

Inclusiveness for a prosperous and food secure drylands

ICRISAT
Annual Report 2013



Vision

A prosperous, food-secure and resilient dryland tropics.

Mission

To reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics.



Inclusiveness for a prosperous and food secure drylands

ICRISAT Annual Report 2013



**International Crops Research Institute
for the Semi-Arid Tropics**

About ICRISAT: www.icrisat.org

ICRISAT's scientific information: <http://EXPLORE/it.icrisat.org>

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Cover photo: Women in Chipata, Zambia shelling groundnuts in the company of friends and family. (S Sridharan, ICRISAT)



Photo: P. Rao, ICRISAT

Contents

Messages

- 4 Message from the Director General
 - 5 Message from the Board Chair
 - 6 Research for development highlights
-

Inclusiveness for a prosperous and food secure drylands

- 10 Watershed management transforms lives
 - 13 Just a small dose will do
 - 16 The power of Green SIM
 - 19 Regaining ground for Malawi's groundnut
 - 22 West Africa: Time-traveling through future climates
 - 25 Leading the way to rural development in the Sahel
-

About ICRISAT

- 28 ICRISAT Governing Board 2013
- 29 ICRISAT senior and collaborative staff members
- 33 New bilateral projects funded in 2013
- 36 Financial summary
- 38 Capacity strengthening
- 50 Publications
- 50 Workshops, conferences and meetings in 2013
- 51 ICRISAT Ambassadors of Goodwill
- 52 EXPLOREit@ICRISAT
- 53 Awards 2013
- 54 ICRISAT in the NEWS

Message from the Director General

Inclusiveness is at the core of what we at ICRISAT, along with our partners globally, do to improve the livelihoods of the people of the drylands – the poorest, the hungriest, and the most marginalized people in the world.

ICRISAT's target, the dryland tropics, is home to 2 billion people, 650 million of whom are the world's poorest of the poor, spread across 55 developing countries in Asia and sub-Saharan Africa. People of the drylands are constantly plagued by poverty, hunger, food and nutritional insecurity, and lack of empowerment. These regions are most vulnerable to climate change with very little rainfall, degraded soils and poor social infrastructure.

Being the only global agricultural research for development center focused on serving the dryland tropics, our commitment at ICRISAT is to put the people of these marginalized regions of the world first – empowering them to gain access to resources and to create opportunities, to lift their living standards, and to enable them to live fulfilling lives.

This 2013, we chose 'inclusiveness' as our theme – in the context of being both *a process and a goal*. In this report, we illustrate how we innovate to include the poor, and the many elements we consider in pursuing inclusive agricultural research for development.

Our inclusive strategy seeks to enable the dryland poor, particularly the women, to participate, rather than be sidelined, in the development process. Our stories of inclusiveness show how the poor and other marginalized sectors are included in building solutions – going past just interacting and asking them what they need, but truly partnering with and letting them take a real role, and a sense of ownership of the innovations.

We innovate to harness markets specifically to benefit the poor, carrying them from impoverished subsistence farming to prosperous market orientation. *We innovate*

to include – to bring innovative techniques that are suitable to small farm sizes with less resources, to millions of smallholder farming families in the drylands. *We include to achieve sustainable growth*, enabling them to manage the risks they face, until they are able to stand on their own, and become more resilient.

In this annual report, we highlight our 2013 research for development achievements, while reflecting on the "I" in our Inclusive Market-Oriented Development (IMOD) approach – the explicit goal to include the poor along the whole agricultural research for development (R4D) chain.

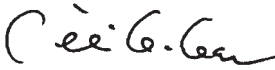
During the year, one of the highpoints of our activities was the visit of Mr Bill Gates, Co-chair of the Bill & Melinda Gates Foundation, to the ICRISAT headquarters for the first time, to gain a better appreciation of the foundation's R4D investments to the institute. During his visit, Mr Gates accepted to become the first ICRISAT Ambassador of Goodwill, to further champion our mission to reduce poverty, hunger, malnutrition and environmental degradation in the drylands.

We are proud to say that in the same year, we have been honored with the acceptance of Dr APJ Abdul Kalam, renowned scientist and 11th President of India, and Rt Hon James Bolger, former Prime Minister of New Zealand to be named ICRISAT Ambassadors of Goodwill, joining Mr Gates.

