



# Healthy Food Systems

The Foundation  
for a Better World

Soils

Water

Crop Nutrition

Value Chains

Production

Consumption

Science

Human Health

Annual Report 2018





Photo: Liam Wright

**Citation:** International Crops Research Institute for the Semi-Arid Tropics. 2019. Annual Report 2018, Healthy Food Systems: The Foundation for a Better World. Hyderabad, India, ICRISAT. 24 pp. ISSN 1017-9933

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**Front cover photo:** A Dima, ICRISAT

**Caption:** Mrs Paulina Zumunta from Bauchi State of Nigeria who participated in a stakeholder workshop on sorghum-based food organized by ICRISAT.

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## Vision

A prosperous, food-secure and resilient dryland tropics

## Mission

To reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics

## Approach

Inclusive Market-Oriented Development (IMOD)

### Healthy Food Systems – ICRISAT's theme for the 2018 Annual Report

Across the semi-arid regions of Asia and Africa, ICRISAT's work for over 46 years has intertwined scientific research in agriculture, but the underlying emphasis has been on health, the environment and livelihoods. This edition of the Annual Report is an effort to place at the center of discourse, the institution's contribution to 'Health' and 'Healthy Food Systems' – not just from the

perspective of people, but also for the planet, sustainable living and a healthier world. Contributing to the Sustainable Development Goals, it also effectively feeds into the existing and emerging priorities of the CGIAR.

Stories and vivid images capture and present the reality of our work. Hope you enjoy the read!



## Message from Board Chair

Health is one of the biggest concerns in this world today and is key in meeting the Sustainable Development Goals (SDGs). As part of a consortium that is the CGIAR System, we have to show how we are contributing to the SDGs.

This year we are referring to 'Healthy Food Systems' – the need of many people and focus of institutions across the world. This is a holistic approach which includes natural resource management, water, the environment, crop and animal health, and human health, of course.

It has been decades since ICRISAT has focused its research programs on the productivity and nutritional quality of our mandate crops and also on how those crops are reacting to climate change. A new initiative (Systems Biology) that the Board has approved is dealing with key questions such as: What is the impact of our mandate crops? What is the impact if we are using those crops in a compound diet? We are trying to link agriculture and health, and we are not alone. ICRISAT is doing this in partnerships and our science is contributing to addressing the big concern that is health. [Video message](#)



Dr Paco Sereme

## Message from Director General

I'm very pleased to present ICRISAT's Annual Report 2018. This showcases our work on science, holistic development and achieved impacts. We strongly believe in the potential of science to make a difference in the lives of small and marginal farmers in the semi-arid tropics, as has been our mission for over 46 years. Critically, how to explicitly manage for risks in agriculture, especially climate-related, but also nutritional, environmental and societal, presents the real challenge for science and technology today.

At a time when the world is focusing on global challenges of food security, nutrition and climate resilience, ICRISAT's learnings and research on hardy dryland crops in semi-arid ecologies have never been more relevant. The 2018 Annual Report with the theme 'Healthy Food Systems: The Foundation for a Better World' captures how nutrition and environmental resilience have been progressively integrated into all our research that encompasses the agricultural R4D value chain.

The CGIAR Research Program on Grain Legumes and Dryland Cereals, which ICRISAT leads, reported significant impacts in 2018. We cherish the many partnerships that we have formed through this global research partnership and look forward to more exciting science and impact in the year ahead.

[Video message](#)



Dr Peter S Carberry

## ICRISAT Governing Board



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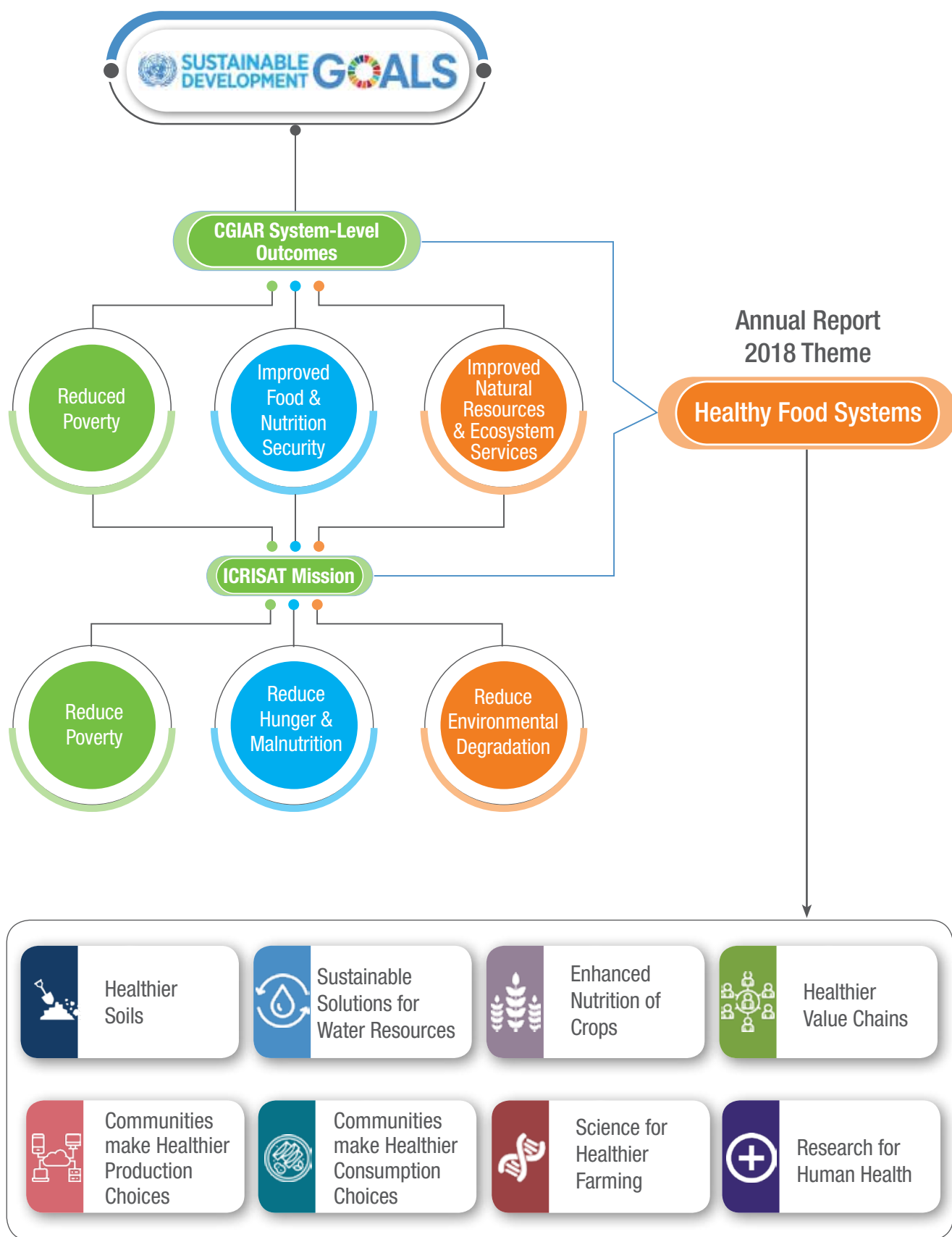
**Folasade Ogunde**  
Nigeria (from April 2018)



