Finger millet formalized as a mandate crop in ICRISAT’s research portfolio

Finger millet \( \text{(Eleusine coracana (L.) Gaertn.)} \), which figured among the six small millets in ICRISAT’s research portfolio, has now been formally made a mandate crop. This decision was taken at the recent Governing Board meeting. This is an important recognition for a crop which has been an integral part of the institute’s research portfolio.

The high nutritive value of finger millet coupled with its ability to thrive under low rainfall and poor soil fertility makes it a ‘climate smart’ crop. The ICRISAT genebank holds nearly 6,000 finger millet germplasm accessions from 24 countries, conserved for use in research and development.

Among the projects that focus on finger millet, the Harnessing Opportunities for Productivity Enhancement of Sorghum and Millets in Sub-Saharan Africa and South Asia (HOPE) project funded by the Bill & Melinda Gates Foundation is showing encouraging results in improving productivity of finger millet and household incomes in East Africa. This was achieved by enabling farmers to adopt improved varieties and associated agronomic practices and linking producers to both input and product markets.

In Malawi, the introduction of three finger millet varieties highly valued by farmers is expected to resurrect a crop that had ‘disappeared’ from the southern region of the country. Farmers wanted access to seeds of Gulu E, ACC 32 and KNE 1124 varieties, so that they can start growing the crop again (http://www(icrisat.org/newsroom/latest-news/happenings/happenings1677.htm#1).

At a recent field day in Kenya, the Kenya Agricultural and Livestock Research Organization and ICRISAT displayed six elite varieties of finger millet for participatory varietal selection by farmers. Finger millet variety U15 was the most preferred for its early maturity and grain color, while IE 3779 was preferred for its resistance to blast disease and tolerance to lodging (http://www(icrisat.org/newsroom/latest-news/happenings/happenings1687.htm).

Through a multi-institutional collaboration, ICRISAT scientists in ESA have generated a whole genome sequence of finger millet. This opens a new chapter in future breeding of this nutritious crop.
Designing robust intervention strategies to improve resilience of smallholder farmers

To better integrate knowledge across disciplines in order to devise higher impact strategies for constrained farming systems, a workshop on systems analysis of smallholder agriculture was held in Niger recently.

The use of systems analysis, encompassing the biophysical and socioeconomic makeup of farm households, requires a range of computer based tools to capture some of the complexities of mixed farming systems and help researchers devise robust intervention strategies which can more effectively lead smallholders out of poverty.

Farm households operate in environments with high climatic variability and are highly heterogeneous with multiple constraints of labor, capital and access to resources. Interventions like these are important because in the resource-constrained mixed farming systems prevalent in the semi-arid tropics, understanding what interventions result in benefits to farm households in terms of improvements in food security and income is not an easy task.

Sharing his experience, Dr Bright Salah Froduah from the University of Ghana, said that the skills he learnt have equipped him to design new farming systems and undertake ex-ante analysis of technology on resource constraints and adaptation to changing climate.

The workshop had two concurrent sessions. The advanced course on crop modelling with the Agricultural Production Systems Simulator (APSIM) was led by former ICRISAT staffer, Dr John Dimes. Dr Ian Watson from Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia and Dr Cyrille Rigolot from National Institute for Agricultural Research (INRA), France, led the session with a team using the Integrated Assessment Tool (IAT) which combines outputs from a range of models and expert knowledge to gain enhanced understanding of bio-economic behavior of mixed smallholder systems.

The hands-on training course from 21-25 September had 20 participants from west Africa representing staff from Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), National Agricultural Research and Extension Systems from several countries, ICRISAT and other CGIAR centers. ICRISAT was represented by Dr Malick Ba, Senior Scientist - Entomology (Grain Legumes / Dryland Cereals) and Country Representative, Niger. Dr Vincent Bado, Principal Scientist – Dryland Systems and Livelihood Diversification (Resilient Dryland Systems), organized the workshop. Dr Anthony Whitbread, Director, Research Program - Resilient Dryland Systems initiated the workshop. The workshop was funded under CRP Dryland Systems and capacity development was by ICRISAT.

