-the ground impacts.

3) Local adaptive research: Focus on local country level needs by involving national stakeholders and partners from both public and private sectors.

4) Scaling for impact: Support the uptake of improved products, technologies, practices, and market policy arrangements, thereby creating an enabling environment through policy change and impact.



Our global research programs consolidate various research functions under a seamless structure to improve the quality of our outputs.

- Global Research Program 1 Accelerated Crop Improvement: Dedicated to develop marketdriven climate-resilient nutritious cultivars with high yield potential and accelerated genetic gain utilizing genebank accessions, genomics, breeding, physiology, disease / insect protection, together with modern tools of speed breeding and data-driven decisions. The aim is to enable farmers to quickly access improved varieties of quality seeds through improved seed systems.
- Global Research Program 2 -Resilient Farm and Food Systems: Dedicated to address critical issues of water management and land degradation in the drylands to deliver innovations to help smallholders adapt to and mitigate the impact of climate change on agriculture. Our success in watershed interventions and soil health improvement are fundamental to increasing incomes, enhancing sustainability, and climate proofing the drylands of Africa and Asia.
- Global Research Program 3 Enabling Systems Transformation: Dedicated to focus on nutrition, agribusiness innovation and women & youth empowerment. The Program works to enable better policies and facilitate innovations, market linkages and capacity development to transform farm and food systems and improve livelihoods and incomes of smallholder farmer in the drylands.

The three Regional Programs - Asia, Eastern and Southern Africa and West and Central Africa - will be responsible for the regional implementation of the activities under the Global Research Programs. The management of ICRISAT at India headquarters along with the regional hubs in Kenya and Mali, will drive the implementation of the Global Research Programs with support from 8 country offices - Niger, Nigeria, Senegal, Ethiopia, Malawi, Zimbabwe, Mozambique and Tanzania.

ICRISAT has also formed the **Crop Improvement Operations Team (CIOT)** in India, Eastern and Southern Africa and West and Central Africa that functions under GRP-Accelerated Crop Improvement. It provides innovative breeding strategies, tools, and technologies to sustainably enhance the genetic potential of crops for yield, biotic and abiotic stress tolerance and grain & nutritional quality improvement.

Infrastructure has also been upgraded for enhanced efficiency. Notable progress in this regard includes, digitization of the seed inventory, setting up of seed processing mechanization infrastructure, an X-Ray fluorescence facility, fully bar-coded field plots and seed storage labels and new equipment such as Near Infra-Red Spectroscopy (NIRS) and a 'Harvest Master' for grain weight and moisture content assessment. In Eastern and Southern Africa, the genebank has been renovated and modernized. The West and Central Africa region has upgraded screen houses, seed processing facilities and has acquired mechanization and digitalization tools to facilitate stewardship.

1.2. Invigorating the workspace: Responding to Covid-19



As the pandemic continued to define the 'new normal' such as mask-wearing and social distancing, ICRISAT's workspaces were redesigned to ensure that they meet international as well as national COVID safety protocols. Pleasingly, despite the pandemic and disruptions, the Institute continued to lead new innovations and deliver against its results framework.

The Institute introduced a number of measures to ensure the safety of our workforce. This included constituting a COVID task force, providing flexible work arrangements, launching a mobile app for COVID self-declaration by employees and conducting vaccination drives.

The use of digital technology assisted in this regard, with the extensive use of virtual meetings, webinars, and online training programs. ICRISAT's visitor services, which were halted during the lockdown, have also been restored virtually. As many as 1,880 students (31 groups), mostly involving three State Agricultural Universities participated in the virtual tours.

A small number of priority visits by ministers, civil servants, scientists, and Corporate Social Responsibility partners were accommodated during this period following strict COVID-19 precautions.







2. Innovate: For better impacts

Changing climate, water scarcity and outbreaks of pests and diseases threaten food production, which affects the ability to produce more food required to meet the needs of a growing population in the drylands of Asia and Africa. The prevailing issues around nutrition are not just limited to developing nations. They speak to the need to transform agriculture in developed nations to address the rising incidence of non-communicable diseases such as obesity. ICRISAT aims to address these cascading problems around agriculture, food and environment by developing highly productive, resilient and nutritionally enhanced dryland crops.