**Laurie Tollefson**  
Canada



**Paul C Anderson**  
USA (till Aug 2018)





# Healthier Soils

## Introduction

Soils are the foundation of a healthy food system. Decreasing availability of land for agriculture makes it important to ensure its optimum utilization. Continual land degradation needs to be halted and reversed with holistic integrated land management strategies for healthier crops and healthier foods.

## Approaches

Our approaches include creating sustainable soil conservation models for adoption; facilitating a movement among communities to sustain and generate greater impact; practicing in-situ and ex-situ soil conservation for greater sustainability and rehabilitating degraded lands through multi-pronged methods.

## Challenges

Generating soil health information, its dissemination to farmers and extension of sustainable context-specific scientific measures to improve it.

“ Breaking the vicious circle of poverty, poor soils, low inputs and soil degradation that farmers are trapped in is a challenge. Right from the paradigm of “external input” of the 1960s and 1970s to the latest concept of integrated soil fertility management, most approaches remain crop oriented or livestock oriented, with less attention to local communities themselves, which are at the heart of land resource management. New integrated and participative approaches that rope in the socio-economic conditions of rural communities in global strategies to manage crop-livestock systems and land resources including rangelands are needed. ”



**Dr Boubie Vincent Bado**  
Principal Scientist - Dryland  
Systems and Livelihood  
Diversification  
West and Central Africa Program

## Key Successes

### Acidic soils of eastern India

Soil health mapping of 37,500 samples from farmers' fields across 30 districts of India's state of Odisha found over 90% soils to be acidic and over 80% deficient in boron.

**Redress:** Over 4,000 soil test-based nutrient management demonstrations were conducted and crop-specific nutrient doses prescribed to build healthier soils.



Photo: ICRISAT

## Restoring degraded lands, improving livelihoods in Niger

Impoverished soils are the bane of the African Sahel.


 **Redress:** A combination of soil and water conservation technologies, fencing, farmer associations, sharing of plots with women and training on cropping enabled 11,970 women in 197 villages in Niger to reclaim 175 ha of degraded land, earning them revenue ranging from US\$ 1,800 - 4,420/ha, about 9 to 22 times more than the traditional system<sup>1</sup>.



Photo: ICRISAT

## Game of slopes in Eastern Africa

Why does land fertility response to fertilizer input vary in any given area in the highlands of Ethiopia resulting in significant yield differences?


 **Redress:** Studies revealed fertilizer response decreases with increasing slope due to decrease in soil organic carbon, clay and soil water content. Yield on foot slopes are up to three times higher than that on hillslopes.



Photo: Joanna Kane-Potaka , ICRISAT





# Sustainable Solutions for Water Resources

## Introduction

The dual objectives of environmental conservation and enhanced food security are centered around water. This is why water initiatives have been the core of ICRISAT's approach for people in the semi-arid tropics.

## Approaches

Our approaches include community-based watershed management; water-efficient innovations for conservation and cultivation and management of water and resources.

## Challenges

Shrinking water resources for agriculture, changes in rainfall patterns, and fragmented small and marginal farms make it a challenge for effective water management for agriculture.

“ Increasing population and growing demand for food and feed mean greater competition for land and water among different users and uses in sub-Saharan Africa. Participatory watershed management practices involving at least 30% women and youth will help strengthen rural community resilience through soil and water conservation technologies such as contour bunding. Improving crop productivity (grain, residue, fodder) using contour bunding can ensure food security in the semi-arid regions of sub-Saharan Africa. ”



**Dr Birhanu Zemadim**  
Senior Scientist - Land and  
Water Management  
West and Central Africa Program

## Key Successes

### Tuning into heavy metal

There exists a need for cost-effective, energy-efficient and eco-friendly wastewater treatment technologies that can also remove heavy metals.


