ICRISAT Happenings Newsletter
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Is there a Future for Orphan Crops?

Opinion piece by ICRISAT Director General

Today's diet of most peoples around the world is dominated by the Big 3 – rice, wheat, and maize – which account for about 50% of the world's consumption of calories. According to FAO about 95% of the world›s food needs are provided for by just 30 species of plants. In stark contrast 30,000 plant species are edible of which over 7,000 species, such as millets, fonio, tef, yam, cassava, Bambara groundnut, jackfruit, mangosteen, sesame, okra and minor cucurbits, and many more were, or still are, a part of the diets of many communities around the world. However, with the rise of industrialized agriculture, the crop diversity on our plates has reduced and only the crops amenable to large-scale industrialized farming have come to dominate our diets.

"Orphan crops are not forgotten by the peoples who subsist on them. However, they have never received global importance, they have never (or rarely) been the focus of concerted efforts to improve productivity or quality, nor have they been the focus of global value chains. They are adapted to often very challenging environments – which resonates well with our current climatic challenges."

Orphan crops, also known in agricultural literature as neglected and underutilized (NUS) crops cover the entire spectrum of food and industrial uses – cereals, fruits and nuts, vegetable and pulse crops, root and tuber crops, oilseeds, starch and sugar, fiber, latex, and dyes. These crops were cultivated or collected from the wild over centuries across all regions of the world. In large parts of India and sub-Saharan Africa millets were, and continue to be, a dietary staple in addition to crops such as cassava, yam, sweet potato, Bambara groundnut, etc. Millets are high in nutritional value and grow in adverse conditions (poor soils, scanty rainfall, high temperatures) while contributing to food security in a sustainable manner. They make use of local agricultural biodiversity to provide nutritious and sustainable diets. Moreover, they contribute to biodiversity and help mitigate the problems of monoculture – soil degradation, high water use leading to depletion of ground water sources, overuse of chemical inputs leading to soil and water pollution, and higher susceptibility to pests and diseases.

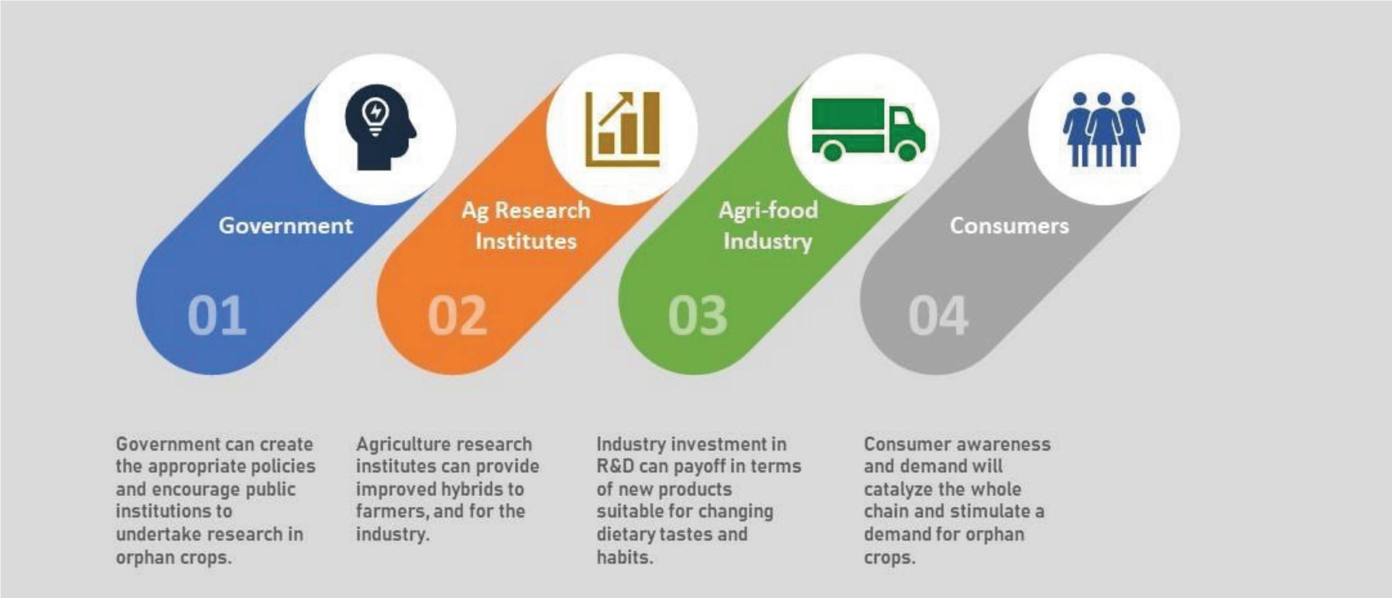
Orphan crops are characterized by underfunding for research and development, very little attention from

Dr Jacqueline d'Arros Hughes, Director General, ICRISAT.

agriculture extension services, weak and underdeveloped value chains, lack of awareness about their nutritional value, a perception that they are a 'poor farmer's crop' and low interest among farmers and industry due to lack of demand. The neglect of orphan crops continues in today's landscape where millions of dollars in venture capital funding are pouring into agri-tech start-ups. The latest is US$ 208 million funding for Inari, a start-up which specializes in seed technology. Inari is developing gene-edited seeds to enhance crop yield while requiring less fertilizer and water. The research will be directed to corn, wheat and soybean.

However, the situation is gradually changing. There is a growing recognition of the role of orphan crops in maintaining biodiversity, contributing to improved nutrition and local incomes in rural communities, serving as an important safety net for resource-poor smallholder farmers as these crops need fewer inputs and are often naturally resistant to the pests and diseases of the local agro-ecology as they are uniquely adapted to the environment they grow in. There is also an increasing awareness among consumers about the nutritional benefits of these crops.

For orphan crops to see a resurgence in demand, action is required at different levels. It requires a simultaneous



top-down and bottom-up approach. Specific policies by national governments are required to mainstream these crops as an integral part of the national food and nutrition security strategy. Policies could also include subsidies for farmers (stimulate supply side) and for the agri-food industry (stimulate demand side). Agricultural research institutes can play a role in genetic improvement of these crops and to develop varieties and hybrids that give higher yield, greater resistance to pests and diseases which may be spreading due to climate change, and that have market and consumer preferred traits such as increased shelf life and suitable for machine processing, among others. Agri-food processors can work with research institutes to develop the varieties they need and invest in the research and development of ready-to-cook and ready-to-eat products suitable to changing lifestyles. Entrepreneurs can be encouraged, with technical backstopping and venture capital financial support, to improve the value chains of the orphan crops. With positioning and information, the demand will come from consumers who are aware of the nutritional benefits and incorporate orphan crops into their diets.

Agricultural research organizations, such as **ICRISAT**, are working with millets, primarily pearl millet, and the minor millets such as finger millet, foxtail millet, kodo millet, proso millet, little millet and barnyard millet. The major growing region for millets is the dry regions of India and sub-Saharan Africa. ICRISAT is working to develop millets that (i) are resistant to the major insect pests and diseases that limit production, as well as with improved tolerance to abiotic stresses, including drought, poor soils and high temperatures; (ii) are high yielding, early maturing hybrids; (iii) have higher levels of mineral micronutrients (iron and zinc) naturally found in pearl millet; and (iv) have appropriate traits for increased use as feed and fodder. Lack of genetic material is also a concern for orphan crops as genetic diversity holds the key to development of new varieties and hybrids to meet the needs of farmers, consumers and the food processing industry. The ICRISAT Genebank conserves 24,373 accessions of pearl millet and 11,797 accessions of other millets.

ICRISAT's **agri-business incubator** works with entrepreneurs to improve the value chain and develop value added ready-to-eat products like crisps, bakery products, and high energy density snack foods. Many entrepreneurs have been supported from idea to commercialization to bring millet-based snacks to supermarket shelves. Supplementary nutrition projects being carried out in tribal areas in India have shown marked improvement in the nutritional status of those communities.

The **Smart Food** initiative of ICRISAT raises awareness among consumers and also brings together entrepreneurs, researchers and policy makers on a common platform to discuss issues around millets and sorghum (ICRISAT's mandate crops) and ways to increase consumption and production in ways that are good for you, the planet and the farmer. Smart Food works across the value chain with private and government research institutes, farmer producer organizations, agri-food producers, entrepreneurs, non-government organizations and policy makers.

The narrative of food and nutrition security must be expanded to include the role orphan crops can play to move towards more nutritious and sustainable diets and agriculture. This calls for fresh thinking around transforming our current food systems towards more healthy, sustainable and diverse food systems. A multi-sectoral dialogue at the upcoming 2021 Food Systems Summit with all stakeholders of orphan crops will provide impetus to mainstream these orphan crops. ■

Simulation models alert on impacts of climate change and need for smarter farming policies in Zimbabwe

Farmer investing in Mucuna for livestock feed.

Integrated simulation modelling conducted by agricultural researchers continue to point to huge impending social and economic impacts from climate change in Zimbabwe. The impacts were measured with various indicators for economic development, nutrition and food security and reveal that more than half the population is vulnerable to adverse effects of climate change. The outcomes point to an urgent need for implementing 'research-informed' climate-smart farming policies in Zimbabwe, given its international and national climate change commitments.

Agriculture accounts for 20% of Zimbabwe's Gross Domestic Product. It has potential for growth with the right investment and policy environment. However, there is a mismatch between specific farming systems, proposed policies, climate-change adaptation interventions and the allocation of financial and technical resources. Research-based decision support tools can help implement effective policies towards climate proofing Zimbabwe's agriculture sector and increasing its resilience to shocks and stresses by envisioning the future of sustainable approaches to food security and economic growth.