A follow-up workshop titled ‘Modern tools for systems analysis and modelling’ will be held at ICRISAT headquarters from 30 November to 3 December. The workshop was organized by ICRISAT and partners from CSIRO, International Center for Agricultural Research in the Dry Areas, and the Center of Excellence for Dryland Agriculture, Chinese Academy of Agricultural Sciences, China.

Finger millet formalized...from page 1

In the Indian state of Karnataka, finger millet is among the ‘climate smart’ crops that figures high on the agenda of the government.

http://www.icrisat.org/newsroom/latest-news/happenings/happenings1664.htm#1

Along with its partners, ICRISAT is targeting commercial production of finger millet, diversification of household-level diets, value addition and processing for food, feed and industry. Efforts are being made to pilot and incubate small and medium entrepreneurs from among the farmer groups and individuals to develop products for the market.

Finger millet facts

- Rich in fiber, iron and calcium (contains 40 times more calcium than maize and rice, 10 times more than wheat and 3 times more than milk).
- Plays an important role in both the dietary needs and incomes of many rural households in eastern and southern Africa and South Asia.
- Accounts for about 12% of the area under millets globally.
- Cultivated in more than 25 countries in Africa and Asia, predominantly as a staple food grain.
- Major producers are Uganda, Ethiopia, India, Nepal and China.

Read more on finger millet: http://exploreit.icrisat.org/page/small_millets/875
Global atlas helps close yield gaps

To help agricultural researchers and policy makers prioritize their efforts to sustainably intensify agricultural systems, the Global Yield Gap and Water Productivity Atlas (http://www.yieldgap.org/) that provides location specific information is a valuable tool. It helps breeders and agronomists evaluate the effectiveness of existing crop management practices and figure out agricultural inputs and management interventions that are needed to close the yield gaps for different crops in various countries.

To meet the growing food and feed demand, sustainable intensification of agricultural production on existing farm lands is critical. Expanding the area under cultivation may not be the best option to achieve this, as it increases greenhouse gas emissions and has a negative impact on biodiversity. “The Global Yield Gap Atlas project is providing a robust spatial framework based on climate, soil and cropping system to target interventions and plan initiatives that have the biggest potential impacts,” said Dr Lieven Claessens, Senior Scientist – Natural Resources, ICRISAT.

The project has been working with agronomists in various countries in Africa, Latin America, North America, South Asia, East Asia, Middle East, Oceania and Europe to collect site specific data on yield potential and yield gaps of various crops (maize, wheat, rice, sorghum and millet). This project was initiated in 2012 to improve yield potential/yield gap estimates for all major crops in the world. ICRISAT works with poor farmers in low-input agricultural systems that are often characterized by large yield gaps.

At a recent project review meeting, participants explored opportunities for using the yield gap data to support agricultural initiatives. Participants gave presentations on their findings on current yield gaps for the various crops, production capacity and water productivity in key target countries. Results from the Global Yield Gap Atlas provide important information on the capacities for various countries to be self-sufficient in staple food crop production now and in the future.

“For now the spatial framework is solely based on biophysical conditions, and we know that adoption of improved technologies does not depend only on biophysical factors. So the next step is to add socioeconomic information like access to input and output markets, farm size, labor availability and off-farm income to better characterize farming systems,” Dr Claessens added.

The project team met on 22-24 September, in Addis Ababa, Ethiopia for the review meeting. For workshop presentations: http://www.yieldgap.org/web/guest/workshop-ethiopia-2015

Global Yield Gap Atlas Project team members have been working with the farmer (L) to increase maize yields with higher quality of protein. He grows maize, sorghum and tef on his 6 ha farm in the Ethiopian highlands.

Recognition

A recent paper that analyzes the publication output of India on cereal crops as reflected by its coverage in Indian Science Abstracts (ISA) and CAB Abstracts during 1965-2010, mentions the following research outputs of ICRISAT.