 **Redress:** An algae-based treatment technology called PHYCOSORB was developed. It removes nitrate, phosphate and heavy metals from wastewater. This technology has the potential to produce biodiesel and biomolecules like bio-pesticides and bio-fertilizers. Trials have shown metal removal efficiency of 60 -70 %<sup>2</sup>.



Photo: S Punna, ICRISAT



## Water not wasted

Water shortage during crucial crop growth phase is known to affect yields in Ballari of Karnataka state, India.


 **Redress:** A treatment unit that can produce 18 m<sup>3</sup> per day of treated wastewater was installed at the village level. The unit's removal efficiencies for Chemical Oxygen Demand (COD), sulfate, phosphate, nitrogen, total suspended solids and total coliform were 64.7%, 57.0%, 32.0%, 62.1%, 96.2% and 89.2%, respectively. As on date, five farmers farming 2.8 hectares of land with meagre water resources are the beneficiaries and are reporting yield increases.



Photo: ICRISAT

## Easing out erosion in West Africa

Water runoff leading to soil erosion is affecting fertility and yields in watershed villages of Mali.


 **Redress:** Introduced farm-level practices like contour bunding with fast growing plant species to control runoff. Composting and irrigation through deep wells powered by solar energy improved production of sorghum and millet by 72% and 58%, respectively increasing farmer income by 20%<sup>3</sup>.



Photo: ICRISAT



# Enhanced Nutrition of Crops

## Introduction

Decades of crop improvement programs have focused on crops in semi-arid, rainfed systems to achieve multiple goals of productivity, profitability and better nutrition.

## Approaches

Our approaches include crop improvement through modern breeding methods for enhanced nutrition traits; identifying wild and indigenous varieties for nutritional properties and working with the national system and government to release varieties and facilitate adoption.

## Challenges

To make crops viable, enhanced nutrition traits alone are not enough. Market traits and profitability need to be achieved as well.

“Improving genetics to enhance crop nutritional quality holds the key to meeting food industry needs and market demand, and to drive nutrition-sensitive agriculture. One of the key challenges in improving crop nutrition quality is combining nutritional quality traits with high yield potential and adaptation traits in a single cultivar. Notwithstanding the challenge, multi-institutional crop improvement teams commercialized biofortified sorghum and pearl millet cultivars, and more recently ‘High Oleic’ groundnut cultivars were identified for release for the first time in India.”



**Dr Janila Pasupuleti**  
Principal Scientist -  
Groundnut Breeding  
Crop Improvement  
Asia Program

## Key Successes

### Africa's first biofortified pearl millet

The prevalence of malnutrition, especially in West and Central Africa, needs urgent attention along with better farm practices.



**Redress:** The launch of Chakti, an extra-early maturing pearl millet variety with bold grey grains and enhanced iron of 57 parts per million (ppm). Also launched ICMV 167001, with 50 ppm iron, 45 ppm zinc and yielding 1.6 tons per hectare. Its bold white grains are preferred by food processors.

**Way ahead:** Push for greater adoption by farmers.




Photo: P Gangashetty, ICRISAT




## Heralding the high-oleic groundnut

Groundnut varieties with higher oleic acid content have longer shelf life, making them more attractive to the market.

 **Redress:** Fast-track approach primes 16 groundnut breeding lines with over 80% oleic acid content as against 45-50% in the regular varieties. As part of the All India Coordinated Research Project (AICRP), India, final testing is complete and ready for release<sup>4</sup>.

## Iron and zinc content in sorghum landraces in Nigeria analyzed


Exploring crop landraces can make a difference to nutrition outcomes

 **Redress:** An analysis of Fe and Zn content in 403 Kaura and Farafara landraces of sorghum in Nigeria showed average concentration of 70 ppm Fe and 46 ppm Zn.



## Exploring traditional food for better nutrition

Food products developed from locally grown crops could help combat malnutrition and poverty.

 **Redress:** A collaborative study has established that the nutraceutical properties of traditional food products can be enhanced by using varieties of millets rich in bioactives and by optimizing cooking methods. A higher Total Phenol Content was observed in upma mix made with sorghum ( $3.79 \pm 0.03$  mg CE/g) and health drink made with millets ( $2.365 \pm 0.02$  mg CE/g) compared to an upma mix made with rice ( $2.56 \pm 0.04$  mg CE/g) and health drink mix ( $1.34 \pm 0.03$  mg CE/g). Higher antioxidant activity was also observed in an upma mix made with sorghum and health drink made with millets<sup>5</sup>.



# Healthier Value Chains

## Introduction

Farming needs to be more economically viable for millions of small and marginal farmers in the semi-arid tropics of the world to achieve the Sustainable Development Goals (SDGs). ICRISAT's unique approach of demand-driven innovation across the value chain enables farmers to achieve improved incomes.

## Approaches

Our approaches include public-private partnerships, from the field to the policy level; engaging women and youth in value chains and leadership and innovation potential and possibilities for market opportunities.

## Challenges

Finding new ways to engage and overcome existing norms in food practices.

“ We designed and implemented a variety of social and behavior change interventions that aimed at improving feeding practices in rural communities. The nutrition initiative, being part of a larger project that took on a whole value chain approach, ensured that communities not only had the appropriate nutrition information and skills in food preparation, but due to efforts by our crops team, they also had access to food. ”



**Ms Christine Wangari**  
Communications and Projects  
Specialist  
Eastern and Southern Africa  
Program

## Key Successes

### Driving demand in untapped African and Asian urban markets

Building large markets for farmers can be achieved by growing urban demand. Modern convenience products are typically required and finding ways that these are also healthy and tasty is important.