2.1. Breeding for Better Nutrition

Iron (Fe) and Zinc (Zn) micronutrient deficiencies are major health concerns for people living in the semi-arid tropics of Asia and Africa. The deficiency of iron in food consumed leads to Anaemia [Iron Deficiency Anaemia (IDA)] and is most common in women and children under 5 years. Biofortification through breeding techniques is a cost-effective approach to increase the micronutrient quantity in staple food crops. ICRISAT, supported by the HarvestPlus Challenge Program of the CGIAR, and in collaboration with public and private partners, has developed and released dryland crops with better nutrient content.

High-yielding biofortified cultivars of sorghum, pearl millet (for grain Fe and Zn content) and groundnut (high oleic acid content) have been commercialized in Africa and Asia in collaboration with national partners. **Dhanshakti,** the first biofortified pearl millet variety, was released in 2014 in Maharashtra, India. **Chakti,** a high Fe-Zn pearl millet, was released in Niger for commercial cultivation in 2018. In 2021 significant efforts have been made to disseminate their cultivation through large-scale seed production in India and Niger respectively.



In addition, seven high Fe and Zn Pearl Millet Hybrids (HHB 299, AHB 1200, DHBH 1211, AHB 1269, RHB 234, RHB 233, HHB 311) were subsequently released in India during 2018 to 2020 in line with the country's standards for biofortified crops (minimum of 42 ppm of iron and 32 ppm of zinc). These were taken forward for cultivation in 2021 with timely availability of quality seed to farmers by ICRISAT.

High iron and zinc sorghum variety, **'Parbhani Shakti'** was released in India in 2018. Released in 2020, the two high oleic groundnut varieties **Girnar 4 and Girnar 5** contain about 80% oleic acid, making them a healthier choice, and with a longer shelf life, the varieties are also preferred by the confectionery industry. The increasing demand for these high oleic varieties in India is evident from the market demand for 30,000 kgs of breeder seed supply in the first year of their release.

The success of ICRISAT's approach "Breeding for Better Nutrition" is evidenced by ICRISAT crop varieties being recommended for large-scale uptake and cultivation by local governments and national partners. In September 2021, one pearl millet variety and two chickpea varieties developed by ICRISAT and partners were dedicated to the country by the Prime Minister of India to combat malnutrition and climate change. In West and Central Africa, following its release in 2018, Chakti has been examined in ten locations across Niger, Nigeria, Mali, Burkina Faso, Ghana, and Senegal, and in over 10,000 farmers' fields. Recently, USAID in Senegal is promoting Chakti to enhance the nutrition of school children. The iron biofortified Chakti along with cowpea and vitaminA biofortified orange fleshed sweet potato is included in school feeding programs under funding from the United States Department of Agriculture (USDA) to improve the nutritional status of children in Senegal. Welthungerhilfe (WHH) is also promoting Chakti for consumption in the Diffa region of Niger.



2.2. Strengthening Seed Systems

Seed systems play a crucial role in ensuring bio-fortified crops reach rural areas. Maintaining genetic purity for improved varieties is critical if successful scale-up is to occur through a national seed system.

Failure to maintain genetic purity leads to the dilution of micronutrients and ultimately derails the efforts to combat micronutrient deficiency through improved varieties. This issue can be addressed by training formal and informal seed actors in producing quality seed and maintaining a steady supply of these quality seeds.

On the seed supply side, the public sector and seedproducing agencies often meet only a small fraction of the demand for improved seed varieties. This imbalance is partially because of the lack of a forecast system to predict the demand for Early Generation Seeds, low yields, poor distribution systems, lack of storage facilities, and unpredictable market prices.

To strengthen seed systems, ICRISAT works with private seed companies and farmer organizations by producing early generation seed and making it available to seed producers at the right time. ICRISAT has conducted training in quality seed production and set up the Hybrid Parents Research Consortium (HPRC) to ensure the availability of parent materials to develop and maintain quality seeds. Through HPRC, private seed companies get access to breeding material and complementary products, in addition to training for effective planning in producing quality seed.

Through the intervention of different projects in WCA, nearly 8.6 tons of foundation seed of Chakti - Africa's first iron biofortified pearl millet - was produced and made available to partners and seed producers during the period 2020-21. As a result, Chakti has emerged as the third highest seed produced variety (i.e., 236.65 tons) in Niger after HKP and SOSAT-C88 varieties which is 4.2% of the total pearl millet seed produced in Niger during the year 2021.



