‘Unless consumers demand food produced in ways good for the environment, farmers have little incentive to adopt technologies’

How will agriculture change in the post-Covid world?
Covid-19 has highlighted opportunities for improved agri-food systems – digital extension systems, increased farm mechanization, decentralized markets and improved farmgate procurement in addition to improved farmer-consumer connect and more efficient value chains. Without protection against the virus, agriculture will continue with less face to face contact. I hope the changes in agriculture will focus on areas exposed by the pandemic as these will also contribute to the long-term goals of sustainable development.

How can farming be made profitable?
Farming is a complex and high-risk activity; the risk is higher in smallholder rain-fed systems. There is no single answer as farming is profitable for a variety of reasons and unprofitable for just as many reasons. Better pest and disease management, soil fertility and good agronomic practices, increased resilience to climate change, availability of quality seed of improved varieties, better access to markets, addressing workforce shortages through mechanization, improved post-harvest practices and processing options, strengthened value chains and a supportive policy environment can make farming profitable.

How can farmers gear up for climate change?
Agriculture is affected by climate change and also contributes to it. In India, where more than 65% of farms are small and rain-fed, climate change is felt most prominently in variations in rainfall intensity, the duration of intra-seasonal dry days during monsoon, and the occurrence of extreme weather events. Agriculture must both adapt to, and contribute to mitigating climate change. Agriculture must minimize the contribution made to greenhouse gas emissions and increase carbon sequestration, and must be climate-smart.

The threat of climate change to our food systems, and the threat caused by our current food systems, must be highlighted to consumers. Unless consumers demand food produced in ways that are good for the environment, farmers have little incentive to adopt appropriate farming technologies.

How is digitization impacting agriculture?
Digital technology has the potential to make agriculture significantly more productive, reduce drudgery, and make agriculture more profitable. Due to the digital lag, the latest, most appropriate and most efficient technology may not always be available to smallholder farmers in the drylands of Asia and Africa. That said, there is a large ecosystem of startups and entrepreneurs, including many collaborating with us, working to make the benefits of digital technology available to smallholder farmers through the widespread availability of smartphones and internet connectivity.
In what ways is ICRISAT working towards reducing malnutrition in India?
The organization is geared towards improving nutrition in the drylands of Asia and Africa where these crops are grown and consumed. The development of India’s first naturally-bred biofortified pearl millet at ICRISAT led to minimum iron levels being defined for pearl millet breeding. Through our agri-business incubator we support startups to develop value-added food products that combine dryland cereals and legumes in healthy, delicious and easy to consume ways. The Smart Food campaign works to diversify consumption through an approach which is ‘good for you, good for the planet and good for the farmer’. In India, we work in a focused manner in predominantly tribal districts to combat malnutrition and improve livelihoods.

How are you maintaining genetic diversity of seeds?
Genetic diversity minimizes risk to farmers; genetic diversity is one of the building blocks of new, adapted varieties. Our Genebank, located in India and Africa, holds over 1,53,000 accessions of dryland crops that support breeding programs around the globe. Genes have been identified for resistance to pests and diseases; tolerance to high temperatures, less moisture, poor soils; and to confer high levels of iron, zinc and other essential elements in the consumed parts of crop plants. Of the total accessions in the Genebank, 1,13,653 have been safety duplicated in the Svalbard Global Seed Vault to ensure their safety and availability for future generations.

How can women in agriculture be empowered?
Women are more than half the agriculture workforce and yet are often marginalized. In agricultural research for development, we must empower women, but as a part of the total agricultural workforce and not in isolation. We need to look at gender equity as a precursor to gender equality. Ensuring equitable access to information and appropriate policies would be a good start.

What are the new areas that you will be focusing on in the next decade?
We will validate and use technologies such as AI and ML [machine learning], gene editing, seed science and remote sensing, as well as technologies yet to be imagined, to minimize the risk to farmers and ensure that consumer demand for a readily available, affordable and diverse diet comprising nutritious and climate-adapted foods in the semi-regions is supported and championed.
A new book, highlighting successful practices and guiding principles based on 12 years of research and implementation across eight countries in Africa and Asia, has been released. It documents the strides made in providing access to high-quality seeds of improved legume varieties to 25 million farmers. This was under the Tropical Legumes III (TLIII) project funded by the Bill & Melinda Gates Foundation.

The book offers critical insights into the processes involved in enhancing the performance and competitiveness of legume crops’ value chains, and addresses challenges that need to be overcome to make innovation platforms more sustainable. It lists several practical ideas that can be of use to development workers, technical staff and project managers.

The TL III project consisted of numerous actors, groups and teams; the book describes the key mechanisms they employed to ensure that seeds and other inputs, knowledge and financial services were all made available to the most underserved communities of smallholder farmers in remote dryland regions of the target countries.

Therefore, this book can act as a primer and guide for other scientists and development workers aspiring to similar goals.

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- An Analysis of Groundnut Innovation Platform Achievements in Brokering Improved Varieties to Communities in TL III Project in Burkina Faso (Miningou, Amos et al.)
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The open access book can be accessed here: Enhancing Smallholder Farmers’ Access to Seed of Improved Legume Varieties Through Multi-stakeholder Platforms – Learning from the TLIII project Experiences in sub-Saharan Africa and South Asia | Essegbemon Akpo | Springer.

Project: Tropical Legumes III

Partners: ICRISAT (lead), International Center for Tropical Agriculture (CIAT), International Institute of Tropical Agriculture (IITA) and other national agricultural research systems partners (NARS) from 7 African countries and ICAR- Indian Institute of Pulses Research, Kanpur, (UP), India.

Funder: Bill & Melinda Gates Foundation

CGIAR Research Programs: Grain Legumes, Grain Legumes and Dryland Cereals
Towards sustainable seed systems in Eastern and Southern Africa

The AVISA project has rolled out its seed systems strategy in Tanzania, Ethiopia and Uganda with an aim to increase ESA’s varietal turnover rate and boost adoption of improved varieties. Digital seed roadmaps, increasing private seed sector and community seed producer participation, innovating digital tools and building business cases for the crops are part of the strategy.