 **Redress:** Processed millet, sorghum and pigeonpea products were tested in urban markets in Tanzania and Myanmar and showed positive market response. In Myanmar, focus group testing of a wide range of processed foods revealed acceptance across age groups, with more than 60% of the consumers saying they would buy Smart Foods. In Tanzania, product options were demonstrated with processors. One processor was selected to design a final product and test the market acceptance through actual sales. In just one week, she generated an additional US\$ 2,672 in revenue, creating a market demand of almost 1,000 kg of grain per week. This work was undertaken by Smart Food and SOMNI project funded by the Australian government and IFAD. Scaling out these Smart Foods in urban markets can bring benefits to processors and farmers alike.



Photo: C Wangari, ICRISAT



## South India's entrepreneurial farmers

Dryland farmers need more profitable avenues through value chains and expertise.

**Redress:** The Agribusiness and Innovation Platform of ICRISAT established processing units in villages in partnership with a global corporate's model to create opportunities for 6,000 dryland farmers. Also created entrepreneurial opportunities and enhanced nutrition of women and youth.



Photo: ICRISAT

## Nutri-Food Baskets reach out to tribal Telangana

Women and children in tribal households were found to be affected by malnutrition, a concern that is high on the priority of development agenda.

**Redress:** The Agribusiness and Innovation Platform introduced a Nutri-Food Basket to 5000 tribal households, especially for pregnant and lactating women and children under five years. The basket's components were prepared from local ingredients to provide energy, protein, fat and micronutrients. After 9 months, tests showed a 73% decline in wasting (severe underweight) in the children.

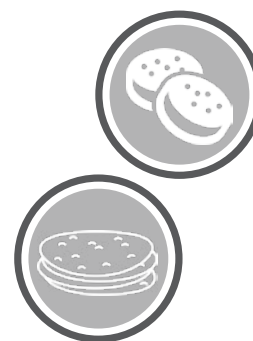


Photo: ICRISAT



# Communities make Healthier Production Choices

## Introduction

Adoption of improved varieties, uptake of new technologies and sustainable on-farm practices are some of the choices that improve the health of crops, livestock and people. While research may help develop these, it is the farmers who make these improved choices for healthier production.

## Approaches

Our approaches include increasing efficiency of smallholder farmers with tools and technologies; greater adoption of varieties with relevance to climate change and nutritional traits and involving in interventions that make a positive impact on livestock and human health.

## Challenges

Adopting changes in some age-old farming practices is not just about greater awareness and proven research. It also needs motivation from within the community and from influencers, to push for a positive change.

“ Today, feeding the world simply by means of calories is no longer viable. We have been struggling for decades to address malnutrition in developing countries despite huge investments in public health by governments. Biofortification breeding in staple food crops is an emerging sustainable solution to this problem. Biofortification is happening together with yield improvement and adds value to crops by narrowing down the genetic gap between yield and nutrition. Therefore, nutritional traits should be the central goal of crop breeding in national and international research institutes. ”



**Dr Govindaraj Mahalingam**  
Senior Scientist - Pearl Millet  
Breeding  
Crop Improvement  
Asia Program

## Key Successes

### Spreading seeds: Growing demand for biofortified pearl millet

Small and marginal farmers find it difficult to access seeds of improved varieties such as biofortified pearl millet.



**Redress:** High-yielding pearl millet hybrids ICMH 1202 (AHB 1200) and ICMH 1203 (HHB 299) biofortified with iron and zinc were notified for all-India cultivation. Breeder seed of Dhanashakti variety was supplied nationally, while hybrids GHB 1203 and GHB 1225 were identified for Gujarat state. Additionally, 36 biofortified inbreds (70-113 ppm Fe; 36-60 ppm Zn) were shared with partners.



Photo: PS Rao, ICRISAT



## Tech for tribal farmers of Telangana, India

Smallholder farmers in remote areas often do not have exposure to technologies.

**Redress:** Over 500 tribal farmers from across Telangana were trained in new technologies in agriculture, horticulture, floriculture, vegetable cultivation, fisheries and dairy farming. Training included field and industry visits.



Photo: ICRISAT

## Cutting down aflatoxin contamination in Africa

The huge concern of aflatoxin in Africa could be managed with better practices.

**Redress:** Integrated crop management technologies were demonstrated in West

Africa leading to effective adoption by farmers. This resulted in significant reduction in aflatoxin contamination of up to 11.2 ppb in groundnut, higher crop value and improved health and nutritional security.



Photo: L. Vidyasagar, ICRISAT



Photo: A Dama, ICRISAT

## Improved tech, enhanced crop production

Better farm practices, including latest agri-technologies and training, can help struggling farmers raise their productivity and incomes.

**Redress:** About 40,835 farmers in Mali were trained on various improved technologies for millets and sorghum and over 32,028 farmers applied them in their own farms. This was part of the Africa RISING's Large-scale Diffusion of Technologies for Sorghum and Millet Systems (ARDT\_SMS) project.

**Results:** Yields increased by up to 60%.



Photo: ICRISAT



# Communities make Healthier Consumption Choices

## Introduction

Driving the demand for healthier foods through greater momentum for healthier crops and dietary diversity is key to a healthier food system. As part of this process, a consumer buzz is being created around the nutrition and ecological aspects of crops in the semi-arid tropics.

## Approaches

Our approaches include awareness around concerns such as aflatoxin for ensuring healthier consumption; working with influencers and policy makers to create greater momentum for millets, sorghum and legumes; promoting the consumption of value-added products with improved health benefits and introducing Smart Food to new consumer groups to widen the consumer segment.