Quantity of seed produced by ICRISAT in 2021

2.3. Building Resilience



ICRISAT has been at the forefront of building resilience for smallholder farmers to withstand climate variability through climate-smart management practices and adaptation strategies.

Various Climate-Smart Agricultural (CSA) technologies have been developed, tested, and adapted to regionspecific contexts for better efficiency and uptake. A combination of different CSA practices - Integrated Soil Fertility Management (ISFM), conservation agriculture, drought tolerant crops and varieties, crop diversification, intercropping, fodder production and preservation, crop protection, crop-livestock integration and postharvest management - not only address the interlinked challenges of food security and climate change, but also offer an opportunity to buffer smallholder agriculture from the effects of climate change. Lack of a clear conceptual understanding of CSA technologies among local extension services and communities is a persistent constraint. To overcome this challenge, ICRISAT engages with communities to identify specific agro-ecological constraints and to prioritize CSA technologies based on the local needs.

In Mali, ICRISAT evaluated various CSA technologies deployed through various projects - Contour Bunding, Microdosing, Intercropping, Zai pits and Adapted Variety - assessed their contribution to smallholder households' food self-sufficiency. The study showed that among the various technologies implemented in the three regions of Mali, the adapted variety of millet ranked first, followed by Microdosing and Zai pits. Contour bunding and intercropping received similar weight, ranking fourth. The study proved that CSA technologies contributed to an improvement in the food status of households.

In Zimbabwe, about 80% of households covered under the Zimbabwe Resilience Building Fund Enhancing Community Resilience and Sustainability (ZRBF ECRAS) project in Chiredzi and Mwenezi Districts are growing improved varieties of sorghum and millets from ICRISAT. 75% of these beneficiaries have since adopted climate smart agriculture practices from various experiential demonstrations ICRISAT has established. Crop yields have increased by 200% and 300% to 0.9t/ha and 1.2t/ha for pearl millet and sorghum, respectively.

> "I managed to sell 20 tonnes of millet at US\$250 per tonne and stored 2 tonnes in a metal silo that I received as part of post-harvest management support from the ZRBF ECRAS project. I also bought a 1 tonne pick-up truck that serves as transport to market as well as a community ambulance."

Rose Farai, Chiredzi district, Zimbabwe







3. Integrate: For improved livelihoods and enhanced natural resource management



Agricultural landscapes are constantly changing; the current pandemic, climate shocks and global conflicts have caused supply chain disruptions, pushing millions into extreme hunger, driving people from their homes and damaging crops and livestock production. It is not adequate to address the problems around agriculture, food and nutrition in silos. An integrated approach where agricultural interventions are responsive to the changing climate, the market and the social dynamics is imperative. ICRISAT has developed and piloted a user-friendly framework for multi-dimensional assessment of farming systems sustainability using 124 indicators across five domains- i. Economic ii. Environmental iii. Social iv. Productivity v. Human well-being, and several themes. This tool is an effective decision support tool for development stakeholders and policymakers to identify entry point activities, co-design domainspecific sustainability interventions and track the impact of sustainability indicators at a farm household level. This framework has been recognized by the CGIAR as one of its "Golden Eggs" innovation. ICRISAT's approach in integrating agriculture with natural resource management, local livelihoods while incorporating gender dynamics has sustained the benefits of various interventions for smallholder farmers.

3.1. Agriculture and Natural Resource Management

In India, ICRISAT has made significant progress in watershed management. The ICRISAT Development Center (IDC) has been channelling projects for the benefit of millions of smallholder farmers as well as protecting the environment to achieve sustainable development. Working with partners and Governments, IDC has demonstrated sustainable farming models that have achieved water neutrality, land rejuvenation and better agriculture productivity. The watershed management projects across 3 states in India have shown great success in improving water tables, increasing crop yields and thereby, improving livelihoods. An assessment of watershed project in Wanaparthy, Telangana and Anantapur, Andhra Pradesh, during December 2020 showed a higher water level of about 1.9m in Wanaparthy and 1.1m in Anantapur.

