Crop diversification with grain legumes improves resilience of cropping systems

Intercropping with grain legumes is one of the key strategies to improve productivity and sustainability of rainfed agriculture in four Asian countries – India, Nepal, Laos and Vietnam. Through farmer-participatory field trials, the productive intercropping options identified to intensify and diversify rainfed cropping systems in these regions were:

- Groundnut with maize in Laos, Nepal and Vietnam
- Pigeonpea with maize in Nepal
- Pigeonpea with soybean in Madhya Pradesh, India

Some of the other initiatives being implemented are ridge planting systems; seed treatment; Integrated Pest Management (IPM); adoption of improved crop varieties and production technologies; promoting community-based seed production groups and market linkages.

Major achievements during the year

Vietnam: Small farmers were linked with a local seed company in Cao Bang province. The farmers produced 400 tons of groundnut which was procured by a seed company. As a result the farmers obtained an additional US$ 75,000 in total income as compared to selling it in the local market on their own.

Laos: Chickpea and pigeonpea were the new legume crops introduced. Also cultivation of groundnut in the dry season led to increase in the yield of wet-season rice by up to 50% giving an additional income of about US$ 614 per household.

Nepal: Seed treatment with molybdenum (Mo) enhanced lentil yield by 25-30% and the IPM for pod borer gave up to 50% increase in chickpea yield. Twelve Community-Based Seed Production (CBSP) groups were also established.

India: Seed treatment of chickpea with Mo, enhanced yield by 22-25% in Mo-deficient soils in Madhya Pradesh. Planting of pigeonpea on ridges with a spacing of 75 cm between ridges and 30 cm between plants prevented waterlogging and gave up to 27% higher yield when compared to flat sowing in control plots.

Other activities

Pest Management: In Nepal and India, farmers were demonstrated the effects of seed treatment with Trichoderma spp and fungicides for managing seedling diseases and IPM options for controlling pod borer in chickpea and pigeonpea.
Community-based seed production groups particularly with women: In all the countries, efforts are being made to enhance adoption of improved crop varieties and production technologies by conducting demonstrations/farmers’ acceptance trials (FATs) and promoting community-based seed production groups. Self-help groups (SHGs) with good representation of women and in some regions women SHGs were formed and engaged in seed production and value addition activities. For example, during 2014-15 in Jharkhand, seed production of chickpea was undertaken by 55 SHGs, groundnut by 62 SHGs and pigeonpea by 177 SHGs.

Agribusiness ventures with women

The project encouraged farmers, particularly women, through SHGs to start small-scale local business ventures with value-added farm produce. In Jharkhand, women farmers were provided with 12 dal mills/huller machines to make dal (split gram) and flour from the legume crops they produced. The products were used for their own consumption aiding nutritional security and the surplus was sold in the local market to gain additional income.

Capacity building: Various activities (formal and informal training, field days, farmers’ fairs, exposure visit of farmers to other locations, programs in electronic media, farmer-friendly literature, etc.) are being used to improve knowledge of farmers and extension personnel on improved crop varieties, integrated crop management, seed production, seed storage and value additions.

The project

These results were highlighted at the Third Annual Review and Planning Meeting of the project – Sustainable management of crop-based production systems for raising agricultural productivity in rainfed Asia – held from 27 to 29 May at ICRISAT-India. The four-year project started in 2012-13 is working closely with IFAD-loan projects in the aforesaid countries and aims to benefit at least 40,000 farmers in each project directly from project innovations. The target geographies of the project are Jharkhand, Madhya Pradesh and Rajasthan states of India, northern and southern parts of Laos, western mid-hills of Nepal, and Ha Tinh and Cao Bang provinces of Vietnam.

Dr Vincent Darlong, Country Program Officer, IFAD Asia and Pacific Region participated in the meeting. At the closing session Director General, ICRISAT, Dr David Bergvinson emphasized on including learnings from the project in development of country strategies. Partners made presentations of the progress made at their locations and Dr Pooran Gaur, Assistant Research Program Director, Grain Legumes, ICRISAT, and project coordinator presented the major achievements for the year 2014-15.