## Challenges

Creation of new markets needs promotion with consumer-friendly new approaches and products that often have to be created from scratch. Awareness is a multi-pronged exercise that needs high involvement and investment.

“ Enhancing the consumption of dryland crops can play a catalyzing role in creating economic opportunities for rural communities, entrepreneurs and youth. The challenge lies in making available appropriate and affordable processing technologies to deliver nutritious and scientifically validated value-added food products to consumers to ensure sustainable business enterprises and demand for dryland crops. Providing an “ecosystem” by setting up agribusiness incubators to foster innovation and entrepreneurship is key to ensuring the sustainability of entrepreneurs, more so among rural communities.”



**Dr Saikat Datta Mazumdar**

Chief Operating Officer - NutriPlus Knowledge Program

Agribusiness & Innovation Platform

Innovation Systems for the Drylands Program

## Key Successes

### Aware and attentive to aflatoxin

Awareness about aflatoxin can reduce contamination that damages crops and decreases incomes.



**Redress:** Over 35,000 stakeholders, 46 schools and 127 women groups in Mali were sensitized about aflatoxin's effect on nutrition and health, through training sessions and media campaigns. This resulted in higher awareness and better preparedness in the general population. In Mali, an earlier report showed prevalence of aflatoxin contamination in farmer granaries (450 ppb), in traders stocks (120 ppb) and in groundnut markets (250 ppb), much higher than international standards (4 ppb in the EU and 20 ppb in the United States).

From 2015-2018, samples from improved technology plots and farmers' practices plots had an average of 3.64 ppb and 18.36 ppb of aflatoxin levels respectively.





## Maximizing nutritional benefits from millets in diets

How millets are cooked and combined with other foods can lead to greater acceptance and nutritional impacts

**Redress:** About 1,500 school children in two schools in the state of Karnataka were fed a millet-based meal. Children from two other schools fed the standard fortified rice and sambar midday meal were the control group for comparison. Ten percent of the children were tracked for their growth (using anthropometric measurements) and sensory evaluations were noted every month to see if the children liked each of the millet meals. After just 3 months, children showed 50% faster growth than those eating the usual fortified rice-based meals, from the time of the baseline measurement. Also the children rated the millet-based meals 4.5 or higher out of 5 for taste, including eating little millet as rice<sup>6</sup>.



## Schooling pigeonpea and finger millet in Tanzania

Behavior change is at the core of building markets.

**Redress:** Pigeonpea, finger millet and sorghum were introduced in school meals to over 2,000 children in four schools in central Tanzania. This was possible after working with school chefs to design menus and also conducting fun information sessions with students. Feedback showed that 87% of children changed their negative perception about these crops; 91% and 98% of the children wanted to include pigeonpea and finger millet, respectively in school meals.



## Delivering nutrition messages through Smart Food community ambassadors

Building a dedicated cadre of community messengers.

**Redress:** Parents of over 60,000 children below age 5 were reached with Smart Food nutrition messages. In just one year, women and children's behavior changed significantly towards a more micronutrient-rich diet, with a 15% increase in diet diversity for women and almost 80% for children.

## Signing up Smart Food brand ambassadors

Engaging ambassadors to reach more people.

**Redress:** Niger's First Lady, Dr Lalla Malika Issoufou, pledged her support to Smart Food and led Niger's first national millet festival. Three celebrity African chefs based in Paris and London became Smart Food Ambassadors, spreading the word through media. Chef Aissatou M'Baye, the Senegalese culinary blogger based in Paris, developed and shared millet and legume recipes through her social media, reaching nearly 500,000 people with 876,437 comments (impressions).



# Science for Healthier Farming

## Introduction

Scientific research is the base of our work in the semi-arid tropics. From innovations to building capacity of researchers to partnering institutions for better impact, the science base provides opportunities for improving livelihoods and building healthier communities.

## Approaches

Our approaches include genomics to fast-track improvement of crops with healthier traits; tested practices for improved outcomes in smallholder agriculture; genebank repository of millets and legumes in the world for biodiversity conservation and gender-responsive research for men and women farmers' equitable participation.

## Challenges

The pathway to a scientifically proven solution that also is effective on the field, is often time consuming. Finding policy and funding support for research is a challenge to be overcome.

“Engaging with GREAT project to customize a training for our TL III partners was the structured opportunity to get the ‘breeder and the social scientist’ in the same room talking about their common agenda, unravelling the disciplinary facets of their breeding program. Each discipline presented, asked questions and together started making ‘joint’ plans that were gender responsive. In the busy schedules of implementing our different pieces of activities in programs, we miss the opportunity to speak to each other and transform our delivery to be truly gender responsive.”



**Dr Esther Njuguna Mungai**  
Senior Scientist  
(Gender Research)  
Eastern and Southern Africa  
Program

## Key Successes



Photo: ICRISAT

## Endgame for aflatoxin in peanut

Aflatoxins produced by fungi, mainly *Aspergilli*, are a health hazard in Asia and sub-Saharan Africa where the fungi thrive. Aflatoxin is associated with carcinogenesis in humans and animals. Until recently, controlling fungal infection in peanuts before harvest was a major challenge given the complexity of peanut-*aspergilli* pathosystem.

**Redress:** Two lines of peanut were developed, one with over-expression of certain plant defense proteins (defensins) and the other that can silence a few genes in the invading fungus. These showed that aflatoxins can be kept at bay and how the two methods, Overexpressing Defensins and Host-induced Gene Silencing, could together make peanuts nearly immune to aflatoxin. The publication of these results showed very high impact<sup>7</sup>.