**Tanzania**

The project worked with Tanzania’s national groundnut and sorghum seed systems teams to:

- Co-develop digital seed roadmaps for five groundnut varieties (Nachingwea 2009, Massasi 2009, Naliendele 2009, Mnanje 2009 and Nachi 2015) and three sorghum varieties (Macia, NACO Mtama 1, NACO H1) prioritized for promotion.
- Facilitate involvement of seven seed companies to produce and avail foundation and certified seed of groundnut and sorghum across Tanzania (Lima Africa Ltd, Mbozi Highlands Economic Group Ltd, Alsem Ltd, Agriseeds Ltd, Temnar Seed Ltd, IFFA Seed Co, Dodoma Agricultural Seed Producer Association (DASPA)) in addition to the ongoing seed production and delivery work with the public seed company, Agricultural Seed Agency (ASA).
- Co-develop and implement a study on business cases for groundnut and sorghum varieties. The study revealed that the return on investment for seeds and grain production ranges from 80-250% and 80-100% over the use of non-improved varieties of sorghum and groundnut, respectively, and that there...
is potential to increase this using high quality seed and accompanying good agronomic practices.

- Co-develop and launch the Seed Revolving Fund Initiative, Youth Engagement and Gender Inclusion (SRF-YEGI). The initiative identified four commodity corridors for groundnut and sorghum in Tanzania, i.e., Southern Zone corridor, Southern Highlands corridor, Western Zone corridor and Central Zone corridor.

In the south, the Southern Highlands corridor includes Mbeya area. It supplies Zambia and parts of DR Congo. The Southern Zone Corridor comprises Mtwara area that mainly supplies Dar es Salaam.

The Central Zone corridor including Dodoma, Singida and parts of Manyara has its produce going to Dar es Salaam or Arusha and to Kenya. The region has the potential to supply sorghum and groundnut to neighboring Rwanda, Congo, Burundi, Uganda, Kenya and Zambia.

The Western and Lake Zones Corridor, which comprise Tabora, Shinyanga and the surrounding areas. The produce from this corridor is sold to Rwanda, Burundi and parts of DR Congo.

Dr Akpo Essegbemon, Seed Specialist, ICRISAT-ESA, says the project activities including trainings, on-farm activities and seed delivery system innovations have not been disrupted by COVID-19.

The innovations he mentions include seed revolving fund initiatives for sorghum and groundnut value chains in Tanzania that can boost access to quality seeds of improved varieties in rural regions. Also, SEEDx, a data collecting mobile application is being rolled out with an intent to collect, organize and make robust data available to all the users.

**Uganda**

Additionally, a digital plan of work has been developed for Uganda. A data collection tool has been developed with National Semi Arid Resources Research Institute (NaSARRI) scientists to study the influence of the brewery industry in enhancing sorghum seed sector development. A seed revolving fund was also initiated with NaSARRI based on the Tanzania experience.

NARO holdings Ltd, NARO-Uganda’s business wing, has already received groundnut breeder seed for bulking and production of foundation seed, besides closely engaging seed companies (Equator seeds & Pearl seeds) and seed certification agency. NARO is Uganda’s national agricultural research organization.

The AVISA Project aims to increase the rate of varietal turnover. The project is funded by Bill and Melinda Gates Foundation and United States Agency for International Development (USAID). It consolidates gains made by earlier initiatives Tropical Legumes III, HOPE-II and HarvestPlus - all funded by the BMGF – while refocusing the work to improve the breeding and seed delivery systems of CGIAR and national agricultural research systems in seven countries of Sub-Saharan Africa.

**About the author**

Grace Waithira is a Communication Assistant in ICRISAT’s East and Southern Africa Program in Kenya.
Ziziphus agroforestry: a yield and income ladder for millet farmers in Niger

Along a long term experiment at ICRISAT’s Sadore research station with Ziziphus mauritania (Pomme du Sahel) trees showed pearl millet yields rising by up to 41% in low input conditions. The observations led researchers to recommend ziziphus trees at 80 plants per hectare and helped show how smallholder farmers in Niger’s drylands can increase productivity and income potential two to threefold from both mono-cropping and intercropping systems with agroforestry.

The experiment, which started in 2004 and featured agronomic work conducted from 2015-2018, involved cultivating pearl millet and cowpea as mono crop and inter-crop in four input scenarios– without organic fertilizer or manure, with Nitrogen, Phosphorous and Potassium (NPK) fertilizer, with manure and with both NPK and manure. Each of these four scenarios for both mono-crop and intercrop was replicated in two blocks– with and without ziziphus trees. The experiment’s results were recently published in *Agriculture, Ecosystems and Environment*.

“Smallholder farmers in the West African Sahel farm on landscapes where poor soils and frequent droughts threaten their food security,” said Dr Bado, the study’s lead author. “They have limited resources to invest on inputs. The experiment we conducted aimed to determine what hardy and income producing trees like ziziphus can do in such systems. To draw conclusions from the experiment that would mirror on-ground conditions, we grouped the observations in two.”

Accordingly, the first group is the low-input group, where no fertilizer was used or only manure was used in the experimental plots. The second is the moderate input group, where either NPK or a combination of NPK and manure was used.

In the first group, pearl millet monocrop plots with ziziphus trees recorded a mean yield increase of 41% without fertilizer and 10% with manure when compared to plots with the same nutrient inputs but without the trees.

Contrastingly, in the second group, ziziphus trees did not increase mean yields (in some cases decreased yields) in plots where NPK and NPK-manure was applied. Similar observations were made in the intercropping plots.

“In the low-input group, ziziphus trees improved water use efficiency of pearl millet and millet-cowpea cropping systems. However, where some fertilizer and manure was applied, the trees did not affect water-use efficiency or yields of crops. But, the income was higher due to the fruit output,” said Dr Anthony Whitbread, Director for ISD Research Program at ICRISAT and one of the study’s authors.
“Increased nutrient supply in the second group meant more competition for light and water in these plots. This observation requires more research to determine the optimal arrangements and density of trees and crops depending on fertility inputs,” he explained.

