A recent research study concludes that the path to cereal self-sufficiency for countries in sub-Saharan Africa (SSA) will require, in addition to yield gap closure, increased cropping intensity and expansion of irrigated production area in regions that can support these options in a sustainable manner.

The study projects a two- to four-fold increase in population and estimates cereal demand to triple for the 10 countries studied by the year 2050. However, trends show that all countries, except Ethiopia and Zambia, have cereal yields growing more slowly than population and demand. For example, the maize yield increase averaged only 27 and 34 kg per ha per year in west and east SSA countries, respectively. Attaining self-sufficiency would necessitate doubling the yield increase. This is elusive in SSA where farmers lack access to markets; and to seeds, fertilizers, and pest management inputs to support higher yields.

Without yield increase, the demand for cereals can be met through crop area expansion or imports or both. Current levels of cereal consumption already depend on substantial imports while crop area expansion comes from deforestation and converting marginal land or previously abandoned crop land as the experience of crop land expansion in Ethiopia and Tanzania show.

Apart from yield increase on existing farmland, other possibilities are to increase cropping intensity (more crop cycles per year on the same field) and to increase the amount of irrigated area where water resources are available.

“There are still possibilities to grow multiple crops per year and to expand the irrigated area, but these are options with many uncertainties,” according to Prof Dr Martin van Ittersum, Principal Investigator of this research study.

If those fails, major expansions of farmland are required which will be at the cost of natural habitats and increased greenhouse gas emissions, or enormous grain imports that must be paid with scarce foreign exchange. However, in some countries, the required area is simply not available, and expansion of farmland is not sustainable, explains co-researcher, Prof Dr Abdullahi Bala.
Although the research was conducted for 10 SSA countries, the study considers it unlikely that the situation is more favorable in other African countries as the availability of arable land per capita is comparatively lower.

The research was conducted using agronomically relevant local data and spatial upscaling protocol to estimate food production capacities in five staple cereals namely maize, millet, rice, sorghum and wheat. The estimations are specific to 10 SSA countries: Burkina Faso, Ghana, Mali, Niger, Ethiopia, Kenya, Tanzania, Uganda and Zambia.

The yield gap analysis is the result of research undertaken by a team of researchers from Wageningen University & Research, several African institutes and the University of Nebraska.

This comprehensive research is based on the collaborative work undertaken in the Global Yield Gap Atlas (GYGA) project, coordinated by Dr Lieven Claessens, Principal Scientist – Resilient Dryland Systems, ICRISAT-Nairobi.

For more information on the GYGA project click here

In a span of one year, 300 farmers in Kerio valley in Kenya earned over KES 4.8 million (USD 46,978) by cultivating 44.5 ha of green grams and over KES 4.2 million (USD 41,106) through cultivation of 161.8 ha of groundnuts.

These farmers were trained in increasing productivity of dense legumes (groundnuts, green grams) and cereals (millet and sorghum). High quality seeds of green grams and groundnuts mainly KS20 variety, CG 7, and ICGV 90704 that are well adapted to hot dry areas of Kerio valley were released to farmers. Farmers were trained on improved planting practices. Prior to this, farmers used to plant less seed (4 kgs per 0.4 ha instead of 8 kgs per 0.4 ha) which reduced their yield to 3-4 bags per 0.4 ha instead of 7-8 bags per 0.4 ha.

Due to the combination of providing high yielding improved seeds and training on better agronomic practices farmers in four areas (Kapkayo, Biretwo, Kabulwo and Arror) tripled their acreage to 364 ha for groundnuts and increased monetary gains from KES 4 million (USD 39,149) in 2015 to KES 25 million (USD 244,682) in 2016. Green gram production also increased significantly from an area of less than 48 ha to over 116 ha with total incomes increasing from KES 2.8 million (USD 27,404) in 2015 to 5.6 million (USD 54,808) in 2016.