## Integrated approaches, improved incomes in south India

Low yields, inefficient water use and low income are deterrents to increasing investments in agriculture.

**Redress:** Through an integrated approach in some districts of Karnataka state in India, interventions including improved cultivars, mechanization, crop intensification and diversification, fodder development, water management and pest and nutrient management led to 15-20% increase in water use efficiency, 15-40% yield increase and income rise of over US\$ 120-150 per hectare in four districts of the state.

## Insights into chickpea's genome diversity

Tapping into the best genetic material is key to accelerating genetic gains in crops.

**Redress:** Whole genome sequencing of 429 chickpea germplasm lines sampled from 45 countries lays the foundation for large-scale characterization of germplasm, population genomics and serves as a resource for trait dissection, accelerating genetic gains in future breeding. Genome-wide association studies identified 262 markers and several candidate genes for 13 traits<sup>8</sup>.

## Gender-responsive agriculture for SSA

Gender-responsive research is essential for improved outcomes in smallholder farms in sub-Saharan Africa. How can agriculture be gender-responsive?

**Redress:** Through trainings organized by Gender-responsive Researchers Equipped for Agricultural Transformation (GREAT), agricultural researchers learnt the theory and practice of gender-responsive research for equitable participation in research activities for the benefit of women farmers, entrepreneurs and farm organizations across sub-Saharan Africa.



Photo: ICRISAT

## Breaking India's pigeonpea yield barrier

Pigeonpea productivity remains one of the concerns for major pulse producers like India.

**Redress:** Participatory management practices were demonstrated across 7,500 hectares in 15 districts of five Indian states. Farmers were shown seed treatment, in-situ soil and moisture conservation techniques, nipping and line sowing. Demonstrations with ICPH 2740, a pigeonpea hybrid, resulted in yields averaging around 1.5 tons per hectare. The highest recorded yield was 3.8 tons per hectare in Osmanabad, Maharashtra state.

## Agronomy in Nigeria gets a boost

Improvements in agriculture to be conveyed to farmers across the region for increasing productivity.

**Redress:** Training in agronomy in Nigeria resulted in improved post-harvest handling by farmers and extension agents. Use of new technologies contributed to grain yield increases of 30% to 64% (improved varieties), 27% to 38% (seed dressing) and 20% to 55% (tillage practices).



Photo: ICRISAT



# Research for Human Health

## Introduction

Underpinning much of our scientific research in enhanced crop, value chains or consumption is the objective of better human health. The rural communities of food producers as well as those impacted by the consuming practices are tackled simultaneously through food.

## Approaches

Our approaches include working to identify the health and nutrition needs of the community; providing solutions towards addressing these concerns through the pathway of sustainable food production and consumption and study impact in contributions to human health.

## Challenges

Scientific research around human health has multiple ethical and human considerations. Therefore, ICRISAT's focus is across the value chain for health outcomes, and indirectly with people.

“ When talking about health with rural women and in rural communities, I realize that the biggest challenge is their understanding of “health”. They relate health to disease. Women, most of the time, relate health to their children's or family health and not their own health. As a researcher, I first make them understand the difference between health and disease. Then follows the more detailed conversation about their health, children's health and how it is linked to food, nutrition, well being and happiness. ”



**Dr Padmaja Ravula**

Senior Scientist - Gender Research

Markets, Institutions, Nutrition & Diversity

Innovation Systems for the Drylands Program

## Key Successes

### Promising resource: Lower Glycaemic Index pearl millet hybrid seeds

Approximately 41 million people will have type 2 diabetes by 2045. Even a 1% reduction in the incidence of diabetes through a modification in diet could have significant social and economic impacts.


 **Redress:** This project builds on the hypothesis that pearl millet has significant genetic variation for favorable starch components leading to low glycaemic index (GI), and lower and stable plasma glucose levels. Ten high SDS (slowly digestible starch) lines were crossed with a common good general combiner seed parent 843-22A to generate 10 testcross hybrids for multilocation evaluation. Two of the commercially viable hybrids showed good grain yield, agronomic superiority and disease resistance (blast and downy mildew), making it ready to commercialize hybrid seeds.



Photo: ICRISAT

### Drive for dietary diversity in Zimbabwe

Diversity in diets is the key to low nutrition levels in small farm households.



#### **Redress:**

Two studies in 3,801 households revealed that promoting nutrition education, crop diversification with pulses and livestock diversification, and improving access to markets improved dietary diversity of farm households by 9 to 24%<sup>9</sup>.