Partners

India: Jharkhand Tribal Development Society, Mitigating Poverty in Western Rajasthan (MPOWER) program, Birsa Agricultural University, Rajmata Vijayeraje Scindia Krishi Vishwavidyalaya

Laos: Ministry of Agriculture and Forestry, Sustainable Natural Resource Management and Productivity Enhancement Project, Soum Son Seun Jai (Community-based food security and economic opportunities programme)

Nepal: Nepal Agricultural Research Council, Western Uplands Poverty Alleviation Program

Vietnam: Vietnam Academy of Agricultural Sciences, Programme for Improving Market Participation of the Poor, Developing Business with the Rural Poor Programme

Investor: International Fund for Agricultural Development

CGIAR Research Program: Grain Legumes

Crop diversification with grain legumes... from page 1

A farmers field day in Nepal.

Project areas in Vietnam, Laos, Nepal and India

Project partner Mr Vinoth Vansy (left) examining groundnut produce with farmers in Laos.
In the shoes of a private seed company

Rather than inviting companies to join our initiatives, ICRISAT senior management instead spent two days with the DuPont Pioneer sales force, breeders and agronomists, visiting the farming communities where they work closely with the farmers.

Collaborations were seen as important to take pearl millet hybrid breeding material to Africa and develop the seed industry there. Also identified were opportunities for partnerships, especially in areas such as mechanization and women empowerment, less addressed by the private seed industry.

“...There is already a long history of collaboration between DuPont Pioneer and ICRISAT. But we have to continually explore opportunities to collaborate...”

Dr Mahala
Director, Cotton and Millet, Multi Crop Research Center, DuPont Pioneer, India

The contribution of CGIAR Centers like ICRISAT in providing high-end science and germplasm was highly appreciated by Dr Rajendra Singh Mahala, Director, Cotton and Millet, Multi Crop Research Center, DuPont Pioneer, India, specifically from the perspective of the long-standing collaboration between ICRISAT and this seed company in pearl millet breeding. “We know the future contributions of ICRISAT and the CGIAR is dependent on developing collaborations with private industry, especially for adoption of technologies,” he said.

In India, DuPont Pioneer’s pearl millet hybrid - 86M11 currently dominates the summer market where high-input agriculture prevails in rotations after groundnut (kharif – rainy season) and potato or mustard (rabi – postrainy season). Bayer CropScience’s 9444 currently dominates in the high-temperature, saline regions. Significant genetic variability remains yet to be tapped in the pearl millet germplasm pool in India alone for both yield enhancement and yield stability (under biotic and abiotic stress), with average grain yield gains of at least 5-8% being realized with each cycle of hybrid release. During farmer field visits in Gujarat state of India, the team was shown millet farms that produced a massive 4t/ha and some even reached 6t/ha. This was achieved in farmers’ fields with high inputs, including water for irrigation. The farmers visited were working in extremely dry and harsh lands were making good profits from improved pearl millet hybrids and their diversified farming system.

Consumption of pearl millet is high in the region visited which the farmers indicated was because it is traditionally eaten and as they grow it, it is easily available. Yet, there is very low awareness of the nutritional value of pearl millet – with no knowledge that it is high in iron and zinc or what these micronutrients are or their importance for women.

On how to make a millet chapati – see video link

Gujarat farmers talking about nutrition in pearl millets (video link)
Walking the talk on environment

Not only is ICRISAT working alongside farmers to sustainably use land and water, but we also take it seriously to apply environmentally sustainable measures in-house. On this World Environment Day, we share a few initiatives undertaken over the years to address the land, water and energy management as well as biodiversity maintenance on site at our headquarters.

While the ICRISAT buildings, constructed to maximize natural light and air flow was a green initiative in the early 1970s, recent initiatives include installation of solar lights, groundwater recharge and wastewater treatment to irrigate crops in our research fields.

Farm based initiatives
There are several farm level green initiatives, that include,

- **Groundwater recharge** – In 2013, four groundwater recharge pits were constructed near the existing borewells that have improved the water levels.
- **Green manure** – Crop residues are shredded and applied on the fields, the land tilled and left fallow for at least a season, thus contributing to better soil health. Vermicomposting of organic waste is also carried out and used in the glass houses as well as in the fields.
- **Solar powered drip irrigation system** – A solar powered drip system was installed for AVRDC (The World Vegetable Center) to irrigate 1.5 ha as a pilot project.