Scenarios guide climate-change adaptation decisions

In response to the need for research-informed climate-change adaptation actions, a workshop was organized on the theme "Building Agriculture's Future Scenarios: Climate Change Adaptation and Sustainability". The goal was to inform agricultural development and climate change adaptation at local-to-national levels and address policy decision gaps. The workshop was designed as a learning dialogue. Researchers met with Government and development representatives on the use of AgMIP decision support tools for climate-change adaptation processes.

A number of future scenarios i.e. Representative Agricultural Pathways (RAPs) were presented to guide decision makers in Zimbabwe in understanding the impact of policy decisions for climate-change adaptation planning processes in the agricultural sector. Figure 1.

The RAPs seek to answer the question of what would happen should Zimbabwe continue agricultural and climate policy investments following any of these pathways (Figure 2).

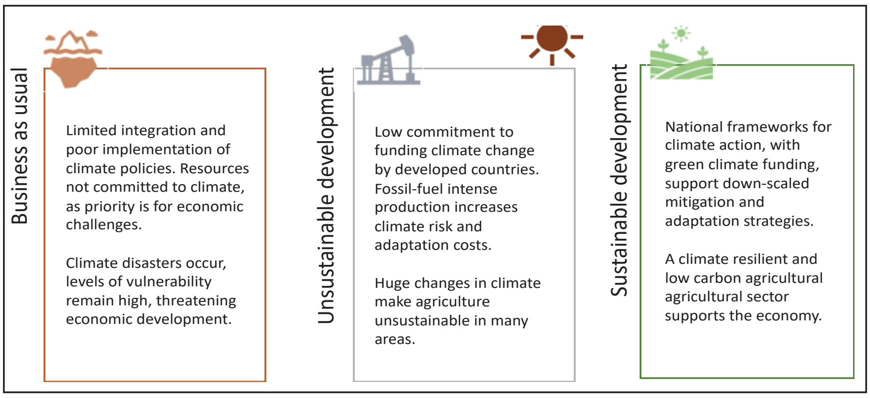


Figure 1. The essence of National Representative Agricultural Pathways (RAPs), policy assumptions and climate impacts.

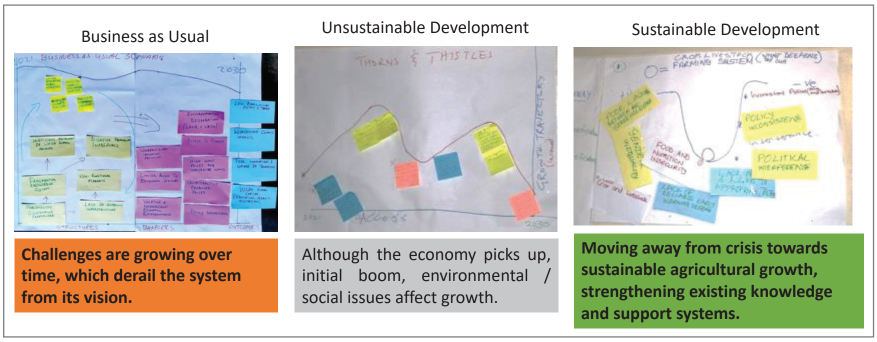


Figure 2. National Representative Agricultural Pathways (RAPs) and their dynamics can guide decision processes for Zimbabwe as policy makers understand the complexity of outcomes of policy decisions.

The RAPs have illustrated that it is important to get agricultural policies right to support the transition to resilient and sustainable development and adaptation strategies by involving all actors through:

Farm and market dynamics: Increased diversification, integration and value addition for crops and livestock, combining biodiversity, sustainable land use and value chain approaches to sustainably intensify agricultural production and increase market offtake.

Capacity building and networking: Investment in institutional capacity and human skills, stakeholder driven and cross-disciplinary joint ventures, financial inclusiveness, gender responsiveness and equality so that sustainable agricultural production systems can evolve.

Influencing policy: Political will enabling policies and risk management, enhanced policy implementation, undergoing regular review in support of national sustainable development goals and climate change adaptation and mitigation planning.

Designing policies and coping mechanisms: Making farming systems more resilient to shocks (e.g. COVID-19).

A critical challenge was identified to bridge the gap between policy, research and what is happening on the ground, so that implemented strategies speak to challenges in climate change adaptation, within particular farming systems. The current gaps are a result of an unstable political and economic environment, competition over resources and institutional weaknesses. As such, policy processes are fragmented top-down with limited interface to using research-based evidence.

Policy makers need to invest in tools that enable policy to action processes based on research needs. Researchers on the other hand, should involve policy makers in the research design, execution, and results process to allow uptake of key messages that can be used for decision-making. This two-way process requires capacity building on both fronts.

Modeling the future of agriculture and food security

The AgMIP Regional Integrated Assessment (AgMIP RIA) help address complexity and capture local conditions by characterizing farming systems relationships and key components. The AgMIP RIA builds on the RAP scenarios to illustrate farming systems in the present and the future. The RIA includes projected climate scenarios (changes in temperature and precipitation), bio-physical conditions like soil fertility, crop and livestock management, crop production and household information to project a range of economic and food security indicators for defined communities and farm types, and how they interact with climate change. Click here for an example from Nkayi District.

Words in action

Workshop participants drew action plans that would allow addressing the collaboration issue:

1. *Widening cross-scale dialogue:* Begin with a virtual awareness creation workshop, stakeholder testimonials to establish buy-in. Policy dialogue events follow that showcase key results, partnering with Zimbabwe Economic Policy Analysis and Research Unit, and developing policy relevant key messages and briefs.
2. *Evidence impact for upscaling:* Feedback and strategic links to Government Ministries, sharing of results through their websites and information channels, to support continuity. As a consortium it is more effective to access funding mechanisms, e.g. Green Climate Fund, NAPs, NDCs.
3. *In-country capacity development, presenting research results beyond AgMIP*: National teams need to trust, understand and apply research methods and results, for different farming systems, with methods evolving as policies change.
4. *A continuous and long-term process* to account for changes in current conditions, shocks and changes in political conditions.

AgMIP CLARE runs a series of interactive workshops with multi-disciplinary national policy and decision makers in Zimbabwe, to reflect on co-developed scenarios and outcomes of integrated simulation modelling for guiding climate-change adaptation planning and action in the agricultural sector.

1. Identifying drivers of change from policy to farming systems workshop: Verification of drivers that influence the future of agriculture in Zimbabwe, adaptation strategies tailored to crop-livestock farming systems, and defining the role of research to make informed adaptation decisions.

2. Building agriculture's future scenarios workshop: Validation of future scenarios and understanding integrated assessment results, including the impacts of climate change, benefits to adaptation under different development pathways, and identification of entry points for research to support actionable policy-making effectively.

3. Towards evidence-based actionable policy-making workshop: Present and disseminate research results on development pathways, climate change impacts and adaptation, to advance research-policy collaboration in Zimbabwe and foster dialogue on implications for National Adaptation Plans (NAP)s, Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs), including requirements for agricultural extension, education and development.

Representatives from the Ministry of Agriculture, Ministry of Environment, Research and Development Organizations at the AgMIP-CLARE Multi-stakeholder Workshop "Building Agriculture's Future Scenarios: Climate Change Adaptation and Sustainability" held at Clevers Lake View Resort, Masvingo, Zimbabwe.

Participant feedback

Models are necessary, as research is costly, and the models can assist us making decisions towards the future. **Ms Dorah Mwenye**, Department of Research and Specialists Services, Ministry of Lands, Agriculture, Water and Rural Resettlement, Zimbabwe.

The scenarios help determine mechanisms and interventions, what to do to remove barriers that hinder implementation of adaptation. **Ms Chiedza Saungweme**, Principal Economist, Ministry of Lands, Agriculture, Water and Rural Resettlement, Zimbabwe.

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Read more about ICRISAT work in Zimbabwe on EXPLORE*it*

This work contributes to UN Sustainable Development Goals

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Originally published in AGRICULTURE TODAY The National Agriculture Magazine

Genomics-Assisted Breeding 2.0 for Sustainable Agriculture

Accelerating genetic gains through genomics-assisted breeding 2.0 approaches will deliver higher produce for smallholder farmers while ensuring sustainable agriculture and environmental protection

Ecological agriculture takes cognizance of the fact that the "symptoms" point to a larger problem facing us – poor agricultural practices resulting in a poor ecosystem that affects crop production, yield, soil fertility, etc. There is a need for a holistic approach that can address these shortcomings and provide an overall solution for the challenges faced in the global agricultural landscape. The world needs to adopt and increasingly deploy modern scientific tools and practices into our crop breeding programs to accelerate the delivery of improved crop varieties in farmers' fields.

In an open access feature review published recently by Cell Press in the *25th Anniversary Issue of Trends in Plant Science, Feeding the World: The Future of Plant Breeding*, scientists from the International Crops Research Institute for the Semi-Arid Tropics, Murdoch University (Australia), ICAR- Indian Institute of Pulses Research, Iowa State University (USA), Leibniz Institute of Plant Genetics & Crops Plant Research (Germnay), Huazhong Agricultural University (China) and Cornell University (USA) present a comprehensive approach of designing future crops. This approach has been dubbed "genomic breeding" or genomics- assisted breeding (GAB) 2.0.

The strategy is to optimize crop genomes with the accumulation of beneficial alleles and purging of deleterious alleles for designing future crops. In the coming decades, GAB 2.0 is expected to play a crucial role in breeding more climate-smart crop cultivars with higher nutritional value in a cost-effective and timely manner while ensuring sustainable and environmental protection.