The study’s three authors including Mr Laminou Sanoussi, Scientific Officer at ICRISAT-Niger, noted that ziziphus trees led to maintaining soil organic carbon and nitrogen levels. The increased crop yield and products of ziziphus agroforestry increased incomes up to three times during the experiment.

Since the 1980’s, ICRISAT has been promoting the technique of microdosing - direct application of small quantities of fertilizer at the time of planting- in combination with water harvesting practices. These low-cost interventions have been shown to maximize the efficiency of input use via increased yields and incomes. When used with agroforestry, these practices can help farmers in the Sahel improve soil fertility, generate multiple income streams and make their livelihoods resilient.

The study was taken up under an EU and IFAD funded project. The study’s authors partnered with Dr Fergus Sinclair and Dr Leigh Ann Winowiecki from World Agroforestry (ICRAF).

Project: Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: Taking successes in land restoration to scale
Funder: EU and IFAD
Partners: ICRAF
CRP: GLDC and WLE

This work contributes to UN Sustainable Development Goals

1. NO POVERTY
2. ZERO HUNGER
8. DECENT WORK AND ECONOMIC GROWTH
12. RESPONSIBLE CONSUMPTION AND PRODUCTION
Breaking barriers to uptake of improved sorghum in Burkina Faso, one social media post at a time

A small number of farmers pioneering seed production of a novel sorghum variety in Burkina Faso are also breaking new ground on social media. Turning the spotlight on Soubatimi, the new sorghum variety that the AVISA Project is disseminating, they have shown a way around one of the biggest roadblocks to Africa’s uptake of game-changing improved crops—unawareness.

“Right from our first cropping year of Soubatimi, I took photos of the plants every 15 days and posted them on Facebook and WhatsApp,” said Sana Pascal Ouedraogo, a research technician who took up farming after retirement. “People were happy to see how well the variety performed and were curious to learn about it.”

“Most people were impressed by the fodder and leaves that remained green up to maturity,” adds Henri Zoungrana, who teamed up with Mr Ouedraogo in 2019 to produce Soubatimi seed on 6 ha in Zoundweogo province, about 102 km from Ouagadougou, Burkina Faso’s capital city.

What and why Soubatimi?

Soubatimi was developed as a dual purpose crop for food and animal feed. It was developed by ICRISAT Mali, IER (Institut d’économie rurale), Mali’s agricultural research institute, and the French research center CIRAD (Centre de coopération internationale en recherche agronomique pour le développement). Not long after its release in 2016, the variety became one of Mali’s most popular sorghum varieties. It has since been trialed in Burkina Faso, Ghana, Niger, Nigeria and Togo. Certified seed production started in 2019 in Niger and Burkina Faso.

According to Dr Baloua Nebié, Senior Sorghum Breeder, ICRISAT Mali, Soubatimi can yield up to 2 tons of grain per hectare and 10 tons of dry stover per hectare in farmers’ fields. In the last two years of seed production in Zoundweogo alone, over 100 farmers came to know of the variety through social media and nearly half of them have lined up for seed in the next cropping season. Around 10 tons of certified seed from 2020’s harvest has been made available for sale in Manga zone and will be used to plant around 1,200 ha this year.

“Lack of awareness of improved varieties translates to low uptake by farmers. Increasing awareness of new crops and improving access to their seed is key to achieving the goals of increased productivity, higher incomes and better nutrition,” Dr Nebie said. “Farmer to farmer communication is highly influential, but we had to see it manifest on social media. For researchers and institutions, this is a nudge to closely integrate social media with other means of extension.”

Dr Nebie’s words are borne out by mobile ownership and social media numbers in Africa. About 1.08 billion people reportedly had a mobile phone in 2020. Among them, 217.5 million used social media, up by about 12% over number of users in 2019. Farmers and agriculture are poised to gain from the growth over the next few years.
For getting seeds certified in Burkina Faso, seed producers must secure and cultivate Soubatimi on at least 3 ha of land that is isolated from other sorghum fields by at least 200 m. The field must be visited by seed inspectors at least three times before harvest.

**Ripple effect**

The peer-to-peer sharing that farmers like Mr Ouedraogo and Mr Zoungrana kicked off led a young farmer Dominique Dipama in a neighboring village to take up Soubatimi seed production.

“I saw pictures of the variety on WhatsApp and decided to produce it the same year. I am very interested in fodder and stalks of Soubatimi that the animals like a lot. With it, I can save money that would go into purchasing feed for animals,” Mr Dipama, who has 50 cows, reckoned.

At Tintanga village about 20 km from Ouagadougou, noted sorghum producer Hamado Bougoumpiga, has already sampled the benefits of the variety. For Mr Bougoumpiga, who owns a herd of 30 cows, the quality of feed for his animals is just as important as the grain for his household.

“I was searching for improved varieties of sorghum that are high fodder yielding. When I saw the pictures of Soubatimi on facebook, I immediately decided to produce it. One month after sowing, my animals tasted it and they clearly liked the sweet stalks,” he said.

“Tintanga village is not far from Ouagadougou and I was looking for new varieties to try. When I saw the panicles three months later, I knew I made a good choice,” he added beamingly.

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

**Partners:** ICRISAT, IITA, CIAT, Institut de l’Environnement et Recherches Agricoles (INERA), Burkina Faso; Institut d’Economie Rurale (IER), Mali; Council for Scientific and Industrial Research-Savanna Agricultural Research Institute (CSIR-SARI), Ghana; Institute for Agricultural Research (IAR) of Ahmadu Bello University (ABU) and Usman Danfodiyo University of Sokoto (UDUS), Nigeria; Ethiopian Institute of Agricultural Research (EIAR), Ethiopia; Department of Research and Development (DRD), Tanzania; National Semi-Arid Resources Research Institute (NaSARRI) of the National Agricultural Research Organization (NARO), Uganda.

**Funders:** Bill & Melinda Gates Foundation and USAID

**Others Projects that have contributed:** (i) Networking4Seed: Growing sustainable seed systems by learning from experiences across Mali, Burkina Faso and Niger, (ii) Dual-Purpose Sorghum and Cowpea Phase II, (iii) Enhancing Smallholder farmers’ Productivity, food and nutrition security in West Africa using High-Yielding and nutritious sorghum and pearl millet hybrids and Varieties (ESPHYV).