▪ Only five out of top 25 prolific institutes have achieved RCI more than 1. Among these ICRISAT had the highest RCI (4.46) followed by IARI (1.57), New Delhi.

▪ Dr RK Varshney’s research paper has been ranked the No.1 paper among the Highly Cited Papers and research papers of other scientists were also ranked among the highly cited papers.

▪ Dr KN Rai and Dr HC Sharma were ranked among the top 10 highly productive authors. Dr Rai was ranked at 5th position and Dr Sharma was ranked at 13th position.

▪ Dr HC Sharma of ICRISAT had the highest value of Citations Per Paper.

The paper titled ‘Scientometrics of cereal crops research in India as reflected through Indian Science Abstracts and CAB Abstracts during 1965-2010’ was authored by Tripathi HK, Sharma Jaideep and Garg KC.

The Indian state of Odisha is speeding up plans to replicate the holistic approach as proven by ICRISAT’s Bhoochetana project in Karnataka. Mr Rajesh Verma, Principal Secretary, Department of Agriculture, Government of Odisha, met the ICRISAT Development Center team and discussed about initiating soil health tests and other natural resource management interventions in Odisha.

Mr Verma reviewed the three projects, for pigeonpea, groundnut and chickpea, which are being supported by the Government of Odisha. The thrust of the review meeting included: Promotion of improved cultivars and production technologies; seed system development; and capacity building of farmers.

Following were the major points discussed during the review:

**Groundnut**

*Interstate seed multiplication:* The seed multiplication ratio in *kharif* (rainy) season is very low (1:5) and consequently the quantity of certified seed produced is low. Further, the seed from *kharif* season planting has to reach the farmers for *rabi* (postrainy) season in a short window of two weeks. *In situ* germination results in poor performance of *kharif* harvested seed. Therefore, it was proposed to look at opportunities of taking up certified seed multiplication in neighboring states to supply seeds for *rabi* season in Odisha.

*Mechanized harvesting:* Groundnut harvesting is labor intensive and this increases the cost of production. Therefore it was proposed to introduce mechanized harvesting during the next season on pilot basis and depending on its success, mechanized harvesting would be expanded to larger areas.

*Seed storage:* In *rabi* season, the seed multiplication ratio is 1:8 in Odisha and can go as high as 1:15. To capitalize on this it was proposed to store seed for 6-7 months for planting in the next season. Use of large-scale seed storage facility with dehumidifier belonging to the Odisha State Seeds Corporation will be explored. For farmer-level seed storage Purdue Improved Crop Storage (PICS) triple layer bags will be introduced on a pilot scale during *rabi* season. Earlier PICS bags were successfully tested by ICRISAT in Anantapur district of Andhra Pradesh to store groundnut seed for 6-7 months.

**Pigeonpea**

*New lines for release:* Hybrid ICPH 3762 is the first pigeonpea hybrid released in the state in 2014. New early duration varieties and hybrids for central Odisha and medium duration varieties for south western regions of the state are slated for release within the next two to three years.

*New areas:* From 2015-16 the project has been expanded to three new districts – Ganjam, Gajapati and Suvarnapur. Earlier during 2011-2015 high yielding varieties and hybrids were popularized, improved crop management technologies demonstrated and seed systems established in Kalahandi, Rayagada, Nuapada, Bolangir and Boudh districts of the state.
Chickpea

Sale of green plants by the farmers: This was identified as a major problem in developing a seed system for chickpea in Odisha. Mr Verma suggested that breeder seed to foundation seed production should be undertaken at government farms and progressive farmers should be involved in production of certified seed to the extent possible. He also suggested that the procurement price of chickpea seed from farmers should be announced in advance to prevent sale of green plants.

Suitable varieties to be identified: Varieties under farmer participatory varietal selection trials in neighboring states will be evaluated and varieties suitable for Odisha identified.