GAB: The Game-Changer

Fifteen years ago, Genomics-Assisted Breeding (GAB) was presented as a milestone future approach in the *10th Anniversary Issue of Trends in Plant Science, Feeding the World: Plant Biotechnology Milestones*. It was envisaged in 2005 that GAB will be a gamechanger for the development and delivery of improved crops varieties (high yielding and resistant to pest and disease, and abiotic stresses).

The success stories we have today speak for themselves. For instance, GAB has expedited timelines of breeding progress across a range of crop species, with the development of more than 130 publicly bred cultivars of different crops. The majority of the noteworthy crop products delivered by GAB include improved cultivars with elevated resistance levels against important diseases such as bacterial blight and blast in rice and rust in wheat, etc.

Key products with biotic stress resistance in some cereal and legume crops through GAB

- Rice: improved rice varieties with resistance to blast and bacterial blight disease
- Wheat: improved varieties resistance to stress response and other agronomic and quality-related traits
- Pearl millet: improved variety with higher resistance to downy mildew
- Barley: improved lines with resistance to eyespot, barley yellow mosaic viruses, and barley powdery mildew
- Soybean: several soybean cyst nematode and multiple disease resistant genotypes
- Groundnut: introgression lines showing higher yield and increased rust resistance
- Chickpea: high-yielding and Fusarium wilt and blight resistant varieties

Among abiotic stresses, tolerance to submergence, salinity and drought remained the key target traits for improvement using GAB. Similarly, several varieties with higher nutrition quality have been developed in many crops through GAB. These varieties include higher grain protein content wheat varieties, improved fragrance and intermediate amylose content rice varieties, quality protein maize cultivars, high oleic acid content groundnut varieties, etc.

Recent advances in genome sequencing, genetic diversity analysis, phenotyping and genome editing technologies can identify and accumulate superior alleles for targets traits in crop improvement.

Key advances in upstream science technologies for accelerating crop improvement

- Availability of reference genomes and genome-wide surveys on comprehensive diversity panels pave the way to associate the allelic variation with phenotypes.
- Methods are now available to evaluate the genetic worth of the vast genetic resources archived in gene banks and streamline application of these resources in crop improvement programs.
- Precise genome editing technologies in concert with enhanced trait architectures enable innovative solutions to engineer complex trait variation.
- High-throughput phenotyping methods are beginning to alleviate the challenge of accurate, precise and large-scale measurements of plant performance.
- Optimized speed breeding protocols remain crucial to accelerating breeding advance when applied with genomic breeding approaches.
- Sustaining gains from genomic breeding mandates fast-tracking exploitation of the minor effect alleles, accumulation of favorable alleles and purging of deleterious alleles.

Development of disease resistant, pest-resistant, abiotic stress tolerant and better quality/nutrition varieties through GAB 2.0 is expected to reduce application of pesticides, insecticides and fertilizers in growing these varieties. Such varieties are also expected to deliver higher produce to farmers while ensuring sustainable agriculture and environmental protection. The plant breeding community will continue to be armed not only with a vast array of data but also with the proper tools and technologies to decipher and implement the knowledge to feed a growing world.

About the author: ***Prof. Rajeev Varshney****, an agricultural scientist is a Research Program Director - Genetic Gains; and Director, Center of Excellence in Genomics & Systems Biology at ICRISAT and Adjunct Professor with Murdoch University, Australia and 10 other universities/institutes in Australia, China, Ghana and India. He is the recipient of the Shanti Swarup Bhatnagar Prize and Rafi Ahmed Kidwai award, the topmost sciences and agriculture awards from the Government of India.* ■

Agri-buzz blog

Originally published on the CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems thrive the future of our food, water and environment

Community participation: Greening the Aba Gerima watershed in Ethiopia

The rolling plains of the Aba Gerima watershed cover the upper portion of Lake Tana sub-basin in north-western Ethiopia. Agriculture is its mainstay, with cereal cultivation occupying about 60% of 984 hectares. But the ecology of the landscape is threatened by the conversion of natural vegetated land to cropland, and continuing land degradation has been affecting the livelihoods of farmers.

From 2012 onwards, a program of voluntary community labor investment based Natural Resource Management (NRM) has been applied to Aba Gerima, including the building of farm bunds, vegetative hedgerows, run-off waterways on cultivated lands, check dams on gullies, exclosures to restrict grazing and in-situ moisture harvesting structures to rehabilitate the degraded hills. In addition, agricultural practices such as improved crop varieties, fodder species, livestock breeds, agricultural machinery and intensified home garden activities have been demonstrated and promoted.

Community-powered resource management

The results have been remarkable: soil conservation bunds built at strategic locations reduced soil erosion by 60-85%, resulting in a 30-40% increase in crop yield due to sediment retention, according to field monitoring and geospatial data. Vegetation cover increased by 50-150%, with an increase in the reclamation of degraded grazing lands and a decrease in the rate of conversion of natural vegetated lands to cropland.

Community participation was key to the greening of the Aba Gerima watershed. "Farmers contributed voluntary labor for the construction of terraces. Each farmer constructed 4-6 meters of soil bund per day following a community mobilization campaign in January 2012. In just a year's time the impact of these interventions could be seen," says Dr Gete Zeleke, Director of the Water and Land Resource Centre (WLRC) in Ethiopia.

The deep engagement of the farmers living in the watershed drew on a traditional basis for regulation. "Community bylaws played a strong role in the building and management of NRM structures and also in restricting free grazing," explains Dr Gizaw Desta, Research Management Coordinator in Watershed Management at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). "This reversed the soil degradation caused by human activity and overgrazing."

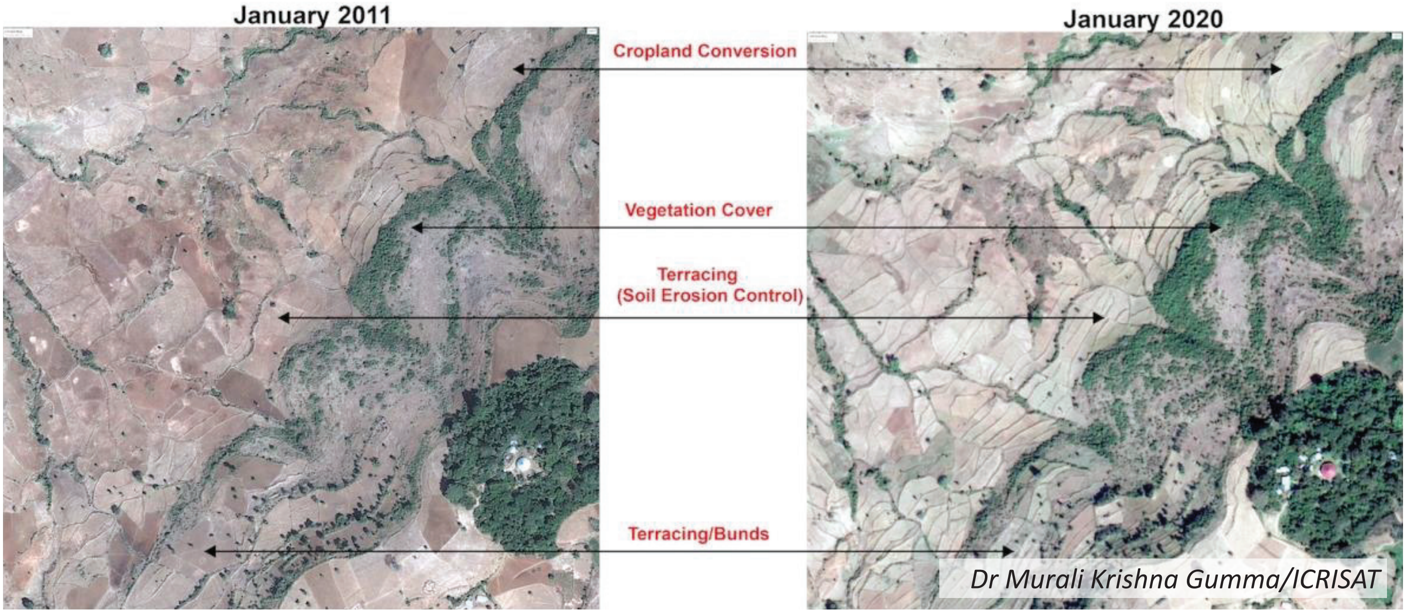
Dramatic, rapid impact

The impact of the interventions in Aba Gerima as well as neighboring watersheds where NRM was not applied was assessed through temporal satellite data and in-situ monitoring from 2013 to 2019. According to Dr Murali Krishna Gumma, Head of the Remote Sensing/Geographic Information System Unit at ICRISAT, the following impacts were clearly attributable to the NRM approach:

- **Increase in vegetation cover:** There was a substantial change from degraded/bare land to vegetation, and a decrease in the rate of conversion of vegetative land cover to cropland in Aba Gerima. In contrast, in the neighboring watersheds, the trend of land-use change from perennial vegetation to cropland continued.

(L)Terraces built voluntarily by farmers in 2012 halt soil erosion and transform the landscape of Aba Gerima watershed in Ethiopia. Credit: Dr Gizaw Desta/ICRISAT, (R) Bekure Melese/WLRC.

(L) 2012, (R) 2013, Dr Gete Zeleke/WLRC.



Increase in vegetation cover after watershed interventions.