**Partners:** ICRISAT, INERA/Burkina Faso, IER/Mali, INRAN/Niger, AMSP, Burkina Faso; UGCPA/BM, Burkina Faso; ULPC, Mali; COOPROSEM, Mali; AOPP, Mali MOORIBEN, Niger and FUMA GASKIYA, Niger.

**Funders:** The McKnight foundation, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

**CGIAR Research Program:** Grain Legumes and Dryland Cereals
To increase adoption of new improved varieties in Africa, a webinar was recently organized under the aegis of the AVISA project to familiarize seed system stakeholders with SEEDx, a mobile application developed by ICRISAT that facilitates data-driven decision making.

Dr Chris Ojiewo, AVISA project Co-Principal Investigator, outlined SEEDx and informed that it allows real-time capturing of data on varieties and allied technologies including date of sowing, agronomic practices, harvest yield, stakeholder feedback from field days and the geo-coordinates of demonstration plots. The collected data serves as key information for making business case for varieties, he said while adding that SEEDx complements earlier efforts made on digital seed catalogues to provide details of varieties’ traits. The webinar included a demonstration on access and use of the application by Mr Satish Nagaraji, Senior Manager, and Ms Kanika Singh, Senior Scientific Officer, from ICRISAT’s Digital Agriculture and Youth Theme.

The need for SEEDx

Farmers in Africa have limited access to quality seed of improved varieties despite the large number of variety releases and registrations. Limited access has led to high reliance on aging varieties that farmers usually obtain from neighbors, saved grain or local grain markets. These varieties lack the traits necessary to tackle existing and emerging biotic and abiotic stresses. Limited access also results in uncertainty in seed markets and makes improved varieties commercially non-viable for private seed ventures. Additionally, seed companies are unable to take informed decisions owing to lack of data on performance of newly released varieties in varied agro-ecological zones.

To address these gaps, SEEDx was developed through the AVISA project to collect, organize and make available robust data. The SEEDx data dashboard ingests secondary data on location-specific weather and soil parameters to create evidence and insights on variety performance.

The tool is already in use by AVISA partners including National Agriculture Research Systems (NARS); CGIAR institutions including ICRISAT, The Alliance of Bioversity and CIAT, and International Institute of Tropical Agriculture (IITA); and Syngenta Foundation for Sustainable Agriculture (SFSA).

What users have to say?

Mr Gerald Alex from Tanzania Agricultural Research Institute (TARI) remarked that the application is user-friendly because his team is able to easily explain its use to extension officers. “Besides capturing basic and relevant information, SEEDx enables access to data from all places without physical visits by researchers,” he added.

Dr Nathalie Vignaux, Seeds2B Operational Excellence Lead at Syngenta Foundation for Sustainable Agriculture (SFSA) noted that the collection of data and storage in one place through SEEDx brings transparency even as it helps in visualization of data, which is the first step towards enhancing varietal improvement process. She also emphasized the need to focus on creating awareness about the tool by demonstrating its use to farmers.

“This will show that SEEDx is more than just a statistical tool for depicting advancement of varieties from one stage to the next. It is an intervention for enhance informed decision-making among value chain stakeholders,” Dr Vignaux said to underscore its importance.

Explaining the reasons for low uptake of new varieties by seed companies, Dr Essegbemou Akpo, Seed Systems Specialist, ICRISAT ESA, said the existence of many new varieties is not widely known. He called on AVISA
partners, especially NARS, to use SEEDx and generate data on the varieties, particularly from their diverse agro-ecologies. “The data will be useful for awareness creation among the stakeholders more so the seed companies,” he said.

Watch the SEEDx animation video here: https://www.youtube.com/watch?v=vOESQtVL7eg&t=3s

This work contributes to UN Sustainable Development Goals

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

**Funder:** Bill & Melinda Gates Foundation, USAID

**Partners:** International Center for Tropical Agriculture (CIAT), International Institute of Tropical Agriculture (IITA), NARS partners from Burkina Faso, Ethiopia, Ghana, Mali, Nigeria, Tanzania and Uganda, and ICRISAT

**CGIAR Research Program:** Grain Legumes and Dryland Cereals (GLDC)
Young Malian researchers gear up for grand challenges with crop modeling

**UE-APSAN Mali project trains next generation of modeling experts**

Budding agricultural researchers are being trained in crop modeling to take on pressing and ever-present challenges of land, climate and food security. In a recent training program at ICRISAT-Mali, eight students learned to model agrosystems with DSSAT software, taking into account smallholder farming constraints.

Crop modeling is a process that describes different stages of crop growth and development depending on weather, climate and soil conditions adapted to the environmental context, explains Mr Adama Douyon, a student completing his master’s research in the Smart Food component of the EU-APSAN-Mali project (Enhancing Crop Productivity and Climate Resilience for Food and Nutrition Security in Mali). The training was taken up as a part of the project’s activities.

“The training’s main objective was to provide learners with knowledge of crop modeling using processes in plant nutrition and physiology, agricultural sciences, soil physic and hydrology, environment and meteorology. With the DSSAT model (dssat.net), they were given current concepts used in the modeling of the processes that determine plant growth,” said Dr Nadine O Worou, agronomist and a specialist in crop modeling at ICRISAT-Mali, who organized the trainings and instructed the participants.

The seven-session training was held on 7 and 8 December 2020 for doctoral and master’s students in breeding, environmental sciences, agronomy and agricultural economists. They were recruited for supporting research activities in the project.

“I understood how to integrate the data into the model, to simulate and to interpret data resulting from the analysis,” said Mr Douyon.

At the end of the two-day training, the participants testified that the sessions enhanced their understanding of crop modeling approaches necessary for different climate change impact studies including those dealing with abiotic plant stress.

“I discovered DSSAT, a very interesting agronomic software. I also learned how to handle agronomic data and acquired essential notions of model sensitivity and data calibration. This will help me make simulations precise,” noted Mr Adama Coulibaly.

For others like Ms Kadiatou Toure, a PhD student deep diving into research, the training has helped comprehend real-world applications of modeling and shape plans for future experiments. And for some like Mr Kibarou Richard Denou, the training has made clear the differences between modeling and simulation.