Artificial lakes at ICRISAT are a source of irrigation and a nestling ground for migratory birds.

- **Afforestation** – The total area under green cover is about 170 ha, comprising of natural vegetation and orchards. This has helped improve the microclimate and the fruits from the orchards are a good source of revenue generation for the research facilities.
- **Artificial lakes** – The ICRISAT lake (64 ha), Suri Sehgal lake (14 ha) and Campus lake (6 ha) are rainfed lakes that are a major source of irrigation and absolutely vital for the entire field crop research. They also are great nestling grounds for a wide range of migratory birds.
- **Wastewater treatment plant** – A biological wastewater treatment plant was constructed across the Red tank lake for ICRISAT Development Center (IDC) to conduct experiments on reuse of sewage/polluted water after treatment by natural methods and use it for irrigating crops. The wastewater is from the residential colonies located adjacent to the ICRISAT campus.

Built environment based initiatives
Initiatives in the built-up area of the campus are several, and include:

- **Reduced power consumption** – The International School building on campus has been constructed with the green concept of maximizing natural light and natural air flow.
- **Recycling waste** – Paper waste from all offices are collected and sold, generating wealth from waste. The wealth generated thus, is used to support the ICRISAT Association for Community Development (IACD) activities which provides training for women in the local villages.

All areas of ICRISAT have over the years, contributed to building a sustainable environment. Scientists have led many initiatives while the management and FETS have contributed to building sustainability.

Mr Suresh Pillay
Manager, Engineering Services,
Farm, Engineering and Transport Services

"..."
The International School building embodies the ‘green’ concept. It is constructed to maximize natural light and air flow.

- **Rainwater harvesting** - Rainwater from roof tops is collected into two large underground tanks (2,060 kl) in the glasshouse area for research use. This was established in the mid 1990s and has helped reduce the annual cost of producing demineralized water (DM) by around ₹0.3 million.

- **Solar power on campus** – About 50 solar powered street lights have been installed as an initiative to use renewable energy and about 40 of these are installed in the international school area. In addition, most compact fluorescent lamp (CFL) and fluorescent lamps on campus have been replaced by LED lamps.

- **Off and on campus transport** – ICRISAT buses and car pool initiative provides transport for 75% of the staff, thus reducing the vehicular flow and pollution. Twelve bicycles have been purchased for the staff to use for movement within the campus.

**Future green initiatives**

- A proposal to set up a 1 MW solar power plant on campus to meet the energy requirements and cut down the use of diesel generators is in the pipeline. This will help reduce pollution and ICRISAT’s carbon footprint.

- Use of bicycle on campus can be further expanded for use to travel to the nearby fields by the field staff.

**ICRISAT celebrates World Environment Day**

About 50 solar-powered streetlights have been installed on the ICRISAT campus.

Eco-friendly transport.

Waste water treatment facility.
Using Land Resource Inventory data for planning watershed projects

Utilizing available Land Resource Inventory (LRI) data* in ‘net planning’ and detailed project report preparation was the main objective of a workshop on integrated watershed management held in Dharwad, Karnataka, India.

This was part of a workshop for the third phase of Sujala Watershed Program (Sujala-3). Dr Shivananda Murthy, Commissioner, Watershed Development Department, Government of Karnataka (GoK), emphasized that the Sujala-3 project should be more science-based and put to good use new technologies. Dr DP Biradar, Vice-Chancellor, University of Agricultural Sciences, Dharwad, in his concluding remarks highlighted the importance of partnerships and the consortium approach for watershed projects. He said that scientific institutions should work alongside farmers and not restrict themselves to research stations. Farmers’ representatives actively participated in the workshop and highlighted their needs in terms of training and net planning.

The workshop was conducted in partnership with University of Agricultural Sciences, Dharwad; Watershed Development Department, GoK and the ICRISAT team led by Dr Suhas P Wani, Director ICRISAT Development Center (IDC) comprising of Dr Raghavendra Rao Sudi, Manager, Watersheds (IDC), scientists Dr K Krishnappa and Dr Tapas Bhattacharyya.