- **Reduced soil erosion:** With the construction of a total of 127 km of bunds, about 8,973 tons of sediment were retained that otherwise would have been washed into the rivers and out of the watershed. This is equivalent to a 9.9 t ha^{-1} rate of soil erosion in the watershed, significantly lower than current average soil erosion (25-65 t ha^{-1}) in Lake Tana sub-basin. Sediment retention on conservation bunds led to a 30-40% increase in crop yield.
- **More fodder crops:** NRM structures were used to grow vegetative fodder species such as river hemp, pigeon pea and Napier grass. Hedgerows on one hectare of soil conservation bunds can easily accommodate 2,100-2,800 kg of fodder shrubs, which can feed a cow throughout the year with supplemental grazing.
- **Reclaiming degraded wastelands:** Abandoned grazing hillslopes with severe soil degradation and bare vegetation were terraced and rehabilitated for fodder use and natural regeneration, increasing cover by 50-150%.

Aba Gerima demonstrates what NRM practices can achieve over time with the right approach. “ICRISAT has led efforts in such participatory integrated watershed development for almost two decades,” says Dr Anthony Whitbread, Research Program Director at Innovation Systems for the Drylands. “Building on the scaling model from India, these demonstration watersheds become ‘learning sites’ such as those set up in Ethiopia, Mali and Tanzania, where the donor community and policy makers may be convinced to support such initiatives.” From space and at grassroots level, the inspiring results of such collaboration are plain to see.

The blog covers work undertaken by the Water and Land Resource Center project which was funded by the Swiss Agency for Development and Cooperation (SDC). The remote sensing and field monitoring data generated by ICRISAT used for this impact study was supported by the CGIAR Research Program on Water, Land and Ecosystems (WLE). ■

Written by **Jemima Mandapati**, Senior Officer – Communications, ICRISAT

Feature stories

Building villages where water saving and waste upcycling is a way of life

(Clockwise from top left): Newly constructed check dam and farm ponds in farmers' fields in Sangareddy district, Telangana State, India.

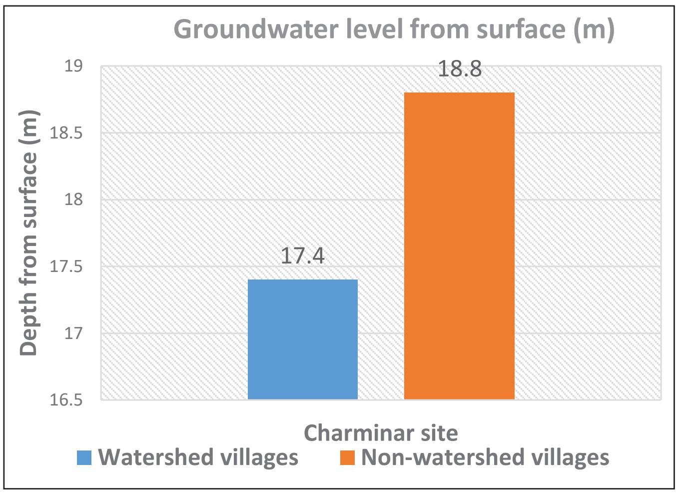
A holistic watershed approach that not just conserves water and soil for better crop production but touches people's lives through science-led interventions has once again delivered significant impacts in a Corporate Social Responsibility project in Telangana state of India.

A participatory approach knit the community as they learned to maintain water structures to harness water for their crops, operate a plant for safe drinking water and use common land and farm bunds for raising fruit trees and forage crops. The women were equipped to be 'nutripreneurs', earning incomes from vegetable gardens and upcycling brewery waste to improve milk production in livestock.

Even during the pandemic, this project in partnership with AB InBev, continues to work to deliver on project goals. A recent project progress meeting highlighted the extra water storage capacity of around 13,000 m^3 created through constructed watershed structures during 2020 and 2021. This adds to the earlier 90,000 m^3 storage capacity created in the project area since 2009. Upcoming plans include the construction of four more check dams that can store 16,000 m^3 of water and the completion of 30 farm ponds. Farm-level water storage solutions are effective as a drought-proofing strategy and system intensification.

Impact on groundwater level: Measurement of groundwater in 10 watershed project villages showed an increase of 1.4 m in groundwater compared to adjoining five non-watershed villages. A video on the impacts of watershed interventions was broadcast on CNBC-TV 18.

Brief history of the project: The collaboration started with SABMiller/AB InBev signing a MoA with ICRISAT in 2009 to develop a watershed site around Charminar brewery in Sangareddy district. Given the significant



Groundwater level (m) as of December 2020 at Charminar site, Sangareddy district.

impact, the project was scaled out in 2019 to a watershed site around Crown brewery in Kondapur mandal of Sangareddy district with the signing of an agreement. This initiative is impacting the lives of around 30,000 people in 10 villages spread across 7,661 ha around Charminar brewery and 5,700 people in 3 villages spread across 1,830 ha around Crown brewery.

Working through the pandemic

Construction of water storage structures: To address the issue of water scarcity and ensure quick access to water for smallholders, farm-level water storage solutions proved very useful. During 2020 and up to April 2021, 37 farm ponds, 2 community ponds and 2 check dams were constructed. This adds to the 455 different structures built during 2009-17, namely, check dams (15), pond/percolation tanks (29), well-recharge structures (12), rock-filled dams (78), run-off disposal (21) and loose boulder structures (300). The total water storage capacity created at the project site to date is around 103,000 m^{3}.

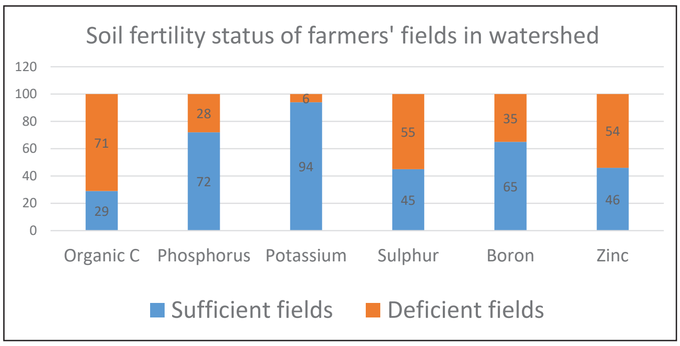
System productivity and sustainability: Soil health mapping has shown widespread deficiencies in terms of low levels of soil organic carbon and deficiencies of secondary and micronutrients. Around 100 demonstrations were conducted during 2020 to show yield benefits to farmers. During the entire project period, a total of 32 t gypsum, 10 t zinc sulphate and 1 t agribor micro/secondary nutrient fertilizers were distributed for around 5,500 demonstrations in farmers' fields. Evaluation of more than 5 t improved seeds of pigeonpea, maize, chickpea, sorghum and other crops were conducted on farmers' fields. Under the productivity enhancement initiatives, improved practice increased crop yields of participating farmers in the range of 10-50% during different years with additional family income of around ₹ 4,000/ ha for rice crop to ₹ 31,000 per ha for sugarcane crop with a benefit-cost ratio varying between 2-12. Eleven composting pits were constructed for integrated nutrient management by recycling farm wastes and cutting costs of chemical fertilizers.

Horticulture & Agroforestry: For system-context productivity, around 1,100 households were provided 2,500 plant fruit saplings during 2020. Earlier initiatives have supported in strengthening agroforestry by planting 25,000 plants on farm bunds/common lands including 7,000 fruit plants in the pilot villages.

Nutri-gardens & Women-mainstreaming: During 2020, around 600 women were provided with vegetable seeds to establish small nutri-gardens for household nutrition and sale of extra produce. These nutri-gardens enabled access to fresh vegetables during the covid-19 pandemic without having to visit the markets. This activity builds on the earlier 500 nutri-gardens that were established.

For strengthening livestock-based livelihoods, women Self-Help Groups developed earlier are effectively managing the spent-malt from breweries as cattle feed. This intervention has led to a monthly income increase between ₹ 1,000-10,000 for women farmers around Charminar (220 households) and Crown breweries (110 households).

Safe drinking water for the village: Two Reverse Osmosis (RO) plants established in Shivampet and Sulthanpur villages around Charminar brewery were effectively managed during 2020 through women Self-Help Group and the Gram Panchayat, respectively, to cater to the 5,000 households with a facility of safe drinking water. These RO plants were built from separate funding from AB InBev during 2018-2019. Each plant has a 2,000 liter capacity per hour and is run on a business model with a fixed charge of ₹ 5 for 20 liters when purchased at the site and at ₹ 10 for 20 liters for door delivery. Each plant sells around 20,000 cans of 20-liter capacity in a year.



Soil fertility status of farmers' fields in AB InBev-ICRISAT watershed around Charminar brewery.

A woman farmer tends to her nutri-garden at the AB InBev-ICRISAT watershed, Sangareddy district.

Safe drinking water facility in Shivampet village.