Under the landscape rejuvenation program across seven districts of Bundelkhand region in Uttar Pradesh, ICRISAT was instrumental in creating about 2.5 million m³ of water storage capacity. In addition to insitu conservation practices, the project also focused on intensive agroforestry interventions in all the pilot sites.

Nearly 350,000 saplings of teak, Malabar Neem (Melia dubia), lemon, guava, and other fruits were planted during 2019 and 2021.

Similarly, in Sangareddy, Telengana, around 13,000 m³ storage capacity was created in 2020 - 2021, through the construction of watershed structures and this has added to the earlier 90,000 m³ storage capacity created in the project area since 2009.

In Ethiopia, community-based land restoration efforts have enabled the implementation of various sustainable land management practices. An evaluation study suggests that the implementation of agronomic practices (intercropping, buffer and strip cropping, and mulching) resulted in a 75% reduction in soil loss and adoption of improved land management practices increased the crop yields by 1.3 to 1.6 times (25-75%).

In Tanzania, ICRISAT identified and mapped natural resources management (NRM) practices and made available high-yielding crop cultivars from associated work in the 8 regions to selected vulnerable groups and introduced 'best practice' agronomy.





3.2. Agriculture and Livelihoods

ICRISAT's Agribusiness Innovation Platform (AIP) has been promoting sustainable livelihoods among tribal women, farmers, and youth in India by linking agriculture, nutritional outcomes, and entrepreneurship. In partnership with the Telangana Scheduled Tribes Cooperative Finance Corporation Ltd., Tribal Welfare Department, and Integrated Tribal Development Agency under the scheme of the Ministry of Tribal Affairs, Government of India, AIP set up nine food processing units. These units established under a public-private partnership funding arrangement, comprising of 60% subsidy from Tribal Welfare Department, 30% funding through bank loans and the remaining 10% coming as contributions by the respective Joint Liability Groups. The unit members received an average profit of US\$130 per month through this service model.

Similarly, under the Crop Livestock Intensification and Marketing in Malawi project, ICRISAT and partners selected and tested prototypes of interventions that allowed the value chains to transform and provide higher income, food security and nutrition for smallholder farmers in Malawi. The farmers developed and tested livestock-specific feed ratios using local ingredients. Twelve units were equipped with hammer mills to process available grains for food and feed, which especially benefited women who were engaged in milling small quantities of diverse grains. Crop varieties with superior fodder traits offered an avenue to cut down on the feed/ fodder cost.

Climate change-induced droughts in Zimbabwe over the last two decades have adversely affected resource-poor farmers the most. Many watched their valuable livestock die during the dry season due to fodder shortages and their inability to buy expensive commercial feed. At the start of the 2020-21 cropping season, ICRISAT introduced three fodder legumes – velvet bean (*Mucuna pruriens*), hyacinth bean (*Lablab purpureus*), sun hemp (*Crotalaria juncea*) and two grass crops – bana grass (*Pennisetum purpureum*) and forage sorghum. Close to 100 farmers were selected to host fodder demonstration plots in 12 wards in Insiza and Matobo districts. The fodder legumes helped in improving soil fertility in addition to providing food and fodder.

3.3. Agriculture and Gender

Mainstreaming gender across all of our research initiatives and activities is a priority for ICRISAT. The Institute constantly strives to provide women farmers with better access to seed, inputs, credit and markets and devise ways to reduce drudgery, involve them in decision-making while fostering entrepreneurship. One key step taken in this regard is to ensure our breeding pipelines incorporate trait preferences from women farmers. In our legume and cereal crop improvement, product profiles are being defined, ensuring consultation across society and ensuring inputs from women and men to ensure the product profiles correctly meet the needs of the consumers as well as farmers. Seed production and delivery systems are being aligned to be more gender-responsive. Our Global Research Program - Enabling Systems Transformation strives to identify gender gaps in adoption, production, market access and welfare outcomes (nutrition and poverty) to analyse their trends over time, to drive the change toward greater gender equality.

'Enabling Value Chains to Create Sustainable Income for Vulnerable People in Crop-Livestock Systems of Burkina Faso and Niger' has increased the income of livestock farmers by 50%. Women increased their income by 64.5% while men increased their income by 43.5%.