ICRISAT will continue to be heavily engaged in inclusive development, working along with the dryland poor as we strive to contribute to real improvements in their lives, as illustrated in the stories in this report. We will be fine-tuning our efforts and strategies, improving our effectiveness, and strengthening our partnerships.

"Inclusiveness" – a process and a goal – will always be at the core of our vision for a prosperous and food secure drylands.




William D. Dar
Director General

Message from the Board Chair

Globally, many people are excluded from development because of their poverty, gender, ethnicity, age, or disability. The effects of such exclusion are staggering and are deepening inequality across the world, particularly in the drylands – home to the world’s poorest and most marginalized people. The solutions can only be realized if all groups of people work together and contribute to create the opportunities, share the benefits of development, and participate in decision-making.

The year 2013 marked ICRISAT’s 41st year of existence, embracing the theme “inclusiveness.” As Chair of the Governing Board, I am very proud of ICRISAT’s commitment to *innovate to include*.

We believe that the eradication of poverty and hunger through sustainable and inclusive agricultural research for development (R4D) greatly depends on how we support the drylands, where many people depend directly upon a highly variable natural resource base for their livelihoods. We can also learn a lot from the people living in the drylands, as their strategies for resilience and their traditional and indigenous knowledge are a largely untapped resource.

Mainstreaming “inclusiveness” along the whole R4D chain will give windows of opportunity for the 2 billion people in the dryland tropics to escape from poverty and hunger. In this annual report, we have stories of innovations designed for the poor, and solutions built with the poor.

Some excellent examples featured in this annual report are: the fertilizer microdosing approach

– where smallholder farmers in ICRISAT’s target countries have refined the techniques for the application of small doses of fertilizer in the right place at the right time, combined with a warrantage system; the Green SIM story on appropriate knowledge and ICT tools for smallholder farmers; and regaining ground for Malawi’s groundnuts through crop improvement, affordable testing, and seed system.

Dr Kanayo Nwanze, President of the International Fund for Agricultural Development (IFAD), said “I have seen the miracles that take place when we give farmers the tools to enhance existing technologies,” when talking about ICRISAT’s microdosing program. This tool has tremendously impacted millions of smallholder farmers’ livelihoods in sub-Saharan Africa with dramatic improvements in yields.

This is just one example of how appropriate technologies and innovations can ensure that the benefits of AR4D reach the end users – in this case, the smallholder farmers – and when they are included in building the solutions they can claim their own.

The Governing Board will always be a constant source of guidance and encouragement to fuel the enthusiasm of the highly dedicated and motivated ICRISAT team – in a journey of inclusiveness, through change, growth, stronger partnerships, global recognition, and enhanced agricultural impacts for the benefit of the dryland poor of the world.



A handwritten signature in blue ink, appearing to read 'Nigel Poole', written over a white background.

Nigel Poole
Chair, Governing Board

Research for development highlights

The year 2013 was a rewarding and fulfilling year for ICRISAT in terms of scientific contributions and impacts on the lives of the smallholder farmers in the dryland tropics of Asia and sub-Saharan Africa.

Presented below are some of the highlights of the research for development (R4D) activities that ICRISAT accomplished during 2013, with Inclusive Market-Oriented Development (IMOD) as the unifying framework, under four strategic thrust areas: Resilient Dryland System; Markets, Institutions and Policies; Grain Legumes; and Dryland Cereals. ICRISAT is also leading two CGIAR Research Programs – Grain Legumes and Dryland Cereals, and is involved as a partner Center in five other CGIAR Research Programs on: Dryland Systems; Policies, Institutions and Markets; Agriculture for Nutrition and Health; Water, Land and Ecosystems; and Climate Change, Agriculture and Food Security.

Crop improvement

More than 905 advanced breeding lines/varieties developed by ICRISAT and partners were included in National Performance Trials to be evaluated for local adaptation and for possible release as improved cultivars for adoption by farmers. This is to make quality seed of improved varieties more available to farmers. ICRISAT and partners (NARS scientists and extension staff, including NGOs and farmers' groups), have also produced large quantities of breeder, foundation, certified and quality-declared/truthfully-labelled seed (total of 72,688.8 tons) for dissemination to the farming community.