Investor: Watershed Development Department, Government of Karnataka, supported by the World Bank Partners: National Bureau of Soil Survey and Land Use Planning (ICAR); University of Agricultural Sciences, Bengaluru, Dharwad and Raichur; University of Agricultural and Horticultural Sciences, Shimoga; Department of Horticulture (Government of Karnataka); College of Agriculture, Gulbarga; College of Horticulture, Bidar; Karnataka State Natural Disaster Monitoring Centre; Indian Institute of Sciences, Bengaluru; Karnataka State Remote Sensing Application Center; and ICRISAT for providing technical support for capacity building and productivity enhancement initiatives.

For more information on watershed management: http://exploreit.icrisat.org/page/natural_resource_management/899

Capacity building in rain gauge monitoring and ISFM

ICRISAT-Niamey organized three capacity building workshops – one on rain gauge reading and two refresher training sessions on Integrated Soil Fertility Management (ISFM) and farm field schools approaches in Mayahi and Matameye (Niger) recently. The workshops are part of the Catholic Relief Service (CRS) program for fighting malnutrition and food insecurity (PASAM-TAI ) in Niger funded by USAID. The training was conducted by Dr Fatondji Dougbedji as part as the CGIAR Research Program on Resilient Dryland Systems.

Planning ESA country strategies

ICRISAT ESA scientists are in the process of framing country strategies for Kenya, Ethiopia, Malawi and Zimbabwe. The overall goal is to improve productivity, profitability and utilization of ICRISAT mandate crops – sorghum, millets, groundnut, chickpea and pigeonpea in the region.

The country strategy workshop was held in Nairobi on 26 and 27 May. The representatives of the regions will refine their strategies following the discussions and will consult with stakeholders at the country level in the coming month.
Farmers assess sweet sorghum opportunity for biofuel

With ethanol production the most viable option for sugar mills facing depressed sugar prices, some mills are looking to use sweet sorghum to produce transport-grade ethanol in the sugarcane off-season. A consortium of researchers and sugar mills are working with the farming community in Telangana, Gujarat, Maharashtra, Pondicherry and Karnataka in India to take this to a new commercial level.

With sugar prices depressed to around ₹2,300 per ton for the past two to three years, the mill is expecting to make profits from ethanol rather than sugar, so they are pinning their hopes on developing a viable sweet sorghum ethanol value chain.

Crop improvement
“As a result of two decades of work, ICRISAT has helped augment the sugar percentage of sweet sorghum cultivars to 22% of soluble solids, and has improved the crop’s resilience to a range of environmental stresses” said Dr P Srinivasa Rao, Senior Scientist, Research Program – Dryland Cereals, ICRISAT.

“ICRISAT’s genetic improvement programs have focused on enhancing sugar content in the stalk, juice quantity and biomass of sweet sorghum. We have developed varieties as well as hybrids suited to rainy season and postrainy season cultivation, and have cultivars for tolerance to stem borer, shoot fly, grain mold, anthracnose, leaf blight, drought and salinity,” Dr Rao said.

Sweet sorghum also requires far less water than sugarcane – about 4,000 cubic meters/ha as opposed to 36,000/ha, according to Dr Rao.

Testing cultivars
Mixed cropping farmers near the Madhucon Sugar and Power Industries mill in Rajeswarapurum, Khammam district, Telangana, India, and researchers recently inspected a 1.5 acre (0.6 ha) trial of six sweet sorghum cultivars at 14 weeks. The trials will provide data on the viability of the crop for the farmers and the sugar mill.

“When the sweet sorghum is harvested at 18 weeks, the stalks will be crushed to extract the juice which the Madhucon mill will make into syrup as their distillery is still being established” said Dr Rao. “We will collect data on biomass yield, juice yield, sugar percentage and yield, and a small mill test will generate data on ethanol production, juice purity and fiber content.”

Next steps
About 5,000 farmers currently supply sugarcane to Madhucon Sugar and Energy Mill annually. The next step is a trial of 50 acres (20 ha) of sweet sorghum to be grown by 20-30 farmers. The farmers at the inspection said they were interested in growing sweet sorghum but were looking for evidence of the crop’s profitability compared to other cash crops such as cotton, chili and groundnut. They indicated they would sell both the sweet stalks and the grain to the sugar mill for ethanol production.

It is expected that 2,400 farmers will grow sweet sorghum in the sugarcane off-season, in April to November, to supply ethanol without the mills having to create significant new infrastructure.