Seed storage: ICRISAT to supply 100 PICS triple-layered 50 kg and 100 kg bags to farmers at project locations to test their efficiency.

Work plan for chickpea

A detailed work plan meeting for chickpea was held as the cropping season begins this month end. The Principal Secretary proposed allotment of more area under seed production to meet the chickpea seed requirement of the state. He offered that the area under Government Agriculture Farms can be utilized for chickpea seed production mostly from breeder seed to foundation seed. In the meeting it was planned to take up seed production in 390 ha during 2015-16 rabi season, out of which 300 ha would be for foundation seed to certified seed and 90 ha for breeder seed to foundation seed. The varieties selected for seed production are JAKI 9218, Nandyal Sanaga-1 (NBeG 3), and Ujjawal.

The other members of the state-level delegation included: Mr Sarojkanta Das, Deputy Director of Agriculture (Pulse); Mr Nimai Charan Swain, State Consultant, Rashtriya Krishi Vikas Yojana (RKVY) Cell; Mr BK Dey, Agronomist, RKVY Cell; Mr RK Panda, Deputy Director of Agriculture, Keonjhar; Mr Kedarnath Mohapatra, Deputy Director of Agriculture, Sundargarh; Mr A Andia, Asst Agriculture Officer, Sundergarh; and Mr Sarat Kumar Tripathy, Consultant, ICRISAT.

The Principal Secretary also met Dr David Bergvinson, Director General, ICRISAT, and discussed the ongoing and future potential collaboration of ICRISAT with the Government of Odisha for enhancing agricultural production and farmers’ incomes in Odisha.

Projects:

- Promotion of improved chickpea varieties in rice-based cropping systems of smallholder farmers in Odisha
- Introduction and expansion of improved pigeonpea production technology in rainfed upland ecosystems of Odisha
- Scaling-up of improved groundnut varieties through established seed system in various cropping systems of smallholder farmers in Odisha

Investor: Department of Agriculture, Government of Odisha, India

CGIAR Research Program: Grain Legumes

Partners: Department of Agriculture, Government of Odisha; Orissa University of Agriculture and Technology, Bhubaneshwar; Odisha State Seeds Corporation.

Officer, Sundergarh; and Mr Sarat Kumar Tripathy, Consultant, ICRISAT.

Photos: PM Gaur, ICRISAT

Farmers at a participatory varietal selection trial in a chickpea plot.
Strengthening capacity within CGIAR to measure project impacts

To develop advanced skills and knowledge for measuring impacts in agricultural research programs a week-long capacity building workshop on Advanced Methods in Impact Assessment was attended by scientists from several CGIAR centers. “The multi-center training workshop brought together social and biophysical scientists from CGIAR centers including ICRISAT, ICRAF, CIP, ICARDA, IITA, CIFOR, Bioversity, World Fish, Africa Rice and IFPRI,” said Dr Kizito Mazvimavi, Head, Impact Assessment Office, ICRISAT.

The topics covered at the workshop included randomized control trials as well as non-experimental methods of measuring impacts. During the workshop, the participants had a chance to develop and refine proposals for three research grants worth up to $11,000 each, offered by University of Illinois at Urbana-Champaign and CGIAR Standing Panel on Impact Assessment (SPIA). The aim of the research grants is to promote the implementation of the assessment methods learned in the workshop.

Organized by the CGIAR SPIA, in collaboration with ICRISAT and the University of Illinois at Urbana-Champaign, the goal of the workshop was to raise the standards of impact assessment approaches and promote their application by social and biophysical scientists from CGIAR centers.

“ICRISAT brought in mentors from the University of Illinois at Urbana-Champaign, USA, to train a new generation of practitioners at ICRISAT and partner institutes to develop advanced skills and knowledge in measuring impacts in agricultural research programs,” added Dr Mazvimavi.

“This initiative will build on earlier efforts on capacity building of both social and biological scientists at ICRISAT and its partner institutes. With key mentors from the USA, this workshop has been a unique opportunity for intergenerational knowledge and skill transfer on methods for ex-post impact assessment to the contemporary community of practitioners,” he added.