Research Outputs

Varieties released in 2021

	Сгор	Country	ICRISAT Name/Pedigree	Variety name
	Sorghum			
		India	2219A x (RS 673 x ICSR 16)	CSH 42
		India	ICSV 93046 x UK 81)-1-2-1-1	Jaicar Chari- CSV 47F (SPV 2593)
		India	Sel. from (SPV 1411 x SPV 720)-2-1-3	Parbhani Supermoti (SPV 2407)
	Pearl Millet			
		Burkina Faso	ICMH IS 14007	IKMH 18001
		Burkina Faso	ICMP 177108	IKMV 18001
		Burkina Faso	ICMP 177064	IKMV 18004
		Senegal	TAAW	TAAW
	Chickpea			
		India	ICCV 13116	NBeG 857
		India	ICCV 15303	GJGK 1617
		India	ICCV 171301	GLK 17301
	Pigeonpea			
•		Ethiopia	Ashenafi	ICEAP 00554
		India	ICPL 99050	TDRG 59
(***	Groundnut			
		India	ICGV 02266	Kalinga Groundnut 101
		India	ICGV 03063	UG 116
	Finger Millet			
		Kenya	GBK 029646	Wimbi
		Kenya	SEC 915 Snapping	AGRY 2
		Kenya	KNE 628	EUFM 8

Crop Improvement

Asia



Sorghum: Red grain sorghum hybrid parents and varieties with high yield, grain mold tolerance, high fodder digestibility, and high protein and polyphenols contents were identified. Five hundred twenty five sorghum lines were screened for grain mold resistance and out of these, 44 lines were found resistant. For the sweet/high biomass sorghum market segment, 112 entries of high brix, and high biomass and forage sorghum cultivars were tested in 8 locations. A sorghum field day was organized to engage with public and private sector partners.



Pearl millet: Eleven new forage type multicut pearl millet Open Pollinated Varities were developed. Fourteen new hybrids were identified for grain yield and grain Fe/

Zn content. Two hundred seventy nine high biomass progenies were evaluated and 130 progenies were selected. A pearl millet field day was organized where the participants selected 3,000 unique breeding lines and about 5,000 seed samples were supplied to public and private sector partners.



Finger millet: Evaluation of 64 finger millet breeding lines and germplasm accessions for blast disease were conducted in 3 locations.

Forty two finger millet lines of short-medium duration were evaluated for yield and agronomic performance in ten locations. One hundred eight finger millet lines of medium-long duration were evaluated for agronomic performance in eight locations. A total of 387 lines (142 new germplasm lines and 245 breeding lines) were evaluated for yield and agronomic performance during the 2021 rainy season to share with National Agricultural Research Systems partners.



Groundnut: Two varieties were released in India; Kalinga groundnut-101 (ICGV 02266) a drought and foliar fungal disease-tolerant variety with good haulm yield for Odisha state, and UG 116 (ICGV 03063) for food and confectionery uses for Rajasthan State. High oleic acid lines are in testing for release in Bangladesh, India, and Myanmar. Based on an empirical approach and transpiration efficiency, 10 promising lines were identified for drought tolerance. Two hundred twenty nine unique lines were tested in seven locations and using selection indices and 57 high oleic lines were advanced to further trials. A training program on "Guidelines for genetic purity testing in high oleic groundnut variety seed production" was organized.



Chickpea: Three chickpea varieties - NBeG 857, GJGK 1617 and GLK 17301 - were released for commercial cultivation in India. Ten lines were found highly resistant and recommended for use

in chickpea breeding programs. A total of 1,634 breeding lines were shared with partners. Yield testing was done with 762 entries.



Pigeonpea: Five pigeonpea varieties - ICPL 99009, ICPL 20114, ICPL 20124, ICPL 99048 and ICPL 99099 - were identified as resistant sources to phytophthora blight. To develop mid-

early hybrid pigeonpea, 2,256 test crosses were made to identify high-yielding hybrids. A total of 350 breeding lines were shared with the partners. A multi-environmental experiment to test the sterility percentage across three locations identified ICPA 2089 as stable Cytoplasmic Male Sterility (CMS) source with male sterility of 99-100%.

East and Southern Africa



Sorghum: Six target product profiles optimized. 27 hybrids evaluated for drought tolerance and yield trials were conducted in Ethiopia and Zimbabwe. Two best striga-tolerant lines identified.