As harvest improved, farmers were briefed on the benefits of collective marketing of produce through aggregation centers at Arror, Kabulwo, Biretwo, Kapkayo and Cheplambus for better price negotiation. Due to aggregation, market access became easier for farmers. For example the Greenforest Company Ltd. based in Nairobi is currently buying the unshelled groundnut at KES 70 (USD 0.68) and green gram at KES 125 (USD 1.22) per kilo.

In addition farmers were trained on correct spacing, timely planting, importance of earthing-up for groundnut to facilitate better pod formation, pest (pod borers, cutworms, aphids) and disease (mainly early blight, cerspora leaf spots and Groundnut Rossette virus) control.

Purdue Improved Cowpea Storage (PICS) bags were introduced to farmers to manage post-harvest loses. Additionally, the bags have been effective in maintaining seed integrity up to next planting season as the bag maintains low levels of oxygen and higher levels of carbon dioxide killing all insects.

Adequate promotion of above mentioned practices and technologies has enhanced the adoption of improved varieties, increased the awareness, contributed to inclusive agricultural growth and availability of surplus for marketing as well as food self-sufficiency at households. Consequently, nutrition has been improved due to enhanced consumption of high value legumes (pigeon pea, groundnuts, green gram) and cereals (sorghum, finger and pearl millet) reducing dependence on livestock for livelihoods.

For information on ICRISAT’s work on grain legumes click here
For information on ICRISAT’s work on dryland cereals click here
For information on ICRISAT’s work in kenya click here

For information on ICRISAT’s work on grain legumes click here
For information on ICRISAT’s work on dryland cereals click here
For information on ICRISAT’s work in kenya click here
Groundnut varieties with higher oil content empowering women in Nigeria

Using improved varieties of groundnut for processing that offer at least twice the potential quantities of oil for extraction in comparison to local varieties is helping to economically empower women in Nigeria. Women Farmers Advancement Network (WOFAN) and ICRISAT are working to promote improved groundnut production technologies for the Yadakwari community in Garun Mallam Local Government Area (LGA) of Nigeria.

The Yadakwari Women’s Community Service Centre is now using these improved varieties to produce more groundnut oil (up to 350 liters per week) in addition to kuli-kuli (a popular local groundnut-based snack; see box). The demand for locally pressed groundnut oil and kuli-kuli is so high that they are being immediately sold in the local markets.

“Improved varieties of groundnut from ICRISAT have brought happiness to many farm-families in northern Nigeria. Husbands grow groundnut, while WOFAN supports their wives to buy the grains produced for use in small-scale oil extraction. Several other families in Kano state go to our office because they can buy unadulterated groundnut oil from women’s groups being mentored by WOFAN,” said Mrs Hadja Salamatu Garba, Executive Director of WOFAN, Nigeria.

“If ICRISAT had not partnered with the Institute of Agricultural Research (IAR) to bring SAMNUT 23 and SAMNUT 24 varieties, which give three times the value of oil we were getting before, we wouldn’t have been able to address current market needs,” said Ms Garba.

Mrs Saadatu Musa, leader of the groundnut processing group of the Centre, has indicated that each kuli-kuli bag easily fetches about 4,000 Naira (US$12) and the oil is sold at about 400 Naira (US$1.2) per liter. The sale proceeds are divided into three parts: shared among members of the groups, savings into the group’s account, and for maintenance of the processing equipment.
The Yadakwari Women’s Community Service Centre comprises three women’s groups (one dedicated to general farming, the second to rice processing, and the third on groundnut processing). Each group has 30 women members. The group focusing on rice processing also receives support from the Competitive African Rice Initiative (CARI).

The project is being implemented by ICRISAT in partnership with 12 national partners and WOFAN is leading the post-harvest operations and market linkages in three states—Kano, Katsina and Jigawa.