Read more about ICRISAT's Natural Resource Management work on [EXPLORE*it*]

Project: Improving agricultural productivity and livelihoods through holistic and sustainable resource management

Funder: Anheuser Busch Inbev India Limited (AB InBev)

Partners: Society for Community Organization and People's Education (SCOPE); READ; Government of Telangana line-department of Agriculture, Horticulture, Animal Health (AH), Irrigation and Groundwater; and ICRISAT

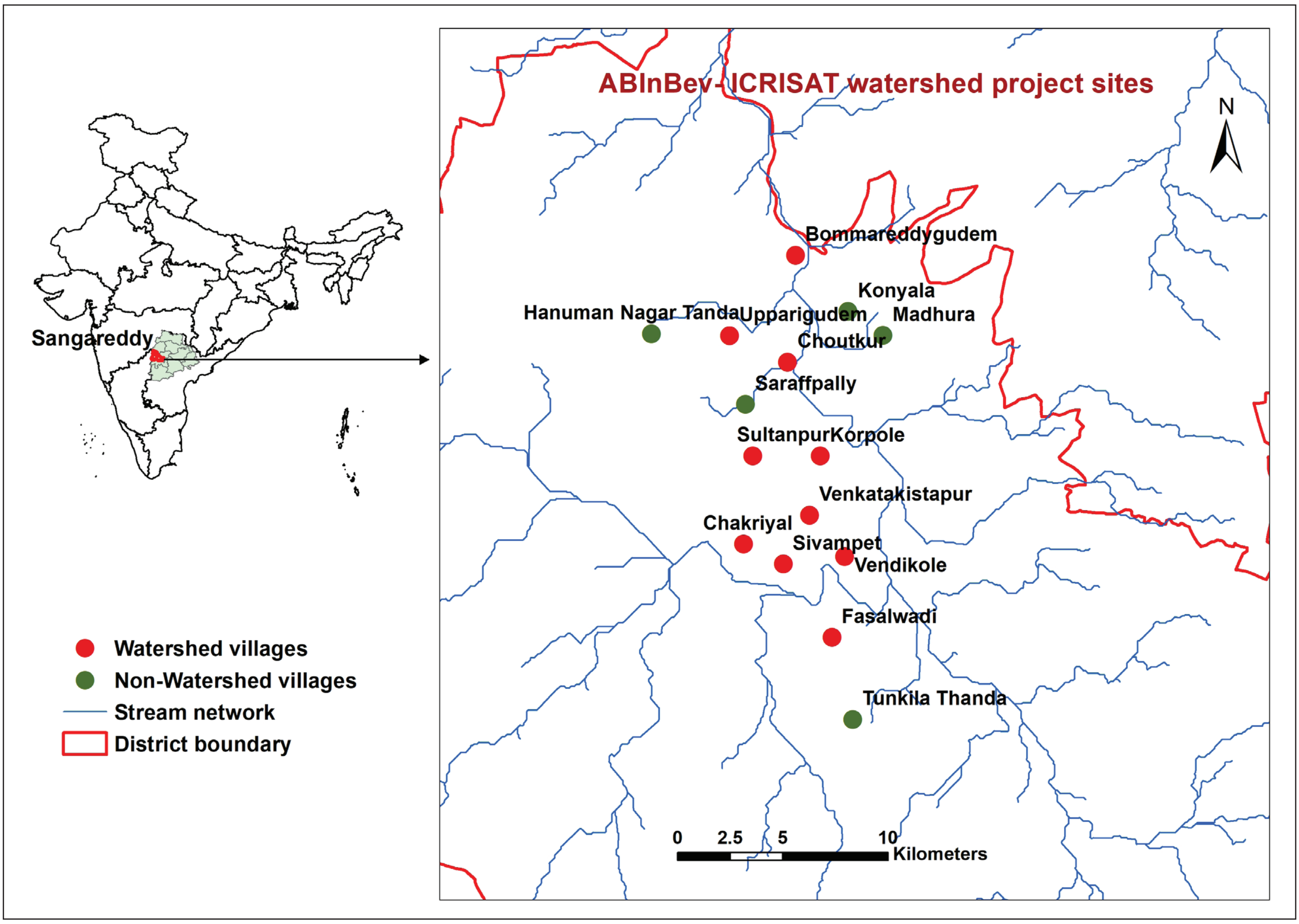
CRP: Water Land and Ecosystems (WLE)

This work contributes to UN Sustainable Development Goals

6 CLEAN WATER AND SANITATION
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
15 LIFE ON LAND
17 PARTNERSHIPS FOR THE GOALS

The project "Improving agricultural productivity and livelihoods through holistic and sustainable resource management" will be closing in August 2021, but the learnings from this site have great potential for upscaling and outscaling across India. ■

Contributing authors: Dr Girish Chander, Senior scientist – Natural Resource Management, ICRISAT Development Center, Asia Program.



Changing rainfall erodes a landscape. Watershed interventions halt the downward spiral

Percolation tank and sunken pits built on a stream in Patnikota village of Kurnool district. (R) Desilted percolation tank in the downstream village of Ayyavaripalli in Anantapur district, Andhra Pradesh state, India.

Watershed interventions have led to 1-2.5 meters higher groundwater levels, providing lifesaving irrigation to the farmers. This was achieved in a challenging environment in two villages in the drylands of Andhra Pradesh, India, which were facing a change in rainfall for the last five years. The steady monsoon showers were turning into sporadic heavy spells resulting in flooding, followed by dry spells that ruined crops. More than half the land lay fallow, until watershed activities were taken up by a Corporate Social Responsibility (CSR) project.

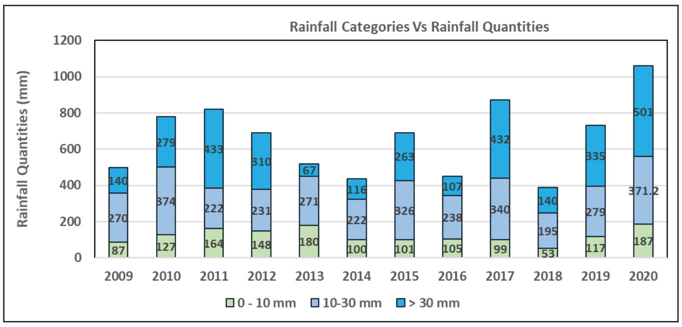
Currently, the recharged rainwater is providing lifesaving irrigation to nearly 410 ha of cultivable area in both the watersheds villages and about three irrigations for about 137 ha of millets or short-duration vegetable crops during the post-rainy season. In 2020-21, a total of 121,500 m3 of rainwater was harvested through 24,150 m3 additional storage capacity that was created to meet crop needs during critical growth stages and to irrigate the post-rainy crops. Improved high-yielding and drought-tolerant crop varieties were introduced to farmers and crop diversification is being advocated.

The CSR initiative of UltraTech in partnership with ICRISAT is reviving livelihoods of more than 500 households in two villages. Water scarcity, low soil fertility, unemployment of landless labor and low agricultural productivity are some of the issues that the project is addressing in Patnikota village in Kurnool district and Ayyavaripalli village in Anantapur district of Andhra Pradesh State.

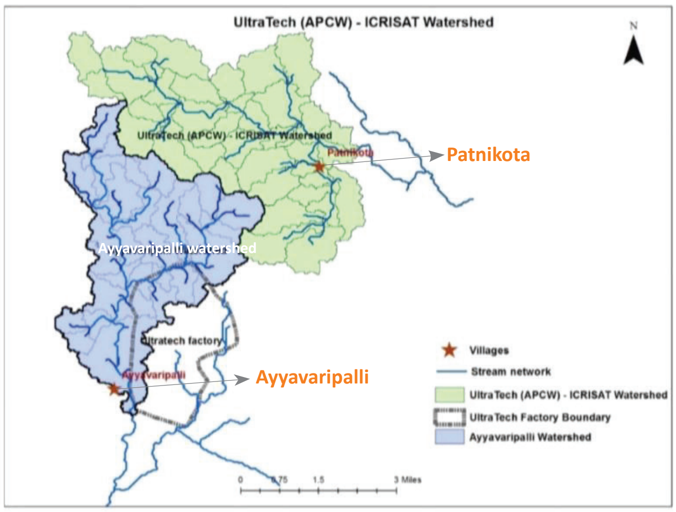
About the watershed

The upstream village, Patnikota, has a population of 2,700 and 630 households. Castor, cotton, pigeonpea, black gram and green gram crops are rain-fed, while sweet orange, papaya and pomegranate are irrigated. The watershed area in the village is around 3,500 ha of which 40% is arable and the rest either is wastelands or used for non-agricultural purposes. Of the total agricultural area, 50% is rain-fed and 50% is irrigated.

The downstream village, Ayyavaripalli, has a population of 1,000 residents and 250 households. Pigeonpea, cotton and black gram crops are rain-fed areas, while paddy and groundnut are irrigated. The watershed area is around 2,750 ha of which 70% is cultivated and the rest is wastelands or used for non-agricultural purposes.



Proportions of low, medium and high rainfall events in annual rainfall in the watershed.



Map of the watersheds near the UltraTech Cements plant, Tadipatri mandal, Anantapur district of Andhra Pradesh.

Of the total agricultural area, 50% is rain-fed and 50% irrigated. Activities in this village focus on productivity enhancement demonstrations and reviving existing water harvesting structures.

Watershed interventions from 2019 to 2021

Water harvesting: Both the villages had severe problems with the runoff from the watershed and the team identified locations for building watershed structures.

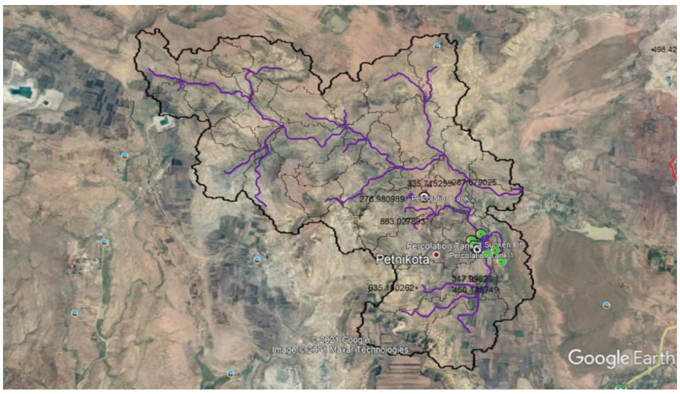
In Patnikota, five sunken pits created a capacity of 1,200 m^3 capacity and harvested 15,015 m^3 of rainwater and two percolation tanks having a capacity of 5,000 m^3 harvested 41,568 m^3 of rainwater.