Pearl Millet: Four target product profiles and three breeding pipelines optimized. 275 high iron lines, 80 forage lines and 228 observatory nursery lines shared. Six hundred lines

submitted to International Livestock Research Institute for fodder quality analysis.



Finger Millet: Five target product profiles and two breeding pipelines optimized. Three varieties released in Kenya and four varieties submitted to National Performance Trials in Kenya & Tanzania.



Groundnut: Three breeding pipelines and five target product profiles optimized. 20 tons of breeder seed produced by the Malawi program to support NARS partners with breeding material.



Pigeonpea: Advanced yield trials conducted in Ethiopia, Kenya, Malawi, Zimbabwe, Mozambique, Zambia, Uganda and Tanzania. Three new lines with high yielding and ascochyta blight resistant traits were identified.



with the produced seeds.

Chickpea: Four varieties recommended for release, eight genotypes earmarked for release. Four hundred fifty kg breeder seed and four tons of certified seed produced in Kenya. In Tanzania, three seed groups were established which produced seeds of cereals (3,805 kg) and pigeonpea (13,750 kg). In total 1,433

new beneficiaries (781 women and 652 men) were reached

West and Central Africa

Pearl Millet: Thirty seven farmer participatory selections and 1,150 demonstrations of the improved varieties were conducted across WCA locations. Multi-location trials for short-duration OPV (150 entries), medium-duration millet OPV (150 entries) and millet hybrids (150 entries) in 10-12 locations were established in Niger, Burkina Faso, Nigeria, Mali and Senegal. The pearl millet breeding program has produced and supplied 1.67 tons of breeder seed and 9.74 tons of foundation seed.



Sorghum: Regional trials were held in 10 to 16 locations from eight countries (Burkina Faso, Mali, Nigeria, Ghana, Togo, Senegal, Niger

and Chad). The process of release of three hybrids ICSH 196002, ICSH 196003 and ICSH 196012 are in process and subsequently, the varieties will be included in the Malian and Economic Community of West African States (ECOWAS) regional catalogue. From the trials across seven locations, 10 promising lines were identified with higher yield than Soubatimi (one of the most popular improved dual-purpose varieties in several countries). Among these 10 lines, four will be included in variety released trials to replace Soubatimi.



Corporate

ICRISAT Governing Board



Prabhu Pingali Governing Board Chair



Trilochan Mohapatra Governing Board Vice Chair Ex-officio, Government of India



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Yaye Kene Gassama Independent



Laurie Tollefson



Yilma Kebede

Independent

Sissel Rogne Independent



Independent (from April 2021)



Folasade Ogunde Independent







Cathy Reade Independent (from April 2021)



Wendy Umberger Independent (until April 2021)









Communications







Popular Research Papers (altmetric score as of Nov 2022)

A Chickpea Genetic Variation Map Based on the Sequencing of 3,366 Genomes

Varshney RK, Roorkiwal M, Sun S, Bajaj P, Chitikineni A, Thudi M, Singh NP, Du X, Upadhyaya HD, Khan AW, Wang Y, Garg V, Fan G, Cowling WA, Crossa J, Gentzbittel L, Voss-Fels KP, Valluri VK, Sinha P, Singh VK, Ben C, Rathore A, Punna R, Singh MK, Tar'an B, Bharadwaj C, Yasin M, Pithia MS, Singh S, Soren KR, Kudapa H, Jarquín D, Cubry P, Hickey LT, Dixit GP, Thuillet AC, Hamwieh A, Kumar S, Deokar AA, Chaturvedi SK, Francis A, Howard R, Chattopadhyay D, Edwards D, Lyons E, VigourouxY, Hayes BJ, von Wettberg E, Datta SK, Yang H, Nguyen HT, Wang J, Siddique KHM, Mohapatra T, Bennetzen JL, Xu X, Liu X. A chickpea genetic variation map based on the sequencing of 3,366 genomes. Nature. 2021 Nov;599(7886):622-627. doi: 10.1038/s41586-021-04066-1. Epub 2021 Nov 10. Erratum in: Nature. 2022 Apr;604(7905):E12. PMID: 34759320; PMCID: PMC8612933.