During 2013, NARS partners have released five chickpea, one groundnut, and two pearl millet varieties using ICRISAT germplasm and/or breeding lines. Thirteen heat-tolerant pearl millet breeding lines were developed with high seed set at more than 42°C. Twelve ICRISAT pearl millet lines resistant to blast were made available to NARS breeders. Eight

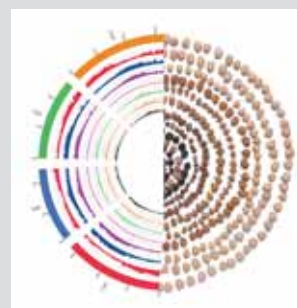
ICRISAT sorghum lines were developed with high biomass and resistance to lodging, and seven lines tolerant to shoot fly were developed.

Database on iron (Fe) and zinc (Zn) in sorghum germplasm

ICRISAT has evaluated a large number of landraces (2246), hybrid parents (>500 B-lines and 100 R-lines), breeding lines and commercial sorghum cultivars (67) over the years (2005 to 2011) for grain Fe and Zn concentrations and important agronomic traits. In 2013, a database on Fe and Zn concentration in sorghum germplasm was made available in the public domain (<http://hdl.handle.net/11038/10081>) for use by global sorghum researchers. For pearl millet, ICRISAT already released a publication in 2009 providing important agronomic traits for 99 designated seed parents (B-lines). This publication has been made available open access (http://ec2-50-19-248-237.compute-1.amazonaws.com/1330/1/157_2009_Morphological_Characteristics.pdf).

Genome sequencing of 90 chickpea lines

An ICRISAT-led global research team has completed high-quality sequencing of not one but ninety genomes of chickpea (Nature Biotechnology, 31: 240-246). The chickpea genome sequencing project was undertaken by the International Chickpea Genome Sequencing Consortium (ICGSC) led by ICRISAT, the University of California-Davis (USA), and BGI-Shenzhen (China) with involvement of key national partners in India, USA, Canada, Spain, Australia, Germany and the Czech Republic.



Germplasm conservation

ICRISAT is conserving 120,454 accessions in its gene banks in five countries across Africa and Asia – at its headquarters in India and its African locations in Zimbabwe, Malawi, Kenya, and Niger. A total of 6863 germplasm lines were distributed by the ICRISAT gene banks during 2013.

In 2013, ICRISAT shipped 104,000 germplasm samples to the Svalbard Global Seed Vault, Norway for conservation as a duplicate set of germplasm. This includes samples of sorghum, pearl millet, chickpea, pigeonpea, groundnut and six small millets.

Tropical Legumes II project

In Malawi's Mchinji area, the Tropical Legumes II project organized farmers into groups to receive start-up groundnut seed from ICRISAT to set up community seed banks, leading to the spread of improved varieties in the communities. In 2013, the activity is currently running in three districts and boasts of 174 seed banks with about 8,000 farmers.

In India, new chickpea and pigeonpea varieties have been adopted in several districts of Andhra Pradesh and Karnataka, replacing the old variety with improved cultivars. The project achieved 85% area replacement of old varieties with new ones in Rangareddy district of Andhra Pradesh, leading to a doubling of productivity – from 750 to 1500 kg/ha during the past 7 years with direct benefits to approximately 40,000 smallholder farmers. To date, the total legume seed produced by partners through the project stands at 222,531 MT.

HOPE (Harnessing Opportunities for Productivity Enhancement) project

In Maharashtra, India the HOPE project's five-point package of practices (*in-situ* moisture conservation, improved cultivars, wide row spacing, use of fertilizers and insect-pest management) with local partners has seen over 25,000



project farmers increasing sorghum grain yields by 35-52% and fodder yields by 27-34% in three years. A new seed consortium was also formed to develop a sustainable seed system for easy access and availability to farmers of improved sorghum seed for the post-rainy season. Growing dual-purpose post-rainy-season sorghum cultivars has provided farmers in the drought-affected Marathwada and Western Maharashtra regions with higher grain yields and better fodder quality and quantity.



Natural resource management

Phase 2 of the Bhoochetana (land rejuvenation) initiative in the state of Karnataka, India was launched in 2013. This followed the success of the first 4-year phase, a partnership between ICRISAT and the state government to help make small farms more productive, diverse and resilient to drought, using science-based, low-cost and sustainable solutions. This program is a good example of how to apply agricultural R4D to smallholder farms on a large scale.

Phase 2 aims at strengthening Bhoochetana's impact across rainfed and irrigated lands in the 30 districts of Karnataka, increasing yields by a further 20%. Despite poor rains in 2011, three million smallholder farmers across the 30 districts of Karnataka saw their yields increase up to 66%, bringing in extra profits of US\$ 130 million.