In Ayyavaripalli, desilting of an existing check dam created a capacity of 2,040 m^3 and harvested 19,380 m^3 of rainwater. Two percolation tanks that have been desilted recently created a capacity of 6,900 m^3 and a total of 45,616 m^3 of rainwater was harvested.

The rainwater harvested through groundwater storage is utilized for drinking and supplemental irrigation during the *Rab*i (post-rainy) season.

Soil health mapping and test based fertilizer recommendations: Soil samples collected from individual farmer fields were analyzed at ICRISAT's soil laboratory. Based on the soil test results, fertilizer recommendation (Urea, DAP, Potash and Zinc) for major crops such as castor, pigeonpea, cotton, groundnut, paddy, pulses and vegetables were given to all individual farmers who had given a sample of their soils for analysis and issued a soil health card.

It has been observed that soil in the entire watershed was alkaline. Zinc, iron, sulfur, organic carbon and phosphorus deficiencies were 71%, 29%, 67%, 38% and 29% respectively. No deficiency of potash, calcium, magnesium, copper, and manganese was observed. The village-level fertilizer recommendation was announced on wall writings at gathering points where farmers meet daily. Farmers' meetings were conducted to share the soil health information and to discuss the fertilizer



Spatial distribution of streams and water conservation structures created in the watershed.

A wall writing that explains the fertilizer.

recommendations. Soil health cards were distributed to the farmers at an event organized by UltraTech Cements.

Improved crop cultivars: Improved crop cultivars of pigeonpea, castor and black gram were supplied to farmers in the watershed. As much as 850 kg of pigeonpea seed (ICPL 87119 and ICPL 8864) was provided for cultivation on 68 ha; 320 kg of hybrid castor seed for 64 ha; and 250 kg of black gram seed for 25 ha in both the villages. About 125 farmers have received improved seeds during the 2019 rainy season (*kharif*) to cultivate 150 ha and 100 farmers have received improved seed to cultivate on 63 ha during *kharif* 2020.

Eco-friendly pest management: Farmers have been educated on pest management strategies and the use of eco-friendly options such as yellow sticky traps, pheromone traps, neem oil and benzoate applications.

Creating awareness through field days: Farmers from the watershed were educated about the various methods of cultivation, best agricultural practices, soil and water conservation, crop demonstrations and an exposure visit to ICRISAT by 42 famers further helped enhance their knowledge. An exposure visit for 25 farmers from the Patnikota watershed to the RECL-ICRISAT watershed in Kurnool district was also conducted.

Income generation through millet products: Thirty women were trained in baking millet-based foods for a week. Trainees were supported with all materials required for a month and were oriented on quality, hygiene, safety and taste aspects. The success of this initiative prompted a three-day training program on millet based baking and cooking conducted by ICRISAT's Food and Housing Services. About 40 women attended the training.

Kitchen gardening: Kitchen garden kits (nine vegetable crop seeds: Amaranths, spinach, tomato, okra, beans, eggplant, bottle gourd, ridge gourd and bitter gourd) were given to 150 households. It is estimated that every household consumes 6 kg of different vegetables every week, saving at least ₹ 400 per week

Crop-livestock integration: Nearly 20 households in Patnikota have small ruminants ranging from 50-100 per household that subsist on open grazing. In Ayyavaripalli, a majority of the farmers own milch buffaloes. The average milk yield per animal is 5-6 liters per day. Availability of fodder is a major constraint and the dry fodder (paddy straw) costs around ₹ 3,000-8,000 per ton depending upon the season. To address this issue ICRISAT shared 30 kg seed of its landmark forage sorghum hybrid (CSH24MF) for cultivation on 4 ha during *kharif* 2020, resulting in increased milk yield of 16%.

Authors: ICRISAT staff – **Dr Rajesh Nune**, Scientist-Hydrology, IDC, **Jemima Mandapati**, Senior Officer-Communications and **Arun Seshadri**, Scientific Officer.

Read more about ICRISAT work on climate change and dryland stresses on EXPLORE*it*

Project: Improving Livelihoods through Integrated Watershed Management Approach

Funder: UltraTech Cements Limited

Partners: Rural Integrated Development Society (RIDS), Anantapur and ICRISAT

CRP: Water, Land and Ecosystems (WLE)

This work contributes to UN Sustainable Development Goals

Visit

CORAF delegation explores collaborative opportunities with ICRISAT in West and Central Africa

Delegation from CORAF led by Ms Safouratou Adaripare, Director of Management Services (L) and Ms Nicole Nkoum, Program Officer (R) visit ICRISAT research fields and facilities in Mali.

An important delegation from CORAF – the West and Central African Council for Agricultural Research and Development – visited ICRISAT in Mali to identify partnership avenues for a project funded by Swiss Cooperation. The Swiss project aims to contribute to the food, nutritional and economic security of more than 10 million people, including 50% women and 60% young people in five countries in West and Central Africa.

The CORAF delegation led by Ms Safouratou Adaripare, Director of Management Services and Ms Nicole Nkoum, Program Officer, visited ICRISAT and hosted institutions CIFOR-ICRAF and World Vegetable Center in Mali. The visitors shared details of the TARS Pro (Agricultural Technologies and Innovations for Increasing the Resilience of Production Systems and Family Farms in West and Central Africa) project and its objectives. TARS Pro is funded by the Swiss Cooperation and will be implemented in five countries (Benin, Burkina Faso, Mali, Niger and Chad) with partner institutions.

TARS Pro aims to contribute to create a bridge between research and smallholders, promote gender equity, youth employment, and facilitate market access to farmers with attractive volumes, prices and quality. The expected project outcomes are as follows:

- Increase the resilience of the food production system of at least 2 million producers/processors (including 50% of women and 60% of young people) in the 5 targeted countries and more than 10 million indirect beneficiaries;
- Sustainably meet the demand for know-how (technologies and innovations) of at least 40% of family farms affected by the intervention of the project; and
- Ensure synergy of actions of actors in the agricultural sector transformation.

Ms Nicole Nkoum said that TARS Pro will be implemented via competitive projects and commissioned projects. Calls for proposals and contracting of selected partners are in the offing and very soon, an orientation and engagement meeting will be organized with various stakeholders in country-wise workshops said Ms Nkoum. Discussions with the delegation also focused on: (1) partnership models that can be used for coordinating international research organization interventions (the case of Africa Rising project was shared); (2) the relevance of technologies and value chains to meet the real needs of communities.

The delegation was briefed about the regional research program of ICRISAT in West and Central Africa, the staff capacity and research infrastructure, including an aflatoxin laboratory in Mali and a regional gene bank in Niger. Research achievements on dissemination of improved climate resilient varieties, good agronomic practices, Smart Food value chains development were shared with the visitors. "Effective execution of ICRISAT projects is through public-private partnerships which include the national agricultural research systems, extension services, NGOs, farmers' organizations and seed companies," said Dr Aboubacar Toure, Senior Scientist-Sorghum Breeding, West and Central Africa Program, who took the visitors on a guided field tour soon after the meeting.

While visiting the off-season sorghum and groundnut trials where varietal breeding cycles are shortened, the delegates showed interest in ICRISAT's crop breeding approach that takes into account farmers' preferences. At the pathology laboratory, the visitors were briefed on the major public health and economic challenges caused by aflatoxin infestation in crops.

Interaction with hosted institutions:

World Vegetable Center: Representing the center, Dr Jean-Baptiste Tignegre, briefed about the contribution of his institution to the reduction of poverty and malnutrition through research and development on vegetable crops. The visitors where shown the facility for vegetable conservation and processing and briefed on techniques of preserving vegetables using the 'Zero Energy Cooling Chamber' and soil-less allotment gardens.

World Agroforestry Centre: Mr Ibrahim Toure, researcher at CIFOR-ICRAF, made a presentation of the institution's strategic plan from 2018 to 2026. Visitors were briefed on technologies being developed toward achieving conservation agriculture, enhancement of local species, diversification of production systems, improvement of genetic materials and their reintroduction at the community level, dissemination of technologies through the establishment of rural resource centers. At the regional nursery, visitors were briefed on the process of domestication of trees and local species in a sustained way, improving productivity and profitability of trees, and improving the nutritional status of rural and urban populations.

The CORAF delegation visited ICRISAT in Mali on April 15. ■

Reported by ICRISAT staff – Ms Agathe Diama, Head Regional Information and Dr Nadine O Worou, Program Officer

For more about ICRISAT work in West and Central Africa visit EXPLORE*it*

CRP-Grain Legumes and Dryland Cereals updates its Theory of Change

The CGIAR Research Program on Grain Legumes and Dryland Cereals, 'CRP-GLDC' strives to improve the production, productivity and marketability of 10 under-researched legumes and cereals that are critical for world food security and nutrition. To account for changes over the past three years, it was imperative to update its Theory of Change. Inspired by the CGIAR Advisory Services (CAS) review in 2020, the GLDC ToC takes a step forward that while helping to close the current phase of this CRP in December 2021, it provides learning on how to best prepare for scaling strategies beyond 2022.

The CGIAR Research Program on Grain Legumes and Dryland Cereals, 'CRP-GLDC' is a complex undertaking. Scientists in seven CGIAR centers (ICRISAT, IITA, ICARDA, ICRAF, ILRI and the Alliance of Bioversity International and the CIAT) and three non-CGIAR centers (CIRAD, IRD and CSIRO) along with the private sector, civil society and National Research Institutes strive to improve the production, productivity and marketability of 10 under-researched legumes and cereals that are critical for world food security and nutrition. They focus on 17 countries in the dryland regions of South Asia, Sub-Saharan Africa, Central and Latin America. In these regions, solutions to poverty, malnutrition and environmental degradation are most needed. To account for changes that have occurred in CRP-GLDC over the past three years, it was imperative to update its Theory of Change to truly reflect the delivery pathways of its impact.