A Systematic Review and Meta-Analysis of the Potential of Millets for Managing and Reducing the Risk of Developing Diabetes Mellitus

Anitha S, Kane-Potaka J, Tsusaka TW, Botha R, Rajendran A, Givens DI, Parasannanavar DJ, Subramaniam K, Prasad KDV, Vetriventhan M, Bhandari RK. A Systematic Review and Meta-Analysis of the Potential of Millets for Managing and Reducing the Risk of Developing Diabetes Mellitus. Front Nutr. 2021 Jul 28;8:687428. doi: 10.3389/fnut.2021.687428. PMID: 34395493; PMCID: PMC8355360.



Millets Can Have a Major Impact on Improving Iron Status, Hemoglobin Level, and in Reducing Iron Deficiency Anemia–A Systematic Review and Meta-Analysis

Anitha S, Kane-Potaka J, Botha R, Givens DI, Sulaiman NLB, Upadhyay S, Vetriventhan M, Tsusaka TW, Parasannanavar DJ, Longvah T, Rajendran A, Subramaniam K, Bhandari RK. Millets Can Have a Major Impact on Improving Iron Status, Hemoglobin Level, and in Reducing Iron Deficiency Anemia-A Systematic Review and Meta-Analysis. Front Nutr. 2021 Oct 14;8:725529. doi: 10.3389/fnut.2021.725529. PMID: 34722606; PMCID: PMC8551390.



Fast-forward Breeding for a Food-secure World

Varshney RK, Bohra A, Roorkiwal M, Barmukh R, Cowling WA, Chitikineni A, Lam HM, Hickey LT, Croser JS, Bayer PE, Edwards D, Crossa J, Weckwerth W, Millar H, Kumar A, Bevan MW, Siddique KHM. Fast-forward breeding for a food-secure world. Trends Genet. 2021 Dec;37(12):1124-1136. doi: 10.1016/j.tig.2021.08.002. Epub 2021 Sep 14. PMID: 34531040.



Assessing Millets and Sorghum Consumption Behavior in Urban India: A Large-Scale Survey

Kane-Potaka J, Anitha S, Tsusaka TW & Botha, Rosemary & Muralidhar B, Upadhyay S, Parkavi K, Karuna M, Raghavendra M, Ashok J & Nedumaran S. (2021). Assessing Millets and Sorghum Consumption Behavior in Urban India: A Large-Scale Survey. Frontiers in Sustainable Food Systems. 5. 10.3389/fsufs.2021.680777.











Financials

2021

Financial Summary: Balance Sheet

	2021	2020
Assets		
Cash and Cash equivalents	16,537	28,827
Investments	10,640	13,674
Accounts receivable	22,279	22,840
Inventories	727	630
Prepaid Expenses	110	127
Property, Plant and Equipment	6,640	7,024
Other assets	1,019	960
Total Assets	57,952	74,082
Liabilities		
Accounts payable	9,282	11,652
Accruals and provisions	1,347	1,406
Payments in advance from donors	8,040	22,392
Long-term liabilities	592	261
Total Liabilities	19,261	35,711
Net Assets		
Unrestricted		
- Undesignated	9,334	9,728
- Designated	21,113	21,113
Temporary Net Assets - OCI	2,098	1,384
Permanently Restricted	6,146	6,146
Total Net Assets	38,691	38,371
Total Liabilities & Net Assets		
	57,952	74,082

Top ten Donors for 2021 with revenue

Donor	US\$ ' 000
CGIAR - System Organisation	11,886
United States of America (USA)	9,586
India	8,137
Bill & Melinda Gates Foundation (BMGF)	5,010
International Center for Tropical Agriculture (CIAT)	2,103
International Institute of Tropical Agriculture (IITA)	1,947
European Union (EU)	1,620
Global Crop Diversity Trust (GCDT)	1,408
Ireland	791
Germany	779
Grand Total	43,267



Partnerships in 2021

Academic Institutions	27
CGIAR	10
Foundations	1
Governments	14
International NGOs	4
National NGOs	22
Private Industries	42



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INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a pioneering, non-profit international scientific research for development organization, specializing in improving dryland farming and agri-food systems. The Institute was established in 1972, by a consortium led by the Ford Foundation and Rockefeller Foundation with support from the Government of India. ICRISAT works with global partners to develop innovative science-backed solutions to overcoming hunger, malnutrition, poverty and environmental degradation for the 2.1 billion people who reside in the drylands of Asia, sub-Saharan Africa and beyond.

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