Gender research strategy

In 2013, gender integration into research has been formalized in a Gender Research Strategy. A few examples of ICRISAT's gender focus in R4D are: (1) Access to knowledge and income opportunities – in 2013, 49% of 3,764 farmers engaged in pigeonpea seed production under the Irish Aid-supported Malawi Seed Industry Development Programme were women, a 13% increase from the previous year; (2) Better understanding of women's role in family nutrition for better policies through the Village Dynamics Studies in South Asia (VDSA); (3) Training and participatory research for better family nutrition under the AnBeJigi project in Mali, where

women have adopted nutritious whole grain recipes using local produce, tested during collective cooking events; and (4) Adoption of improved crop varieties to ease women's workload, like the CG7 groundnut variety in Malawi, a bunch type that is easier to harvest than traditional spreading varieties.

Integrating nutrition

Integrating nutrition is an essential cross-cutting theme in ICRISAT's holistic approach to R4D. ICRISAT works with smallholder farmers to grow more resilient, nutritious and diverse food. Our R4D solutions in the fight against malnutrition include: development of micronutrient-rich biofortified crop varieties; appropriate grain preparation and processing to improve nutrition value in Mali; promoting the cultivation of legumes for a more diversified diet helps improve the family's nutrition in Malawi; and participatory aflatoxin awareness programs, and training in the management of and access to aflatoxin-resistant seeds in Mali.

In June 2013, world leaders came together to sign a global pact in the fight against malnutrition at the Nutrition for Growth Summit co-hosted by British Prime Minister David Cameron. ICRISAT's work with smallholder farmers to grow more resilient, diverse and nutritious food and the institute's focus on gender was featured in a photo slideshow published on BBC (<http://www.bbc.com/news/world-22820185>) in line with this historic event.



Impact assessment studies

Four impact assessment studies were completed in 2013. This included studies on: (1) Impact of fertilizer microdosing research and development in semi-arid Zimbabwe; (2) Impact assessment of Lucheba watershed management in China; (3) Assessment of the impact of improved pigeonpea research and development in Tanzania; and (4) Socio-economic impacts of groundnut research and development investments in Malawi. ICRISAT's impact assessment

studies aim to establish the contribution of the institute's R4D in achieving institutional outcomes – self-sufficiency, intensification, diversification, resilience, nutrition and health, capacity building and gender perspectives.

Agri-business incubation

In 2013, the Agri-Business Incubation (ABI) program under the Agribusiness and Innovation Platform (AIP) celebrated its 10th anniversary highlighting its success as a proven model in agribusiness incubation replicated in different locations in India, and scaled-up to a global level, especially in Africa and Asia, through partnership with various R4D agencies. To date, it has supported over 200 agribusiness ventures, benefited more than 500,000 farmers in Andhra Pradesh and neighboring states in India, facilitated the commercialization of more than 100 agro-technologies, and extended its handholding and mentoring services to 22 Business Planning and Development units set up under the National Agricultural Innovation Project (NAIP) under the Indian Council of Agricultural Research (ICAR).

More recently, ABI has taken its co-business incubation services to Africa, mentoring and handholding six value chain agribusiness innovation and incubation consortia spread across five countries in Ghana, Mali, Kenya, Uganda and Zambia. This is being done in partnership with the Forum for Agricultural Research in Africa (FARA) as part of the Universities, Businesses and Research in Agricultural Innovation (UniBRAIN) project.

ICRISAT's data management policy and implementation guidelines

In close sync with the CGIAR Open Access and Data Management Policy approved by the Consortium Governing Board in 2013, ICRISAT has developed a Data Management Policy to mainstream better data management, for quality data sharing and making it open access for public use. This policy promotes data management practices across the Institute and helps to bring in the required cultural shift among staff to share research data and make it open access for future use.

Increased use of Open Access data platforms

ICRISAT and partner scientists are making datasets available to the global community. Scientists upload their validated published and unpublished data into Dataverse platform. To date, 464 data files are available in Dataverse (<http://dataverse.icrisat.org/dvn/>). The archive is witnessing a gradual increase in usage. This archive complies with all modern protocols and identifier systems.