A Theory of Change (ToC) describes the theory-guided transformations and system changes necessary to achieve development outcomes. It represents the best understanding or hypothesis at a given point in time, of how multi-actor interventions can bridge the gap between research outputs and outcomes in development. It allows for continuous examination and adjustment of the design, implementation, management and assumptions based on the need.

The CRP-GLDC was designed with five Flagship Programs (FPs) working along two impact pathways to develop, scale and sustain cereal and legume varieties suited for dryland agro-ecologies. It aims at enabling between 4.4-11.8 million people to get out of poverty and another 12.7-24.8 million people to meet daily nutritional requirements. While this is a big strategic development goal to which CRP-GLDC contributes significantly, it will not be the only mechanism to achieve it.

How then should the necessary transformation of agriculture and dryland food systems take place in practice? Breeding of drought-tolerant cereals and nitrogen-fixing peas and beans alone is insufficient. System transformation requires investments into the development of markets and trade, related institutions and targeted measures to enhance consumer demand for dryland cereals and grain legumes (GLDC crops).

It is understood that while such transformations cannot easily be engineered, the best scientists can do is to identify and remove bottlenecks and help to change path dependencies that prohibit transformations. Rather than prescribing the change, the relevant food system actors must formulate plausible assumptions to guide the transformation. For the CRP-GLDC, the core assumption is that farmers convert to improved crops if there is a demand for GDLC crops in their communities as well as the markets. Therefore, demand-oriented development of value chains, supported by crop improvement to increase the adaptability and quality of GLDC crops has become a central assumption of the theory of change.

While the program's demand-led orientation has not changed in this update to the ToC, it fosters better integration of decentrally organized flagships making the impact pathway (causal chain from research output to development impact), clearer, more realistic and reflective of the operational mechanisms of the CRP-GLDC. FP2 on transforming agri-food systems, which received no funding, has now been positioned as a scaling mechanism for CRP-GLDC. Moreover, FP6 on Common Bean for Markets and Nutrition has been integrated with the CRP-GLDC to offer strategic insights from the commercialization of beans for other GLDC crops. There is a lot that CRP-GLDC can learn from the Pan-African Bean Research Alliance (PABRA) – especially the development of markets and thus an increase in demand for GLDC crops.

However, not all GLDC crops are sold through traditional markets; sorghum and millet are still subsistence crops. Across the Sahel, for example, both cereals depend on informal markets and home consumption. Beyond fostering the production efficiency among producers, integration of smallholders into the market system, sustaining and scaling benefits of the system are paramount. In the revised Theory of Change, researchers seek the best possible integration of markets and substance-oriented strategies.

The CRP-GLDC shows how dynamic a Theory of Change is in reality. It necessitates adaption if the economic or technical conditions for programs change. For instance, not funding FP2, meant that impact pathway 2 (scaling and sustaining) could not be implemented as originally anticipated. In response, CRP-GLDC introduced a cross-cutting theme on Markets and Partnerships in Agri-Business (MPAB). As a part of the ToC revision, the scaling and sustaining impact pathway was removed while MPAB and FP6 were integrated into the ToC. FP outcomes were realigned incorporating FP6 outcomes along the impact pathways of FP1, FP4 and FP5 given their congruence. This left CRP-GLDC with only one distinct impact pathway [integrative solutions] (see Revised CRP-GLDC impact pathway diagram below).

The success of the revised ToC, will depend on the formalization, coordination and support of cross FP linkages with requisite resources. A ToC differs significantly from traditional program planning. Traditional programming only links activities to a goal, paying more attention to quantitative performance and assumptions about external factors without effort to involve key stakeholders and networks to support the realization of impact. Inspired by review of the CRP-GLDC in 2020 by the CGIAR Advisory Services (CAS), we have now taken the GLDC ToC a step forward that while helping to close the current phase of this CRP in December 2021, it provides learning on how to best prepare for scaling strategies beyond 2022. ■

Authors: Michael Hauser, John Mugonya (Team, FP1: Priority Setting and Impact Acceleration)

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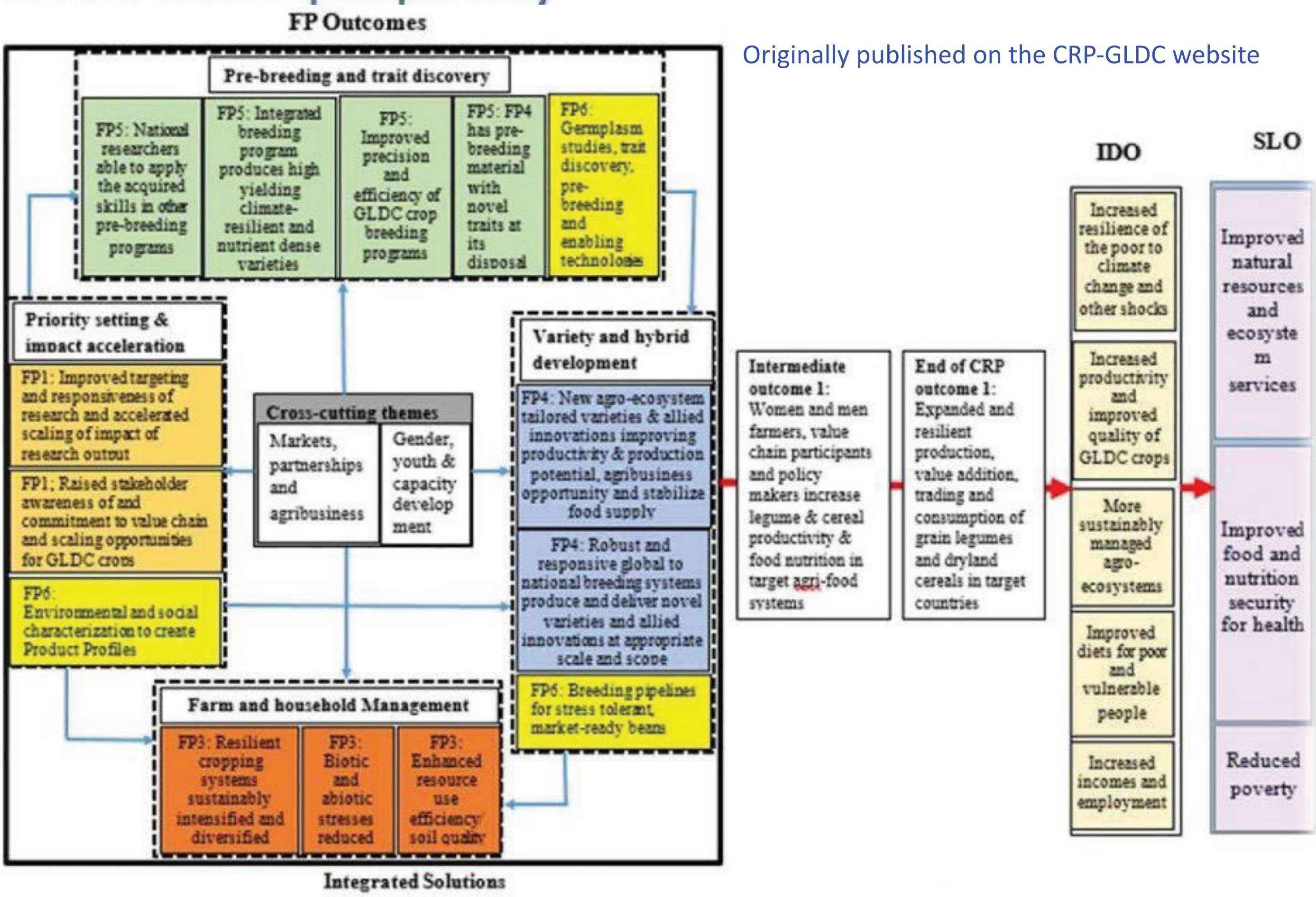
This work was undertaken as part of, and funded by the CGIAR Research Program on Grain Legumes and Dryland Cereals (GLDC) and supported by CGIAR Fund Donors.

Revised GLDC impact pathway



Originally published on the CRP-GLDC website

Source: Adapted from the original GLDC impact pathway

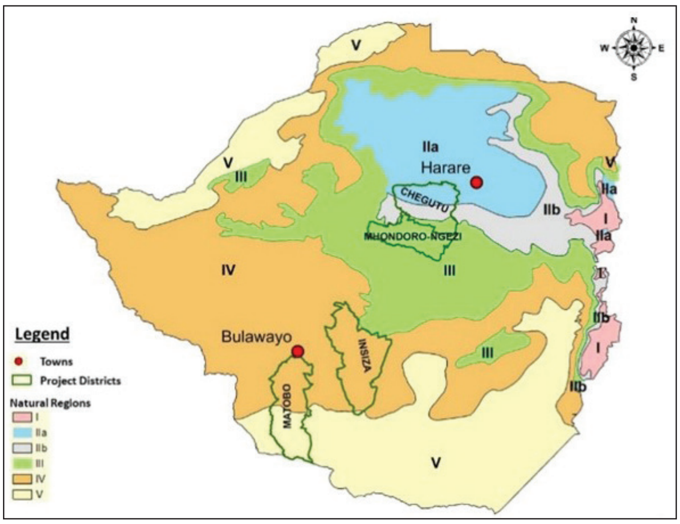
Capacity building for climate resilience

Dryland crop technology to rescue drought-hit crop-livestock farmers in Zimbabwe

A practical class on haymaking (left) and silage making (right) at Matobo District Agriculture Centre of Excellence.