## Addressing anemia and nutritional deficiencies among tribal mothers and children in India

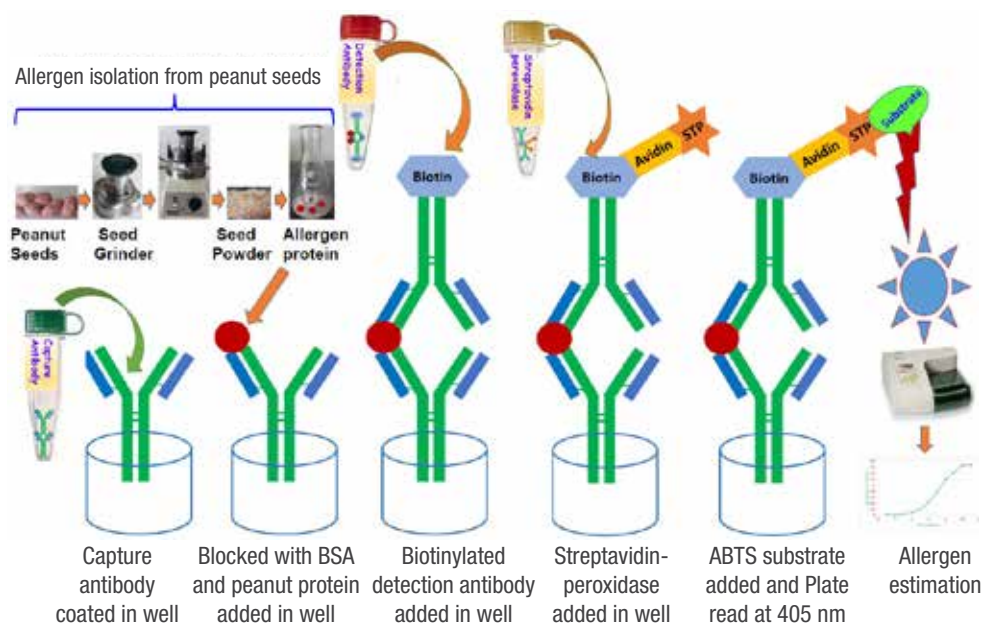
The tribal districts of Asifabad, Jayashankar Bhupalpally and Bhadradi Kothegudem in Telangana, India show lack of dietary diversity and nutritional deficiencies manifesting as stunting and wasting in children and anemia among pregnant women, lactating mothers, and children under 6 years.

**Redress:** Project "Giri Poshana" (tribal nutrition) provides nutrition support to 13,000 tribals using energy dense and nutritionally balanced food products developed by ICRISAT, using locally available sorghum, millets and pulses and covering 12 mandals (administrative units) spread across 414 angawadi (community feeding) centers. Capacity building and creating awareness about nutrition and food safety has been an integral part of the initiative. The Government plans to expand this intervention to 30 fully Scheduled mandals of the state within 2-3 years.

## Improved ELISA-based protocol developed; identified hypoallergenic groundnut lines for major allergens

Monitoring groundnut-based products and their sources to detect allergens is key to developing improved groundnut varieties with minimum/no allergens and estimating the levels in groundnut-based products in the food chain to ensure food safety.

**Redress:** Developed the first ELISA-based protocol for five allergens to estimate their quantities in groundnut kernels. Wide variation was found in allergen proteins in allergens Ara h 1 (77 - 46,106 µg/g), Ara h 2 (265 - 5426 µg/g), Ara h 3 (382 - 12676 µg/g), Ara h 6 (949 - 43375 µg/g) and Ara h 8 (0.385 - 6 µg/g). More samples are being screened to identify genes and alleles responsible for allergenic proteins for further deployment in accelerated development of hypoallergenic groundnut varieties using genomics-assisted breeding<sup>10</sup>.



## Managing malnutrition in Bangladesh

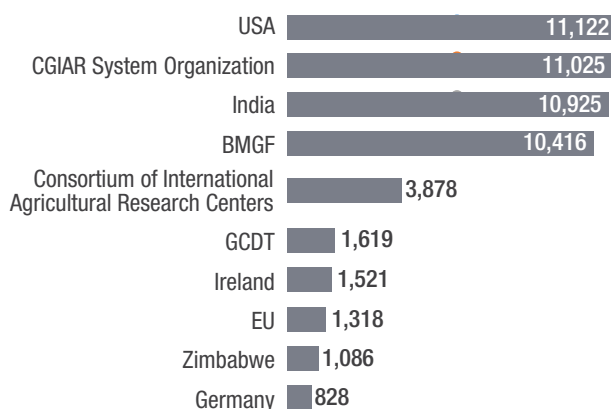
There is a high rate of malnutrition among children in the flood affected "Char areas" (river banks) of Bangladesh

**Redress:** Four hundred and sixty four primary school children between 5 to 10 years in Jamalpur and Lalmonirhat districts of Bangladesh were provided with energy dense peanut-based supplements (peanut bar and peanut biscuits) formulated using peanuts grown by smallholder farmers. This resulted in improved attendance of children in the schools. An end-line study to monitor the effect of the intervention on anthropometric parameters and hemoglobin levels after 6 months of feeding trials is in progress.

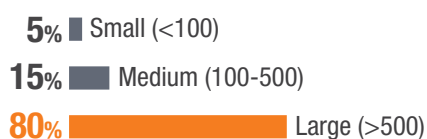


# Financial Summary

## Top ten donors for 2018 (in US\$ thousands)



## Contribution to grant revenue by project size (in US\$ thousands)



in US\$ thousands

Balance Sheet		
	2018	2017
<b>Assets</b>		
Cash and Cash Equivalents	19,828	22,221
Investments	33,821	31,812
Accounts Receivable	15,756	17,408
Inventories	915	610
Prepaid Expenses	304	346
Property, Plant and Equipment	7,280	7,418
Other Assets	3,826	3,212
<b>Total Assets</b>	<b>81,730</b>	<b>83,027</b>
<b>Liabilities</b>		
Accounts Payable	9,850	9,534
Accruals and Provisions	1,531	2,913
Payments in advance from donors	28,916	23,523
Long-term liabilities	546	2,714
<b>Total Liabilities</b>	<b>40,843</b>	<b>38,684</b>
<b>Net Assets</b>		
Unrestricted Net Assets		
- Undesignated	12,426	18,664
- Designated	21,113	21,113
Temporary Net Assets - OCI	1,220	508
Permanently Restricted	6,128	4,058
<b>Total Net Assets</b>	<b>40,887</b>	<b>44,343</b>
<b>Total Liabilities &amp; Net Assets</b>	<b>81,730</b>	<b>83,027</b>

## Staff

**29** Nationalities **10** USA, Europe and Australia **9** West and Central Africa **2** Asia and Southeast Asia **8** Eastern and Southern Africa

## Age



## Partners

**153** Academic  
**15** CGIAR  
**24** Foundations  
**120** Governments  
**21** International NGOs  
**165** National NGOs  
**20** Seed Companies  
**12** Sub-regional Organizations  
**101** Private Industries  
**102** NARS  
**733** Total



# Communication Highlights

## ► Global media footprint

Increased global media coverage with a footprint of over 110 media exposures



How to Eat as if the Planet Mattered



Are forgotten crops the future of food?