“This training will be of great use to me in my future research work on sorghum modeling,” said doctoral student Mr Youssouf Bolozogola. He expressed the need for more training before he can apply his learnings.

Stressing the importance of regression analysis, Ms Adja Rokiatou Sangare said about DSSAT use, “I learned how to enter data, start a simulation, see the results, analyze the outputs and also check the parameters from regression analysis. The last step makes it possible to know if the model is good or not, and what to calibrate.”
“The simulated and observed values must be evolved to conclude that we have a good result. We can reduce model errors by making a calibration if the need arises,” added Mr Sékou Armand Sanogo.

“I would like a follow-up system to be put in place to support the students as they move to practicing what they have learned,” Mr Fabrice Fei-ingtena said, voicing the group’s demand.

**Project:** Enhancing Crop Productivity and Climate Resilience for Food and Nutrition Security in Mali (UE-APSAN-Mali)

**Funder:** European Union

**Partners:** Institut d’économie rurale (IER), Organisations des producteurs (Union locale des producteurs de céréales-ULPC), Sene Yiriwaton, Coopérative des producteurs de semence du Mande - COOPROSEM, Union Nietaa et Jigiseme, Services de vulgarisation agricoles, Direction nationale de l’agriculture-DNA et particulièrement les Secteurs d’agriculture de Kayes, Ségou, Kita, Koutiala et Yorosso, ONGs (Mali Agricultural Market Development Trust- MALIMARK, European Cooperative for Rural Development-EUCORD, Association Malienne d’Éveil au Développement Durable-AMEDD) et Compagnies semencières (Société de Production de Semences Améliorées- SOPROSA, Camara Semence, Doun ka fa, Faso Kaba et Zamoho); Universités au Mali, CORAF/WECARD and ICRISAT.
Agri-buzz blog

Does improving food market access improve rural household nutritional outcome in developing countries?

Diversification of farms is often advocated for bringing diet diversity to rural households and improving nutrition, but how does it compare to market access? This blog traverses an extensive review of literature on the subject that was recently published. The review sought to determine the association between market access and dietary diversity in developing countries. Verdict: the answer lies in context and detail.

A significant number of undernourished people live in rural Asia and Africa, many of whom are in smallholder farm households that largely depend on agriculture for livelihood. Typically, farmers consume a considerable share of what they produce, mostly cereals that lack essential micronutrients; hence, increasing on-farm diversity with different types of crops, vegetable and livestock species is seen as a promising way to improve household nutrition. However, farm diversity is declining on small farms across the world due to increased market oriented production systems and is resulting in increased dependence on local markets for diverse food. Therefore, local markets have become important in supplying diverse food to rural households.

In a recently published article in the Global Food Security Journal, this blogpost’s author with ICRISAT colleagues Dr S Nedumaran, Senior Scientist-Economics and Dr R Padmaja, Senior Scientist-Gender Research, investigated evidence for relative importance of local market access over farm production diversity for a household’s dietary diversity. The researchers screened 786 empirical research publications and identified 28 studies featuring related research in 14 developing countries (5 from Asia and 11 from Africa).

A consistent positive association between access to markets and dietary diversity was noticed in the studies reviewed. A few of them reported that market access had a more significant positive effect on dietary diversity than farm diversity. However, these findings cannot be generalized as they are context-specific.

Additionally, the study, “The interplay between food market access and farm household dietary diversity in low and middle income countries: A systematic review of literature”, demonstrates complexities associated with conceptualizing market access and difficulties in measuring it. The researchers believe information about multiple market access indicators in a specific context may thus better help conceptualize and measure market access.

The authors also identified eight research/knowledge gaps for future research. A few of them along with a few policy recommendations are mentioned below.

- Future research should focus on analyzing specific country or regional contexts, particularly in a diverse country like India, which is diverse in many aspects like agro-ecologies, socio-economics, culture, etc.
- None of the studies addressed how safe and hygienic foods are sourced from markets compared to their farms’ produced food.
- The use of market food price as an indicator might provide valuable insight into the roles of markets in dietary diversity. Market price as an indicator was not considered in any of the studies.
• More studies analyzing household dietary diversity’s seasonal differences must consider both own-farm production and markets as food sources.
• Either on-farm diversity or market access alone may not achieve the goal of improved nutrition in rural areas. That said, a policy emphasis on markets is warranted given the role they can play in complementing own production and the importance of food and nutrition security as a development goal. Food determines nutritional outcomes and therefore, nutrition-sensitive agricultural interventions that enable market access and promote farm diversity are needed to ensure nutrition sufficiency.

ICRISAT’s work in the TIGR2ESS project’s flagship-1 “Sustainable and Transformative Agrarian and Rural Trajectories (START)” is well placed to understand the relative importance of market access and farm production diversity on rural households’ nutritional outcome in semi-arid areas of Telangana, India. Empirical research is in progress to address a few of the knowledge gaps mentioned above. Through this work, it is hoped that the knowledge gaps identified can be filled by contributing to literature and providing evidence-based policy support to governments and development agencies in order to help design appropriate policies and programs to improve nutritional outcomes.

Dr Ravi Nandi
Associate Scientist-Socioeconomics/Agricultural Economics, ISD-MIND, ICRISAT.

Project: Transforming India’s Green Revolution by Research and Empowerment for Sustainable Food Supplies (TIGR2ESS)
Funder: Global Challenges Research Fund
Partners: Cambridge University, MS Swaminathan Research Foundation, PRADAN, University of East Anglia, UK, and ICRISAT
CGIAR Research Program: Grain Legumes and Dryland Cereals (GLDC) and Water, Land and Ecosystems (WLE)

This work contributes to UN Sustainable Development Goals
Cues to making crop improvement in Africa gender responsive

A cluster of activities are helping make The Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa (AVISA) Project’s crop improvement efforts gender-responsive. The activities include: Gender responsiveness in product profiling, Youth transitions in the drylands and Gender dynamics in seeds systems (G-SEED).