For more information on ICRISAT’s work on groundnuts
For more information on ICRISAT’s work in Nigeria

**CGIAR Research Program:** Grain Legumes
**Project:** Increasing Groundnut Productivity of Smallholder Farmers in Ghana, Mali and Nigeria.
**Investor:** United States Agency for International Development (USAID).
**Partners:** Institute for Agricultural Research (IAR); Nigerian Agricultural Seed Council (NASC); Centre for Dryland Agriculture of the Bayero University of Kano (CDA/BUK); Federal University of Agriculture-Makurdi (FUAM); Green Sahel Agricultural and Rural Development Initiative (GSARDI); Catholic Relief Services (CRS); Women Farmers Advancement Network (WOFAN) and the Agricultural and Rural Development Authorities of Kebbi, Sokoto, Kano, Jigawa and Katsina, Nigeria, and ICRISAT.

This work contributes to the UN Sustainable Development Goals

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Kuli-kuli is a popular snack in northern Nigeria made from groundnuts. It can either be eaten alone or with a mixture of other foods. It is sometimes ground and mixed with salad or used as an ingredient for some foods. To make *kuli-kuli*, groundnuts are roasted and ground into a paste. The paste is then mixed with spices, salt and powered pepper. The paste is stripped of excess oil and made into desired shapes (round, cylinders, etc.). The oil removed in this process can then be heated and reused to fry peanut paste until it solidifies. It is then removed from oil and allowed to cool until ready to be eaten.
A new study has found that improved chickpea adoption by farmers in Ethiopia significantly increased household income while also reducing poverty. The study found that a 10 percent increase in the area planted with improved chickpea is associated with a 12.6 percent increase in income per capita and a 12.3 percent increase in total income. The study also indicates that adopting improved chickpea varieties can reduce the probability of a household being below the US$2 poverty line.

The study found that an increasing number of farmers adopted improved varieties in the Shewa region between 2006-07 and 2013-14 seasons. “In 2006-07 only 30% of farmers planted improved chickpea. By 2013-14 this share rose to almost 80%. The area dedicated to improved chickpea moved up from 0.17 hectare average to more than 0.4 hectare by 2014. Furthermore, many households started planting chickpea, bringing the share of chickpea growers up to 90% from an initial 65%,” said Dr Kai Mausch, Scientist-Economics at ICRISAT-Kenya.

The increased input use associated with improved chickpea cultivation contributes to significantly higher yields. These increased yields allow households to sell a larger share of their production into the market. While improved varieties command only a small mark-up, the return to improved chickpea is significantly higher given the significantly larger volume of sales. All this leads to chickpea sales making up a larger share of total income for those who adopt improved varieties. “Overall, increasing access to improved chickpea appears to be a promising pathway for rural development in Ethiopia,” said Dr Mausch.

The research carried out under ICRISAT’S Tropical Legumes II project (TLII), with the Ethiopian Institute of Agricultural Research, computed the impact of adoption, while accounting for possible errors from access to technology transfer and improved seed. On the basis of their observations, the authors concluded that average adoption rates for improved chickpea varieties in the rest of Ethiopia remained much lower than those in the area under the study.

However, Ms. Simone Verkaart, Junior Professional Officer Technology Transfer, ICRISAT-Kenya cautions, “While this success story looks very promising for large parts of Ethiopia, attempts to increase the coverage to other chickpea growers or to non-chickpea growing regions should be preceded by careful economic and agronomic assessments to ensure replicability. While the upsides are evidently clear to farmers, traditional knowledge and market access may differ, which could change the outcomes.”

Policies that specifically target the poorest and remove obstacles for the diffusion of improved chickpea varieties, along with efforts targeted at building partnerships along the value chain, may go a long way in promoting smallholder welfare through adoption.

Outcomes from this research has been published in the journal Food Policy: Verkaart S, Munyu GB, Mausch K and Michler DI. 2016. Welfare impacts of improved chickpea adoption: A pathway for rural development in Ethiopia? http://dx.doi.org/10.1016/j.foodpol.2016.11.007

The study was made possible through the financial support provided by the Bill & Melinda Gates Foundation, ICRISAT and the Netherlands Junior Professional Officer (JPO) program. The authors were supported by the Debre Zeit Agricultural Research Center (DZARC) of the Ethiopian Institute of Agricultural Research (EIAR), and their respective institutions in conducting the study.
Enhancing awareness on improved sorghum and groundnut technologies in Mali

Farmers from four regions of Mali learnt about groundnut hybridization, sorghum hybrids and multipurpose sweet sorghum, open pollinated varieties of sorghum, varieties resistant to abiotic and biotic stresses with short and medium duration to cope with climate change, hybrid seed production and aflatoxin management during a field day organised by ICRISAT.