Plant phenotyping training course

A week-long training on high-throughput phenotyping methods offered an opportunity for participants to know about different phenotyping sensors and their application in crop improvement.

The course discussed and demonstrated multiple and diverse aspects of plant phenotyping, covering the cell to whole plant scale, including growth-related, as well as physiological and performance-related plant traits. The sessions provided hands-on training on measurement of phenotypic traits by using simple and advanced imaging techniques and image analysis.

The use of image analysis software has direct application in ICRISAT’s data analysis work, while several physiological techniques like leaf water potential measurement, soil water content and leaf gas exchange measurements can be applied for enhancement of phenotypic trait measurements. Root phenotyping techniques and analysis software like Smart root, EzRhizo, Root tracer, are tools that can enhance the work in root phenotyping.

A poster titled “QTLs for water saving and vigor traits in “QTL-hotspot”: New opportunities for enhancing drought tolerance in chickpea” based on the results produced as part of ICRISAT’s high throughput crop phenotypic platform (LeasyScan) activities was presented by Mr Sivasakthi K, Research Scholar, Crop Physiology Lab, ICRISAT.

The training titled, “Practical Course on Insights into Plant Biological Processes through Phenotyping” was held on 13-19 September at Belgium, and was organized by the European Molecular Biology Organization and the Department of Plant Systems Biology, VIB-University of Ghent, Belgium.
Recent analysis of long-term studies on the dynamics of rural poverty in Bangladesh has revealed surprising fluctuations in the incidence of rural poverty over the past three decades.

A team of researchers in Bangladesh – who currently partner with ICRISAT in the VDSA project – found that while the poverty head count ratio fell from 62% to 44% between 1988 and 2004, it rose to 45% between 2004 to 2008. With a rural population of 109 million this means an additional 13 million people fell into poverty between 2004 and 2008.

However, more recent analysis of VDSA data shows a steady recovery and reduction in poverty between 2009 and 2013, with average per capita income increasing 2.4 times during that period.

**Increased income with increased poverty levels**

The first set of findings which covered 62 villages were included in a paper titled: Did the commodity price spike increase rural poverty in Bangladesh? This study found that prior to the global crisis in commodity markets in 2007-2008, Bangladesh had enjoyed two decades of relative success in reducing rural poverty.

From 1988 to 2004 the percentage of rural households below the poverty line fell from 62% to 44%, a reduction that was associated with a shift towards non-farm employment. However, the surge in commodity prices in 2007–2008 and the resultant higher prices in food staples such as rice increased the poverty incidence to 45% and pushed millions below the poverty line.

During the period 2004-2008 the per capita income continued to rise to a rate of nearly 15% per year with the average per capita income increasing from US$264 to US$417. Yet at the same time food prices rose dramatically with the poverty threshold growing at an average annual rate of 10%. This helps to explain the paradox where farm income increased yet at the same time higher food prices harmed the consumers and actually increased poverty levels.

Analysis of more recent VDSA data by ICRISAT which monitors 500 households in 12 villages across the country has shown a steady increase in per capita income since that period with income increasing from US$186 in 1988 to US$445 in 2013. There has been a marked increase in dependence on non-farm sector income along with a greater use of modern technologies and financial and capital infrastructure: the expansion of irrigation facilities, adoption of modern varieties, access to agricultural credit, improved market access through better roads and transport infrastructure and increased educational attainment.

“Basically the two studies show the same result that agricultural technologies and agricultural research have the power to reduce the poverty level,” says Dr Uttam Deb, Principal Scientist, Economics, RP-Markets, Institutions and Policies, ICRISAT. “While it is necessary to raise household incomes - the essential condition for reduction of poverty is to have a lower level of real prices in agricultural commodities. You will only be able to achieve that through introduction of improved agricultural technologies which will achieve a reduction in per unit cost of production.”