Scientific publications

ICRISAT has a strong scientific publication record (<http://oar.icrisat.org/>). In 2013, ICRISAT scientists produced 364 publications, which include 221 peer-reviewed journal articles (168 ISI/Thomson and 53

non-ISI/Thomson), 12 books, 54 book chapters and several others, giving an average of 2.75 publications per scientist (1.27 publications in Thomson Scientific Indexed journals per scientist and an average of 1.48 publications in non-Thomson Scientific Indexed journals). Management will continue to encourage all scientists to publish the results of their research in high quality journals in combination with open access outlets. ■



CL Laxmipathi Gowda
Deputy Director General - Research



Photo: S Sridharan, ICRISAT

Watershed management transforms lives

An inclusive and participatory integrated watershed management program has brought prosperity to the small rainfed village of Lucheba, China.



Village roads constructed through collective action

Until a decade ago, the steep slopes of the Lucheba watershed were hot spots of poverty and malnutrition. Agriculture in this rainfed area was a challenge for smallholder farmers, with scarce water supply compounded by degraded natural resources, low crop yields, and lack of access to roads and market.

Fast forward to 2013 – the watershed area is now covered with lush green vegetation. The old and dilapidated houses that once stood in the village square have been transformed into brand new concrete houses with big courtyards and gates, equipped with modern appliances and gadgets.

“We started using harvested rainwater for cultivation, and everything just changed,” said Mr Peng Fay Ou, a farmer with a one hectare landholding in the Lucheba watershed. With seven members in the family, he used to earn 3,000 RMB (US\$ 500) per year. Now his agricultural income has increased three folds, to 10,000 RMB (US\$ 1,650) per year, largely due to growing vegetables thrice in a year using harvested rainwater.

ICRISAT’s interventions through its participatory integrated watershed management program (IWMP) have changed the lives of hundreds of smallholder farmers and their families in the small village of Lucheba.

Unlocking the potential of rainfed areas

For the people of Lucheba, change began a decade ago, when ICRISAT and the provincial government brought to the village the results of its long years of research for development work on integrated management of natural resources for sustainable rainfed agriculture. In partnership with the Guizhou Academy of Agricultural Sciences (GAAS), the national agricultural research system, local communities, and farm families, ICRISAT led a consortium of partners in implementing the Lucheba watershed program supported by the Asian Development Bank (ADB) from 2003 to 2006.

Focused on reducing poverty and land degradation by adopting an inclusive, farmer participatory approach, the watershed management program introduced into



Photo: ICRISAT

An investment of US\$ 472,191 in the Lucheba watershed development program has gained a net present value of US\$ 14.7 million, and 31.14 benefit-cost ratio at 20% internal rate of return (IRR).

under the Lucheba watershed program.

the small village various interventions such as soil and water management, improved cropping systems, crop diversification, integrated nutrient management, and integrated pest management practices, along with other income-generating microenterprises such as poultry and pig rearing.

Throughout the program's duration, the communities were involved and played an active part, from identification of constraints and interventions, implementation, monitoring and evaluation, to impact assessment.

As an entry point activity, the community came together in implementing two drinking water schemes by harvesting water from natural springs, and transporting the water through pipes in the villages.

Throughout the program, the community undertook the construction of 151 rainwater harvesting structures-cum-irrigation water storage tanks, planting of 133,600 trees on 100 ha of wasteland, construction of an approach road, and crop diversification with high-value vegetable crops in the watershed.

More than 260 biogas plants were set up in the village households to reduce pressure on fuel wood and to protect the forests. The whole village now has biogas-powered street lighting.

Farmers with support from the project, their own contribution and partial support from the government, constructed a 4.8 km village approach road from the main road to facilitate the transportation of the vegetables produced to the markets. Later, a 6 km-long field road was constructed with support from the government.

Clear and sustained impacts

In 2013, seven years after the completion of the ADB-supported watershed program implemented in 2003-2006, ICRISAT revisited the small village of Lucheba in a study titled "Impact Assessment of Lucheba Watershed, China" targeted to gain a fair understanding of the extent of impact of the watershed program at the village level involving the whole community.

Now managed by farmers and other community members, the Lucheba watershed program has clearly demonstrated the long-term sustainability of an inclusive development intervention in terms of crop productivity, women empowerment and poverty eradication.

While a large number of studies have pinned watershed development program as among the most appropriate strategies for the development of rainfed agriculture ecosystem, few have been as successful and sustainable as the Lucheba watershed program.