Farmers visited the exhibition stands and participated in tasting of sweet sorghum syrup and value-added products of groundnut. Their discussions with researchers covered groundnut and sorghum production technologies and improved cultural practices, constraints and opportunities to improve the crops and production systems.

In the pathology laboratory where aflatoxin detection in groundnut and other crops are being carried out, the farmers were explained the importance of pre- and post-harvest aflatoxin management and different techniques to detect aflatoxin in groundnut products in laboratory, including ELISA (Enzyme-Linked Immunosorbent Assay) test.

During the visit, farmers appreciated the variability of breeding materials available, sorghum hybrid seed production and field management techniques. The enthusiasm and expectations of the farmers were heartening:

“I am happy with the performance of the dual-purpose sorghum varieties. I was able to cultivate some of them this year in an experimentation field. Despite the low rainfall, I got good crops yield. Dual-purpose sorghum is useful both for human consumption and livestock feeding and that explain my preference to these varieties. I urge ICRISAT to continue its support to farmers’ cooperatives. This will help them to produce quality seed, which in turn will contribute to improving food security and our incomes,” said Mr Mamadou Goita, a producer from Kifosso, Sikasso region.

“More women can earn better livelihoods nowadays thanks to groundnut seed production. The women group in Wakoro which I am a member of has been working with ICRISAT during the past ten years; today we can get up to 2 tons of groundnut per hectare using improved varieties in our own fields,” said Ms Djeneba Ouattara.

“With the changing climate and drought conditions, many of our local groundnut varieties are no longer adapted. It is reassuring to know that we can count on research to access improved seeds of varieties that are better adapted to our farming conditions,” said Ms Mariam Camara, a participant from Kayes region.

According to Mrs Balla Togola, “Research carried out by ICRISAT and its partners in Mali has improved farmers’ access to quality seeds. Research efforts should be encouraged that will help farmers to benefit more from agriculture.”

The field day was organized on 18 November, at ICRISAT Samanko Research Station, Mali. Eighty five farmers including 26 women and 59 men representing different villages from Mopti, Kayes, Koulikoro and Sikasso regions attended the program. The field day was coordinated by Dr Ayoni Ogunbayo, Country Project Manager, Mali; USAID Project, and Dr Baloua Nebie, Scientist, Sorghum Breeding, ICRISAT, Mali. The field activities were facilitated by Dr D Hailemichael Shewayrga, Senior Scientist, Groundnut Breeding and Dr Aboubacar Toure, Senior Scientist, Sorghum Breeding.

For more information on ICRISAT’s work in Mali, click

For more information on Aflatoxin click

This work contributes to the UN Sustainable Development Goals
Enhancing productivity through micronutrient management

A recent study reveals that chickpea variety (JG-130) grown with balanced fertilizers including micronutrients and bio-fertilizers under rainfed condition recorded 15% and 40% higher grain yield compared to JG-130 and local chickpea variety grown without micronutrients respectively. For groundnut the application of micronutrients increased groundnut pods per plant by 9%, seeds per pod by 6% and pod yield by 13%.

Application of balanced fertilizers significantly enhanced growth, yield attributes and yield of groundnut and chickpea. The net economic gain under balanced fertilization was ₹ 3,024 per ha for chickpea and ₹ 7,155 per ha for groundnut. In addition to economic gains a positive residual benefit on the succeeding crops was also documented. For example, the mean yield of wheat was 3,010 kg per ha as a result of residual effect. The yield increased by 231 kg compared to the yield (2,779 kg per ha) without the application of micronutrients.