Gender responsiveness in product profiling
According to Dr Tawanda Mashonganyika, former product manager with CGIAR’s Excellence in Breeding (EiB) platform, while markets vary place to place, women are key players in them. As varieties developed using gender responsive (G+) tools address needs of both men and women, Dr Mashonganyika says they will have a greater chance of being adopted and a greater impact upon adoption.

In The AVISA Project, a cross-functional team has come together to develop product profiles that are gender responsive. A few salient points in this regard include:

Market economists in the team collecting data from farmers and consumers, both men and women, through choice experiments to understand utility that men and women assign to certain traits.

ICRISAT is participating in ongoing efforts by the Gender and Breeding Initiative (GBI) and EiB teams to design and test tools that can be used to “measure” gender responsiveness (G+ tools) in profiles of products and customers. As the learnings become clear, these tools will be applied in project’s breeding programs.

Youth transitions in the drylands
A study on youth transitions in the drylands in Tanzania, Uganda and Ethiopia revealed that definitions of youth in rural communities are based on cultural processes that are highly gendered.

For instance, girls have a much shorter transition pathway compared to boys. When a girl becomes a mother, she is not identified as “youth”; she is now a mother/an in-law/ a wife. When planning youth integration activities for The AVISA Project, awareness of these cultural definitions to avoid reinforcing exclusions in our interventions have been considered.

The youth transition study is informing the design of the Youth Quality Centers. These centers will be tested as a mechanism for integrating youth in the legumes and cereals seed value chains in Tanzania, working with quality inputs and outputs. This will be under the Seed Revolving Fund Initiative-Youth Engagement and Gender Inclusion (SRFI-YEGI), a cross-functional activity that is being implemented by ICRISAT, partner seed companies, Centre for Behavior Change Communication (CBCC), Tanzania Agricultural Research Institute (TARI) and regional governments in Tanzania.
In collaboration with CRP-GLDC, ICRISAT partnered with Sokoine University of Agriculture, Makerere University and Haramaya University for the study.

**Gender Dynamics in Seeds Systems (G-SEED)**

From the studies conducted on gender integration into breeding and seed systems, key learnings include:

Socio-cultural and gender considerations are crucial in grain legumes and dryland cereals seed systems to the adoption of improved varieties. They are also an important consideration for developing demand-driven product profiles for breeders to develop varieties that meet tastes, preferences, needs and practices of the society like gifting seeds that are early and drought tolerant to a new bride to help the family achieve food sufficiency.

Farmers are accessing grain legumes and dryland cereal seeds from open-air markets, cereal stockists, neighbors and friends instead of certified seed sources.

Cereal stockists play a significant role as influencers because they are present in almost all market centers in rural areas and are the first link to the market for rural farmers – especially women farmers.

For improved adoption, information packaging and communication have to be enhanced because, currently, information gaps exist between breeders, farmers and other seed system players that impedes adoption of improved seeds. For instance, the available information may be perceived as complicated by smallholder farmers. Many farmers also tend to associate certified seed with large-scale commercial farming.

ICRISAT, CGIAR Research Program-Grain Legumes and Dryland Cereals and CGIAR’s gender platform are helping The AVISA Project implementing these activities. As AVISA attempts to meet end-user demands and preferences, it is ensuring that the efforts to strengthen seed production and delivery systems are gender-responsive. It is now beyond doubt that a higher and equitable rate of varietal turnover is achievable only with gender-responsive efforts.

The AVISA Project aims to increase the rate of varietal turnover. The project is funded by Bill & Melinda Gates Foundation and United States Agency for International Development (USAID). It consolidates gains made by earlier initiatives Tropical Legumes III, HOPE-II and HarvestPlus – all funded by the foundation – while refocusing the work to improve the breeding and seed delivery systems of CGIAR and national agricultural research systems in seven countries of Sub-Saharan Africa.

**About the author**

Grace Waithira is a Communication Assistant in ICRISAT’s East and Southern Africa Program in Kenya.
Dr Rajeev Varshney, Director for Genetic Gains Research Program, achieved an H-index of 100. H-index is an author-level metric that measures both productivity and citation impact of an author’s publications across the global scientific community. It is calculated by counting the number of publications in which an author has been cited by other authors. Dr Varshney explains, in this Nature Blog, explains what the metric means in scientific publishing and why it is a milestone, especially in an agricultural scientist’s life.

H-index is an author-level metric that measures both productivity and citation impact of an author’s publications across the global scientific community. It is calculated by counting the number of publications in which an author has been cited by other authors. H-index 100 means each of the latest 100 of the author’s papers have been cited at least 100 times.

Opinions vary on these metrics and the number of citations is not the only way to measure scientific impact. But it certainly is one of the many metrics that recognize a scientists’ scientific outputs through publishing, and in turn, recognizes their science. Research publications are a great way to share the latest advancements in science with the global community. They also help reduce redundancy or duplication in research while directly or indirectly saving the valuable time and effort of the scientific community as also taxpayers’ money.

Generally speaking, medical science generates more research innovations that are used by different biological disciplines, including agricultural sciences. As a result, citations in medical science research are higher than agricultural science publications. When agricultural science publications have high citations, it does indicate that the research is making an impact in advancing science. The milestone of 100 h-index is a recognition of the high-quality science at ICRISAT with colleagues and partners from across the globe.

The metric that matters even more
The real battle that agricultural science should wage is against hunger, food insecurity and malnutrition. Scientists in the same discipline anywhere can learn from the latest research and take it forward to address issues of smallholder farmers while advancing the cause of scientific research for global good.

As scientists, we believe in every study we conduct irrespective of the results we get. Some of the research we conducted with a large number of global partners has an edge over the others because of massive learnings from the multidisciplinary scientists involved. For example, our genome sequencing work of 429 chickpea lines was a collaboration of 39 scientists from 21 research institutes across 45 countries. It tapped next-generation sequencing (NGS) technology to better understand the genetic architecture, centre of origin, migration route as well as genetic loci for agronomic traits in chickpea. This study with several brilliant minds from across the world offered much learning for me.

There is a great sense of satisfaction when the upstream research we conduct delivers results in farmers’ fields in addition to advancing the cause of science for global good. As a genomics scientist, I provide research outputs for breeding programs that develop improved crops.