Climate change-induced droughts in Zimbabwe over the last two decades has hit 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. The impact of drought on livelihoods is undeniable, but the problem was exacerbated by massive knowledge gaps. A 'needs assessment' project survey found that 90% of farmers had no knowledge on fodder production and preservation technologies and there was an urgent need to build capacity to prevent the crisis from deepening.

To understand the scale of these challenges, the Zimbabwe Agriculture Knowledge and Innovation Services (ZAKIS) surveyed four project target districts, namely Matobo, Insiza, Mhondoro-Ngezi and Chegutu.



Map of Zimbabwe showing Chegutu; Mhondoro-Ngezi; Matobo and Insiza districts in relation to Natural Regions.

The study showed that farmers had little knowledge on fodder flow or pasture management. Legume and cereal crop residues were going to waste, there was no established concrete plan to produce fodder crops and farmers could not afford to buy fodder from agro-dealers. The project therefore identified fodder production on-farm as the only sustainable solution as it relies on use of locally available resources.

Addressing the massive knowledge gaps was identified as an entry point and trainings were rolled out in the target districts by ICRISAT in partnership with the Department of Research and Specialist Services (DRSS). Technologies like fodder production and preservation can make a huge difference in boosting communities' climate resilience and improving degraded rangelands. Feed supplementation using home-grown feed will help farmers to reap multiple benefits from having a healthy herd, improved soil fertility, improved incomes and improved livelihoods.

Growing fodder crops: At the start of the 2020-21 cropping season, ICRISAT introduced three fodder legumes – velvet bean (*Mucuna pruriens*), hyacinth bean (*Lablab purpureus*) and sun hemp (*Crotalaria juncea*) and two grass crops – bana grass (*Pennisetum Purpureum*) and forage sorghum) as fodder crops. Close to 100 farmers were selected to host fodder demonstration plots in 12 wards in Insiza and Matobo districts. The plots are serving as fodder seed multiplication hubs and field schools for fodder production and preservation. The selected fodder crops are drought tolerant and the legumes are a rich livestock protein source while the grasses provide the much needed energy. In addition, the fodder legumes help in improving soil fertility.

Fodder preservation: To augment the learning at the demonstration plots and give extension staff both a theoretical and practical grounding in fodder preservation, two Trainer of Trainers (ToT) workshops were organized and rolled out. The objective was to build capacity of participants through hands-on training on fodder preservation particularly hay and silage making to provide feed to livestock all year round. Preserved feed is vital for livestock classes like steers which provide draft services during land preparation and as such these animals need to be in good shape at the onset of the agriculture season. Cows and goats in late pregnancy during the dry season will also benefit from the preserved feed.

In total, two workshops reached 50 (18 females, 32 males) ward-based AGRITEX extension staff and Department of Veterinary staff officers. The first workshop held on 29 March targeted Matobo and Insiza districts and the second workshop held on 12 April targeted Mhondoro-Ngezi and Chegutu districts. The trained staff will carry out cascading trainings to farmers in their wards. To date, the cascading trainings have reached over 200 farmers in ten wards in the four districts. ■

Contributing authors from ICRISAT: Dr Martin Moyo, Country Representative – Zimbabwe, Mr Farai Dube, Research Associate and Ms Angeline Mujeyi, Research and Evaluation Associate.

Read more about ICRISAT's work in Zimbabwe on EXPLORE*it*

Project: The Zimbabwe Agriculture Knowledge and Innovation Services (ZAKIS)

Funder: European Union (EU)

Partners: Weltehungerhilfe, ICRISAT, Sustainable Agriculture Technology, Community Technology Development Organisation, and the Government of Zimbabwe, Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement

CRP: Grain Legumes and Dryland Cereals (CRP-GLDC)

This work contributes to UN Sustainable Development Goals

Field Day

Public and private sector scientists pick pearl millet material for their breeding programs

Public and private sector scientists selecting pearl millet material from breeding plots at ICRISAT, Hyderabad.

Public and private sector scientists visited 20,000 pearl millet breeding plots at ICRISAT this week to select material for their breeding programs. The plots displayed promising hybrid parental lines (both seed and restorer parents) bred for different traits and adaptations. Materials with tolerance to drought, heat, downy mildew and blast, iron and zinc biofortified, exclusive forage type and promising lines bred using West and Central Africa (WCA) material were put up for selection.

Dr Arvind Kumar, Deputy Director General -Research ICRISAT, in his inaugural address congratulated the group for contributing towards achieving genetic gains of about 3% per annum for pearl millet productivity in India. He urged the participants to use the opportunity to select promising materials for developing resilient and nutritionally rich cultivars for the future.

Dr Vilas Tonapi, Director, Indian Institute of Millet Research, Hyderabad commended ICRISAT for broadening the genetic base of pearl millet cultivars by providing diverse range of breeding lines to programs in public and private sector. Representing the private sector seed companies, Dr RS Mahala from Seedworks International, appreciated the efforts made by ICRISAT to facilitate selection of breeding materials in such challenging times. Dr Harish Gandhi, Theme Leader Crop Improvement and Interim Global Head, Asia Program, said that ICRISAT will use a variety of mechanisms to share breeding materials with public sector institutions, given the challenges of Covid-19.

Dr SK Gupta, Pearl millet breeder at ICRISAT, informed that the breeding program in India has derived promising hybrid parental lines using diverse materials from Western and Central Africa to **diversify the genetic base** of available germplasm. These new materials were highlighted during the field day. A significant number of materials with high grain iron and zinc in promising agronomic backgrounds were available reflecting the institute's **drive to mainstream nutrition** in its breeding programs. Participants were advised to select such materials to enhance micronutrient content in future pearl millet cultivars to help eliminate micronutrient deficiency in millet-consuming populations.

About 40 scientists representing 25 public and private sector organizations selected material for their programs. COVID-19 protocols were followed and field visits limited to 10-12 participants were staggered from May 1-5. ■

Read more about pearl millet research on EXPLORE*it*

Project: Improved Pearl Millet Hybrid parents for Increased and Stable production

Funder: ICRISAT- Pearl Millet Hybrid Parents Research Consortium (PMHPRC), HarvestPlus, Indian Council of Agricultural Research (ICAR)-ICRISAT Partnership Project

Partners: 27 seed companies, ICAR centers, State Agricultural Universities

CRP: Grain Legumes and Dryland Cereals (GLDC) and Agriculture for Nutrition and Health (A4NH)

This work contributes to UN Sustainable Development Goals

Workshop

Farmers' Hubs for quality seed and input supply and market linkage launched in Nigeria

File photo of an input supply store.

The Syngenta Foundation for Sustainable Agriculture (SFSA) launched 13 Farmers' Hubs to service 13,000 sorghum and cowpea farmers in Kano and Jigawa States. The initiative was in response to survey findings on low farm yields attributed to difficult access to quality seeds, inputs and adulterated agro-chemicals (including adulterated fertilizers) in Northern Nigeria.

The hubs are an integral component of the operational strategy of SFSA in Nigeria to boost crop productivity while facilitating linkages with different markets. At the inaugural event that took place in Kano city, the Country Program Manager of SFSA-Nigeria, Mr Isaiah Gabriel, said that this initiative is part of the implementation of the Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa (AVISA) Project in Nigeria.

Given the long distances many farmers have to travel to find quality input supply stores and markets, the hubs will also serve as sales points for farm produce, facilitate access to weather information and provide hands-on training and link AVISA partners in Nigeria to extension services of NGOs and the Agricultural Development Programmes (ADPs). The decision to construct the hubs was based on findings from many adoption and value chain studies jointly carried out by ICRISAT and national partners in Northern Nigeria.

Mr Gabriel said that managers have been screened and agreed upon with farmers to ensure the effective functioning of the hubs. He cited the example of the hub manager of Bichi who had a turnover of 5 million Naira ($13,089) within two months of operation and announced a 'support fund' from SFSA, which is available to Hub Managers of the targeted Local Government Areas of Kano and Jigawa States. SFSA will continue to provide technical back-stopping and mobilize same from national and international research institutes such as the Institute for Agricultural Research (IAR), International Institute of Tropical Agriculture (IITA) and ICRISAT.

A total of 45 participants attended the launch, including Dr Hakeem Ajeigbe, Country Representative of ICRISAT, Seeds Systems Champions of Primary Objectives 4 (PO4) Professor Daniel Aba of IAR, Professor Lucky Omoigui of IITA, Dr Michael B Vabi, Socio-economist/M&E Scientist of the AVISA Project, representatives of three private seed companies based in Nigeria and the 13 Hub Managers and farmers. The workshop was held on April 19. ■

Read more about market access and value chains on EXPLORE*it*

Contributors: Mr Gabriel Isaiah, Country Program Manager, SFSA-Nigeria; **Dr Michael B Vabi,** Socio-economist/M&E Scientist, AVISA Project, ICRISAT-WCA ; **Lucky Omoigui,** Seed Systems Scientist, IITA – Nigeria; and **Dr Hakeem Ajeigbe,** Country Representative/ Systems Agronomist, ICRISAT-Nigeria

Project: Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals (AVISA)

Partners: Institute for Agricultural Research (IAR), Nigeria and International Institute of Tropical Agriculture (IITA)

Funder: The Bill & Melinda Gates Foundation

CGIAR Research Program: Grain Legumes and Dryland Cereals

This work contributes to UN Sustainable Development Goals

1 NO POVERTY · 2 ZERO HUNGER · 8 DECENT WORK AND ECONOMIC GROWTH · 17 PARTNERSHIPS FOR THE GOALS

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