A three-year study carried out in severely micronutrient deficit semi-arid areas of Uttar Pradesh, India, shows that prolonged and overuse of fertilizers to increase crop yield has resulted in rapid depletion of micronutrients from soils. Instead of single nutrient deficiency, multi-nutrient deficiencies are emerging. Multi-nutrient soil deficiency directly impacts crop productivity and indirectly contributes to malnutrition.

The beneficial effects of balanced fertilization are better growth and productivity of crops which resulted in lower production costs, better profitability, and improved chances of producing a good yield under adverse climatic and soil conditions.

Results from this study also strengthen the argument that balanced fertilizer application is beneficial and necessary to ensure long term sustainability, especially in the context of intensive agriculture.

The research findings showed that 88% farmers appreciated the impact of balanced fertilization. However only 9% farmers actually used them. The unavailability of micronutrients and lack of awareness by farmers seems to be a major hurdle in scaling up the use of micronutrients. Hence a concerted effort is required by researchers, extension personnel, policy-makers, fertilizer industry and dealers to ensure micronutrient is available to farmers at affordable prices.

This study was conducted at Domagor-Pahuji watershed in Babina block of Jhansi in Uttar Pradesh. In this area, the National Research Centre for Agroforestry (NRCAF) a unit of Indian Council of Agricultural Research (ICAR), Jhansi, is developing a model watershed in consortium mode with ICRISAT and Development Alternatives, a non-governmental organization.

The findings of this research were published in the Indian Journal of Soil and Water Conservation and this paper has been selected as the best paper of 2016 by the Indian Association of Soil Water Conservation (IASWC).


http://oar.icrisat.org/9819/

This work contributes to the UN Sustainable Development Goals
Scaling up climate smart agriculture for Telangana, India

Given the high climatic variability in Telangana state in India, stakeholders came together to discuss context specific climate smart agriculture (CSA) practices and identify synergies to design and promote local level CSA implementation plans.

In Telangana, severe fluctuations in rainfall have negatively impacted rainfed farming systems in both low rainfall (600 mm) zones of southern Telangana and high rainfall (1000 mm) zones in the northern part of the state. Drought is a common and recurrent feature of the region. This has adversely impacted the livelihoods of resource poor farmers.

The workshop began by reviewing cases of climate smart villages (CSV) initiated in India and specifically Telangana. Climatic risks were identified at *mandal* level (smallest administrative division) covering all 30 districts of Telangana. Median values of 29 Global Climate Models (GCMs) and projections of future climate data were obtained by using the most recent Coupled Model Intercomparison Project (CMIP5) and were used to analyze future climate projections and identify highly vulnerable hot spots. Mandsalas in southern Telangana were identified to be more vulnerable.

The next step was to prioritize CSA practices that are adaptable and location specific, factoring in diversity at grassroots level. Climate risks are experienced differently by different groups which depends not only on the geography and production systems but also on the socio-economic status of farmers, government policies, investments in agriculture, etc. Therefore, based on the newly identified climate risk data, participants prioritized potential CSA interventions for the state. Methodology for prioritization of location specific CSA practices was presented by Dr Shalander Kumar, Scientist, Dryland Systems in South Asia, Innovation Systems for the Drylands Program, ICRISAT-India and Dr Arun KC, CGIAR Research Program Climate Change, Agriculture & Food Security, CCAFS, New Delhi. Climate risk data was presented by Dr Dakshina Murthy, Senior Scientist - Systems Modeling, Innovation Systems for the Drylands Program, ICRISAT-India and team.

Multi-criteria analysis was used to prioritize CSA practices. Adoption barriers in terms of resource requirement, capacity and knowledge of extension agencies and farmers, social acceptability and policy constraints were also assessed for each prioritized CSA practice. The group also deliberated on incentives such as subsidies, credits and tax breaks to promote CSA interventions.