ICRISAT’s collaborative work on genomics-assisted breeding helped develop and release the first set of products in 2019. There were three high yielding, wilt resistant varieties of chickpea and two high-oleic varieties of groundnut. The Ethiopian Institute of Agricultural Research also released a high-yielding chickpea variety. The groundnut varieties were among the 17 biofortified crops dedicated to India on World Food Day 2020.

My efforts in genomics-assisted breeding will continue with an aim to accelerate the replacement of older crop varieties to help smallholding farmers improve their income and ensure better nutrition and health for the society.
The India CSR Network has awarded Mahindra & Mahindra Limited (M&M) for its watershed development efforts in India’s Telangana state. The efforts involved creating 51 water harvesting structures in Buchinelli village over three years that led to harvesting 137,000 m³ rainwater every year, benefitting around 150 farmers. Water harvesting with other initiatives like introduction of high-yielding crops yielded up to 40% higher productivity.

Representing the project team from M&M, Rural Education and Agricultural Development (READ) and ICRISAT, Dr Rajesh Nune, Hydrologist at ICRISAT Development Center (IDC), received the “Best Watershed Project in Agriculture” award during an awards distribution ceremony that was held online on 16 January 2021.

“We thank India CSR for recognizing us,” Dr Nune said while acknowledging the recognition. “This collaboration addresses several issues including declining groundwater levels, surface water availability, declining soil quality, low crop yields and malnutrition, particularly among women and children. Through science-based interventions, we are showing farmers how they can harvest rainwater during monsoon and use it effectively in the dry season without degrading existing groundwater resources.”

He further said that the efforts have increased yields by 15% to 40% and led to additional incomes ranging between ₹ 5000 and 15000 (US$ 68 to 205) per acre (0.4 hectare) per year.

“Many people in Buchinelli village work in the Mahindra & Mahindra factory located just across the village. It is laudable that the sense of giving back to the village by M&M has transformed the village. This is the true spirit of CSR,” Dr Sreenath Dixit, Head, IDC, said.

Read more about the project’s initiatives here.

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Project: Improving Livelihoods and Agricultural Productivity through Integrated Watershed Management  
Funder: Mahindra & Mahindra Ltd.  
Partners: Rural Education and Agricultural Development (READ)  
CRP: Water Land and Ecosystems (WLE)

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This work contributes to UN Sustainable Development Goals
The Food and Agriculture Organization (FAO) has acknowledged ICRISAT scientists Drs Kaushal K Garg, KH Anantha, Sreenath Dixit and Anthony Whitbread for their contributions to the 2020 edition of its annual flagship publication, *The State of Food and Agriculture*. The edition was dedicated to overcoming water challenges in agriculture.

For the publication, the ICRISAT team contributed a background report on strengthening resilience through water management in rain-fed agriculture systems. Case studies from India and Ethiopia were also submitted. ICRISAT’s contributions to the FAO publication were made in collaboration with Prof Jennie Barron of the Swedish University of Agricultural Sciences, Uppsala.

The India case study was of scaling up water management interventions in Bundelkhand region to transform it into a productive landscape for sustainable farm livelihoods. The interventions reduced run-off by 36% in the intervention area of Parasi-Sindh watershed in the region. Soil loss reduction of 62% was achieved. This increased groundwater recharge by 46% and crop productivity in the range of 10 to 70%.

Similarly, government-led sustainable land management programs for landscape rejuvenation in Ethiopian highlands were discussed in the Ethiopia case study. In the Yewol Mountains, for instance, a five-fold increase in irrigable land was recorded after the interventions took effect. Collaborations between Ethiopia’s Ministry of Agriculture and national and international innovation and knowledge centers were crucial for the work in the highlands. Both government and non-government organizations supported transfer of technology and development of tools to scale it up.

The State of Food and Agriculture report also mentions interventions in Kothapally watershed in south India. ICRISAT has implemented several interventions in this watershed area. The report states that these interventions reduced sediment loads in rivers and has had a positive impact on in-stream river ecology and lifespan of reservoirs.
Launch

WIRES: Newly launched platform to connect and inspire women in research across CGIAR

A new employee-led group, formed to support and celebrate women in science and research at CGIAR, was recently inaugurated. Women in Science and Research (WIRES) aims to create a safe, supportive space for women to explore opportunities and excel in their chosen areas. WIRES is coordinated by volunteers from various CGIAR centers. Its mission: To increase the visibility of women research and science professionals by ensuring their voices are heard and contributions are recognized. At its inaugural webinar, people from across CGIAR joined in to listen to illustrious women scientists narrate their life experiences.

Dr Claudia Sadoff, CGIAR’s Executive Management Team Convener and Managing Director of Research Delivery and Impact, began by stating that even at fairly senior levels, often women needed to fight unconscious bias from others and lack of confidence from oneself. She reminded the women that in order to make the most of the space they achieve, they have to stay strong and constantly push forward and create opportunities not just for themselves but for those after them. However, she also stated that one needed to be true to oneself and exercise choice as per their values, not according to others’ expectations.

Ms Alice Ruhweza, CGIAR System Board Member and Gender, Diversity and Inclusion (GDI) champion, recalled an exciting all-women trip to Antarctica that she had been on, which opened horizons of abilities and possibilities for her. She encouraged women to “Be visible, but don’t be afraid to be vulnerable.” “Think about what you can contribute and how you can do that,” she said.

Dr Chin Yee Chan, Scientist at WorldFish, described the various challenges she faced as a young researcher when the laboratory that she worked at shut down. “I learnt not to give up,” she says, all through several such hardships. “Uncertainties are always there in research particularly in these challenging times, but it is important to take one step after another and just keep going.

Dr Sadoff stated that gender-related policies were in the process of being refreshed under the One CGIAR initiative, with a set of relevant goals to ensure an inclusive and diverse workplace.

Dr Safaa Kumari, ICARDA Plant Virologist who was acknowledged on BBC’s 100 Women 2020 list, recommended that organizations, at the time of recruitment, consider how best they can stand out as a gender champion, especially for women.