Extended partnership to deliver high-yielding, disease-resistant finger millet to farmers



119 Organizations Shaking Up the Food System in 2019



As Asians get rich and healthy, 'smart crops' replace rice on future menus



## ► Communicating science

50 videos created to share messages.

Over 147 original stories written for the web and newsletter.

Revival of ICRISAT Happenings as a weekly internal newsletter and as a monthly for external readers.



## ► Website

% New Visits: **58.48%**

% Increase smart devices: **27.45%**

## ► Social media

f Reach (monthly avg.): **52,646**

t Impressions (monthly avg.): **147,575**

in Reach/Impressions (per month avg.): **31,613**

YouTube Reach/Impressions (per month avg.): **100,000**

Read the full report: [annualreport2018.icrisat.org](http://annualreport2018.icrisat.org)

### CGIAR Research Program on Grain Legumes and Dryland Cereals

- ▶ A Research for Development investment of US\$ 413 million over five years
- ▶ Commenced 1 January 2018
- ▶ Builds on the work done by three CGIAR Research Programs from 2012 to 2016  
Grain Legumes | Dryland Cereals | Dryland Systems



## CGIAR Research Program on Grain Legumes and Dryland Cereals (CRP-GLDC)

This is the first year that ICRISAT is reporting on the CRP-GLDC, a CRP that we are gratified to lead along with our valuable partners. This CRP aims to increase the productivity, profitability, resilience and marketability of nine grain legumes and cereals through priority research for development initiatives.

### Key Results

- Expansion of multilocation and national testing sites resulted in commercialization of 73 cultivars of the GLDC crop commodities in 16 target countries of Africa and Asia.
- An ex-ante poverty impact evaluation conducted by the CRP-GLDC showed that early-maturing and drought-tolerant grain legumes and dryland cereals varieties and hybrids with resistance to pests and diseases are the priority research and technology options.
- The role of gender norms and social change in technology adoption and distribution of benefits from adoption was established.
- Modelling frameworks are being considered to evaluate the trade-offs and co-design farming systems, besides looking at portfolios of household activities, enterprises and management practices that enhance livelihoods.
- Breeding for heat tolerance in chickpea and pearl millet and for low nutrient adaptation in cowpea and groundnut were mainstreamed.
- Machine-harvestable chickpea and lentil to promote youth and women entrepreneurship, high oleic groundnut for nutrition and grain sorghum suitable for brewing were market traits of industrial importance that were focused on.
- Modernized breeding efforts and pre-breeding for prioritized traits together with genomics, transgenics, phenomics and breeding tools were undertaken.

### Progress towards the CGIAR's Strategy and Results Framework

- **361,000 ha:** Chickpea in Myanmar under improved cultivars, released through a partnership between Department of Agricultural Research (DAR) and ICRISAT
- **1.845 million ha:** Area covered by pearl millet hybrids commercialized in India under the Hybrid Parents Research Consortium (HPRC); gave an additional income of US\$ 74 per ha, equivalent to US\$ 133 million per year in India
- **572,000 households:** Direct beneficiaries of the adoption of innovative technologies in Karnataka state, India
- **Yields double from 660 kg/ha (1998) to 1400 kg/ha (2017):** Adopting of new chickpea varieties
- **Adoption of biofortified pearl millet cultivar Dhanashakti in India:** 35,000 farmers; >65,000 ha
- **New biofortified cultivars released contributing to improved diets:**  
India: Sorghum (Parbhani Shakti); Bangladesh: Lentil (Barimasur 9); Nepal: Lentil (Khajuro Masuro 4) and Kenya: Pearl millet (EUFM 403).

### Innovations

- Multi-model systems analysis was used to identify Low Emissions Development Pathways – exploring synergies and trade-offs in south India
- The Crop Network Group (CNG) as a platform for crop Product design, development, testing advancement and delivery in Africa
- Introgression of high oleic trait in groundnut.



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Photo: ICRISAT

**ICRISAT appreciates the support of CGIAR investors** to help overcome poverty, malnutrition and environmental degradation in the harshest dryland regions of the world. See [www.icrisat.org/funders/](http://www.icrisat.org/funders/) for full list of funders.

We think of them as visionary funders — far-sighted governments, development banks, foundations, charitable organizations, private sector companies, and individuals. who recognize that the elimination of poverty is the key to a peaceful world with food security and prosperity for all.



INTERNATIONAL CROPS RESEARCH  
INSTITUTE FOR THE SEMI-ARID TROPICS

ICRISAT is a member of the  
CGIAR System Organization



**We believe all people have a right to nutritious food and a better livelihood.**

ICRISAT works in agricultural research for development across the drylands of Africa and Asia, making farming profitable for smallholder farmers while reducing malnutrition and environmental degradation.

We work across the entire value chain from developing new varieties to agribusiness and linking farmers to markets.

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Nov-2019

ISSN 1017-9933