The paper ‘Did the commodity price spike increase rural poverty in Bangladesh?’ was recently awarded the ‘2014 Best Paper Award’ at the International Conference of Agricultural Economists in Milan, Italy.

**Reference**

- Uttam Deb, Cynthia Bantilan, Soumitra Pramanik and Patan Elias Khan, Poster on “Dynamics of Rural Livelihoods and Poverty in Bangladesh”, ICRISAT March 2015.
India Citation Award 2015 awarded to Dr Rajeev Varshney

Dr Rajeev Varshney, Research Program Director and Director, Centre of Excellence in Genomics (CEG), ICRISAT, has been awarded the Thomson Reuters Research Excellence - India Citation Awards 2015. This award recognizes professionals for their research excellence that has influential contribution to global R&D. The India Citation Awards review scientific research citations within Web of Science – a premier global search and discovery platform – to identify most influential researchers in the country.

“I dedicate this award to my colleagues and collaborators from ICRISAT and other organizations with whom I got an opportunity to work on challenging projects,” said Dr Varshney on receiving the award. He added, “I am thankful to my colleagues, collaborators, friends, well-wishers, teachers and my family.”

Dr Chandra Madramootoo, Chair, Governing Board, ICRISAT, congratulated Dr Varshney saying, “This is a great honor and we are proud of you.” Dr David Bergvinson, Director General, ICRISAT said, “The award is a recognition of the scientific rigor, research excellence and high quality research that we follow as individual scientists and at the organization level.”

“India has always been an important contributor to the global research output. The Thomson Reuters India Citation Awards aims to encourage and celebrate excellence in research by objectively identifying highly impactful work,” said Mr Arvind Pachhapur, South Asia Head, Legal, IP & Science Business, Thomson Reuters.

Dr Varshney has made it to the Highly Cited Researchers List for the second time. He was also on the 2014 List. The list features the top 1% researchers who have made an impact on science and research at a global level (http://highlycited.com/).

The awards were presented at a ceremony in New Delhi on 18 September.

New publications

Common beans: Benefits for farmers engaging in market-oriented production

Authors: Miguel M, Mwakiwa E, Sambule N, Kee Tui SH, Rainde JO, Coma GP and Manda D
Published: 2015.
Abstract: In areas like Dororo, in Manica district, Central Mozambique, commercialization of common beans (Phaseolus vulgaris L.) is one of the most important strategies for farmers to improve their livelihoods. Young farmers and women especially invest in common beans as a way to build their assets and secure their family needs. Engaging in an Innovation Platform (IP), these farmers have learned that they can benefit more from common beans. Combined with draft power animal management this has increased productivity and production of common beans. They now collectively decide at what time they would sell their produce and at what price, expecting 50% higher revenues than what they would get by selling individually. This leaflet illustrates common bean production and market practices generated through demonstrations in the MOREP project. They are useful for farmers in similar environments like in Manica district. (This flyer is also available in Portuguese.)
http://oar.icrisat.org/9024/

Sustainable intensification of smallholder farming in central Mozambique: Benefits from better integration of crops and livestock

Authors: Rainde JO, Kee Tui SH, Vilela P, Quembo C, Assane F, Gule C, Senda T and Masikati P
Published: 2015.
Abstract: The Government of Mozambique gives particular importance to strategies for sustainable intensification of agriculture in the smallholder-farming sector, accounting for more than 95% of the total agricultural land. Better integration of crops and livestock is key to sustaining vital smallholder farming, rewarding higher agricultural production and improving the overall wellbeing of smallholder farms, especially in provinces like Tete and Manica, with high potential for crops and livestock. This leaflet illustrates the benefits from better integration of crops and livestock. We describe forage production and draft power animal management as two complementary technologies critical for sustainable intensification of smallholder farms, demonstrated in the MOREP project. These technologies are useful for farmers in similar environments like in Tete and Manica provinces. (This flyer is also available in Portuguese.)
http://oar.icrisat.org/9025/