Sweet sorghum has multiple uses:
- Fuel – Ethanol production (stalk and grain)
- Food – Cereal grain, syrup/molasses (grain and stalk)
- Feed – For poultry (grain)
- Fodder – For livestock (stalks and leaves)

Project: Commercialization of sweet sorghum as a complimentary feedstock for ethanol production in the sugar mills of Maharashtra, Tamil Nadu and Gujarat

Partners: Indian Institute of Millet Research, Jawaharlal Nehru Technological University – Hyderabad, the National Federation of Cooperative Sugar Factories Limited, and ICRISAT

Investor: Department of Biotechnology (DBT), Government of India

CGIAR Research Program: Dryland Cereals
Welcome

Mr Ram Kiran Dhulipala, an Indian national, has joined as Strategy and Operations Officer in the DG’s Office, on 1 June at ICRISAT-India. He holds a Bachelor of Technology (Electrical) degree and did his MBA (Systems and Finance) from Indian Institute of Management, Calcutta in 2011.

He brings with him 10 years of work experience and prior to ICRISAT was employed with Unisys Global Services (India) Private Limited, Bangalore as Program Manager (Business Operations & Analytics). He has rich experience in assisting CXO level members and good exposure in supporting Global Directors and CFO, interface/ liaison with Regional Directors & Regional Managers, Business operations and analytics, communication, Corporate Finance, Strategy, etc., as well as in process design / re-engineering and relationship management, managerial and operational support.

We welcome Mr Dhulipala to Team ICRISAT and wish him all success.

New project

Project title: Commercialization of sweet sorghum as a complimentary feedstock for ethanol production in the sugar mills of Maharashtra, Tamil Nadu and Gujarat

Principal Investigator: Dr P Srinivas Rao

Investor: Department of Biotechnology, Govt. of India

Aims: Sweet sorghum, similar to grain sorghum except for its juice-rich sweet stalk, is being grown for its food-feed-fodder and fuel value. Under Bio-Power strategy, ICRISAT has developed many sweet sorghum varieties and hybrids which have a sugar yielding potential of 2.5 to 4.0 t/ha. The National Biofuel Policy (NBP-2009), Govt. of India considers sweet sorghum as one of the potential feedstock adapted to marginal lands without effecting food security.

Currently, the sugar industry is in a crisis like situation as the sugar prices are very low. Hence, the industry considers the operational efficiency of sugar factories can be enhanced by using sweet sorghum for ethanol production. The market price for transport grade ethanol is favorable at ₹44. This new project tests the improved sweet sorghum cultivars for their adaptation in different sugar mill areas of India.

Further this project develops a productive sugarcane- sweet sorghum intercropping model for adaptation by sugarcane growers for enhancing their on-farm benefits. A large scale demonstration of sweet sorghum ethanol chain is planned including socio-economic analysis.

Readers’ Comments

I am very excited about the information contained in this newsletter. Small grains are an answer to food production in low rainfall areas. I am quite familiar with finger millet, not only because that’s what I eat almost exclusively, but also that my father-in-law has transformed the Gutu community, in Zimbabwe by getting the community to grow finger millet. Maize wasn’t doing well and more often than not people ended up with low yields and often failed to feed their families. All this changed when people were led back to finger millet. Drought tolerant crops are the way to go and we should find ways to promote their adoption in most of low rainfall Africa.

I was also quite enthused by the dry season groundnut in Nigeria. I would like to get more information on that. It’s a very interesting area, which can change the lives of smallholder farmers in Zimbabwe. Kindly let me know how it’s done and what key lessons we can pick from that in order for us to extend to Zimbabwe.

– Jimmy Shindi, Econet Services, Zimbabwe

I constantly look forward to receiving a copy of the Happenings and similar information materials from ICRISAT. Being global in its scope, I believe there is so much to learn and use from such technologies appropriate for our condition and situation in here!

I receive verbal and online feedbacks from our students in particular regarding the modern approaches i.e. systems and process, the Institute uses like genomics and the IMOD, which we hope we can successfully use and integrate in our institutional way of doing our researches for development for meaningful impact!

– Gilda Victoria B Jacalan, PhD, Director, University Public Affairs Office, Benguet State University,