“Confidence, gratitude and a conscious effort towards a healthy research lifestyle,” were listed by Dr Chan as the key factors for a successful and productive research career. “While it is important to stay focused on set priorities, you should also develop hobbies to keep you healthy and happy,” she said.

Dr Neal Gutterson, CGIAR System Board Member and GDI champion, the sole male panelist, said, “Data shows that greater diversity brings better research results; it attracts innovative research findings. Our stakeholders are very diverse, so to ensure uptake and have impact of our innovation strategy we need diverse groups.”

When asked, “How will the Gender, Diversity and Inclusion Framework contribute to our new innovation strategy of CGIAR?” Dr Gutterson replied, “We have an ambitious strategy with an ambitious goal. To achieve it, it’s going to take all of us – from across the spectrum of diversity of gender, nationality, disciplines. If we have to deliver the aspirations of the smallholder farmers, we need different ways of thinking,” he said.

On the role of male colleagues in supporting an inclusive environment, Dr Alice Ruhweza said, “Gender equality is not a women’s issue. It is a human rights issue. Men play a critical role in it, because often they have the power and influence to make a difference. Most importantly, gender equality generally means better outcomes for science.”
A background about the creation of WIRES and the introduction to the webinar was given by Ms Agathe Diama, Head – Regional Information and Smart Food Coordinator, ICRISAT-WCA, who is also one of the founding members of WIRES and was the event’s facilitator.

“WIRES wishes to recognize excellent CGIAR women scientists and researchers, and profile them as role models for younger women. Here, women can get to know and support one another, across geographies and disciplines, across nationalities and age. It is also about helping individuals find support and inspiration from people they would not normally meet, and encourage staff to connect and participate, especially in learning and social events,” she said.

Ms Diama announced two upcoming WIRES events. The first event, a 12-hour marathon knowledge session, is scheduled on 11 February to observe International Day of Women and Girls in Science. Young women scientists and researchers from across CGIAR will be invited to talk about their work during the event. The second event will be organized on 8 March to observe International Women’s Day.

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**New Publications**

**Adoption and welfare impacts of pearl millet technologies in Nigeria**
Authors: Vabi MB, Abdulqudus IA, Angarawai II, Adogoba DS, Kamara AY, Ajeigbe HA and Ojiewo C
Published: Documentation. ICRISAT
[http://oar.icrisat.org/11689/](http://oar.icrisat.org/11689/)

**Enhancing smallholder farmers’ access to seed of improved legume varieties through multi-stakeholder platforms**
Authors: Akpo E, Ojiewo CO, Kapran I, Omoigui LO, Diama A and Varshney RK

**Examining intended consequences of MGNREGP intervention on women empowerment: evidences from block level study in Jodhpur district of Rajasthan**
Authors: Chand K, Choudhary BB, Shalander K and Tewari P
Published: Indian Journal of Extension Education, 56 (2). pp. 93-96

**Soil organic carbon and associated soil properties in Enset (Ensete ventricosum Welw. Cheesman)-based home gardens in Ethiopia**
Authors: Wolka K, Birhanu B, Martinsen V and Mulder J
Published: Soil and Tillage Research (TSI), 205. pp. 1-10. ISSN 0167-1987
[http://oar.icrisat.org/11692/](http://oar.icrisat.org/11692/)

**Aflatoxin contamination: Knowledge disparities among agriculture extension officers, frontline health workers and small holder farming households in Malawi**
Authors: Gichohi-Wainaina WN, Kumwenda N, Zulu R, Munthali J and Okori P
Published: Food Control (TSI), 121. pp. 1-8. ISSN 0956-7135

**A latent class analysis of food hygiene and handling practices among urban and peri-urban residents in Hyderabad, India**
Authors: Lagerkvist CJ, Hatab AA, Nedumaran S and Ravula P
Published: Food Control (TSI), 121. pp. 1-9. ISSN 0956-7135
[http://oar.icrisat.org/11694](http://oar.icrisat.org/11694)

**What does gender yield gap tell us about smallholder farming in developing countries?**
Authors: Nchanji EB, Collins OA, Katungi E, Nduguru A, Kabungo C, Njuguna EM and Ojiewo CO
Published: Sustainability, 13 (1). pp. 1-18. ISSN 2071-1050
[http://oar.icrisat.org/11695](http://oar.icrisat.org/11695)

**Tapping the economic potential of chickpea in Sub-Saharan Africa**
Authors: Fikre A, Desmae H and Ahmed S
Published: Agronomy (TSI), 10 (11). pp. 1-22. ISSN 2073-4395
[http://oar.icrisat.org/11683/](http://oar.icrisat.org/11683/)
Exploitation of hybrid vigor for identification of promising sorghum F1 hybrid for high grain yield and resistance to sorghum midge

Authors: Hamidou M, Souleymame O, Salifou M, Ba MN, Kapran I, Gracen V, Ofori K, Yirenkyi Danquah E and Marques I

Published: International Journal of Agronomy (TSI), 2020. pp. 1-5. ISSN 1687-8159

http://oar.icrisat.org/11684/

The celery genome sequence reveals sequential paleopolyploidizations, karyotype evolution and resistance gene reduction in apiales


Published: Plant Biotechnology Journal (TSI). pp. 1-14. ISSN 1467-7644

http://oar.icrisat.org/11685/

Conventional and molecular breeding approaches for biofortification of pearl millet

Authors: Govindaraj M, Yadav OP, Srivastava RK and Gupta SK


http://oar.icrisat.org/11686/

Culm strength: key trait to identify lodging tolerant genotypes in pearl millet

Authors: Gupta SK, Shaikh CG, Ponnaiah G, Kalleshappa CC, Kholova J, Jayalekha AK and Verma YS

Published: In: 16th ROME International Conference on Advances in Agricultural, Biological and Environmental Sciences (RAABE-20), Feb. 3-5, 2020, Rome, Italy

http://oar.icrisat.org/11687/

Small RNA sequencing reveals the role of pearl millet miRNAs and their targets in salinity stress responses

Authors: Shinde H, Dudhate A, Anand L, Tsugama D, Gupta SK, Liu S and Takano T

Published: South African Journal of Botany (TSI), 132. pp. 395-402. ISSN 0254-6299

http://oar.icrisat.org/11688