A diverse group of 60 researchers, scientists, policy makers, members from civil society and officials from various departments of Government of Telangana participated in the workshop organized jointly by Environment Protection Training and Research Institute (EPTRI), CGIAR Research Program on Climate Change, Agriculture and Food Security and ICRISAT. The two-day workshop was hosted by ICRISAT on 6-7 December.
This workshop was attended by participants from: Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad; PJ Telangana State Agricultural University (PJTSAU), Hyderabad; National Bank for Agriculture and Rural Development (NABARD); Telangana state departments of agriculture, horticulture and animal husbandry; State Seed Corporation (SSC); National Seed Corporation (NSC), Ground Water Department; State Co-operative and Marketing Federation (MARKFED); State Warehousing Corporation and Rural Development; District Water Management Agency (DWMA); Non-governmental organizations such as Dhan; Watershed Support Services and Activity Network (WASSAN) and South Asia Consortium for Interdisciplinary Water Resources Studies (SaciWATER).

Among the dignitaries present were: B Kalyan Chakravarthy, Director General, EPTRI, Dr V Praveen Rao, Vice Chancellor, PJTSAU, Dr Peter Carberry, Deputy Director General, ICRISAT and Dr Anthony Whitbread, Program Director, Innovation Systems for Drylands, ICRISAT.

For more information on ICRISAT’s work on climate change click here.
Training workshop on agricultural forecasting tool

At a recent workshop participants were trained on how to reliably simulate crop yields over space, and use aggregated forecasts to improve food security on sub-national to national scales using the CCAFS Regional Agricultural Forecasting Toolbox (CRAFT). CRAFT is a computer based decision support system to forecast short- and long-term crop yield and to analyze agricultural risks. During the workshop, participants were shown how to generate soil, weather and observed data and import the data into CRAFT. Expertise in Geographic Information System (GIS) is a pre-requisite to use CRAFT which is a challenge for many users. Therefore, to make it user friendly, the workshop discussed on adapting Quantum GIS (QGIS) or R functionalities to automate data preparation. Participants reported bugs while using CRAFT and these inputs were utilized in fine tuning the software.

The workshop discussions also aimed at using CRAFT as a benchmark for yield prediction in West Africa. “CRAFT not only provides an attractive software platform to investigate model complexity tradeoffs in spatial yield forecasting, it also learns from, and builds upon existing modeling skills and priorities in the region. As such it will help foster partnerships that increase the reliability and granularity of yield forecasts, and will thus help strengthen food security at coarser scales, and the delivery of farm support services into the last mile,” said Dr Pierre Sibiry Traore, Head GIS, ICRISAT-Mali and Project Leader, Capacitating African Smallholders with Climate Advisories and Insurance Development (CASCAID).

Commencing on 28 November, the two-week long workshop was organized at University of Florida, USA. It brought together West African resource persons to fine tune CRAFT using historical reference data from Mali’s cotton growing belt. Nine participants representing the Agrhyemet Regional Centre, University of Bonn, Germany, University of Florida and ICRISAT took part in the training. For more information on CRAFT click here For information on ICRISAT’s work on climate change click here

CRAFT is a framework for running multiple crop simulation models under a unified user interface and spatial aggregation of the simulated results into interactive thematic maps. Running on gridded data sets, CRAFT requires spatially continuous weather, soil and agricultural management inputs. CRAFT utilizes merged weather data sets developed by the National Meteorological Agency of Mali under the ENACTS (Enhancing National Climate Services) initiative with crop masks and crop type maps produced by ICRISAT and partners under the Sentinel-2 Agriculture project. CRAFT was developed in partnership with Washington State University, the University of Florida, and by Asia Risk Centre (ARC), a sister company of Risk Management Solutions (RMS) Inc.

Projects - Capacitating African Smallholders with Climate Advisories and Insurance Development (CASCAID); Agricultural Model Inter-comparison and Improvement Project (AgMIP); Sentinel-2 Agriculture (Sen2agri); Climate Change, Agriculture and Food Security (CCAFS).

Investors - CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); UK Aid; European Space Agency.

Partners - CCAFS; Washington State University, USA; University of Florida, USA; Asia Risk Centre (ARC); Agrhyemet Regional Centre, Niger; International Research Institute on Climate and Society (IRI), Columbia University, USA and ICRISAT.

CGIAR Research Program - Climate Change, Agriculture and Food Security (CCAFS).