Engaging people, inclusive growth

Mrs Song Pangying is now a micro-entrepreneur. While her husband works away on their one hectare land, Mrs Song runs a small grocery shop in another village. The family's investments have extended to poultry raising.

Mrs Song's daughter-in-law, Mrs Caiyang Ju is 22 years old, cooks for the family and takes care of the home in the absence of her mother-in-law. She plans to expand to vegetable cultivation to earn more income for the family for a better life.

"We wanted to move to cities in search of better opportunities. Back then, money was very hard to come by. But now due to the watershed program we are able to identify new ways to earn more," says Mrs Wang Xianhui, women group leader in Lucheba. "Our village environment is cleaner than in the cities."

Economic transformation in Lucheba

- Increased average household land area with irrigation by 94%; reduced rainfed area by 34%.
- Area with high-value crops, like vegetables, of average household increased from improved water conservation measures
- Yield levels of crops increased by 6-19% in rice and maize, and 32-673% for various vegetables.
- Farm-based employment and income shows that diversification in favor of high-value vegetable crops has increased labor earning by 82%.
- Farm income from crops, largely vegetables, increased by 192%.
- Total household income rose by 32%.
- Crop diversification significantly improved household food availability/security, shifting dietary patterns in favor of fish, meat, milk and eggs, while retaining cereal consumption.
- The Lucheba watershed development program cost of US\$ 472,191 has gained a net present value of US\$ 14.7 million, and benefit-cost ratio of 31.14 at 20% internal rate of return (IRR) on investment.



A woman farmer enjoying the sight of her lush field of vegetables.

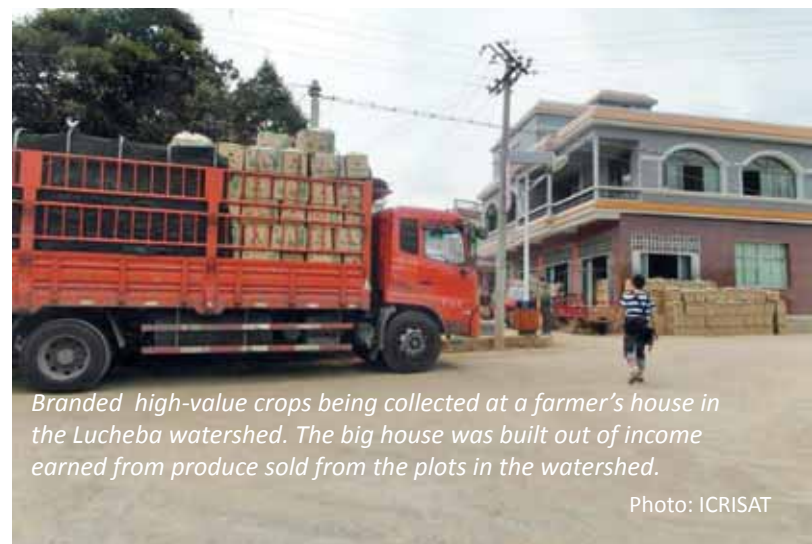
Photo: ICRISAT

"In all 1,347 people residing in the 43 km² area with 340 households in 6 village farmers' groups have benefited immensely in terms of improved quality of life, better environment, and increased incomes," said Mr Yang, village chief of Lucheba.

"Our farmers are now well trained with new technologies, and are able to cope better in any adverse situation, like low market prices. The change in the village happened when our farmers started growing vegetables instead of rice – farmers now harvest rainwater, and are highly aware of water-use efficiency," Mr Yang added.

The impact assessment study confirms that the Lucheba watershed model holds promise as an appropriate approach for improving the natural resource base and enhancing livelihood options, and that it can be replicated in other dryland ecosystems in China. The outcomes of the case study also suggest that scientists and policy makers of technical and institutional arrangements for watershed development programs should have an in-depth understanding of the socio-economic and ecological linkages and stakeholders' perceptions for long term shared watershed management.

The Lucheba watershed program has indeed shown that building solutions and making decisions together bring lasting benefits for all. ■



Branded high-value crops being collected at a farmer's house in the Lucheba watershed. The big house was built out of income earned from produce sold from the plots in the watershed.

Photo: ICRISAT



Photo: M Moyo, ICRISAT

Philip Tshuma and his family proudly show extension agents their sorghum and pearl millet fields with microdosing application.

Just a small dose will do

In Zimbabwe, a bottle cap's worth of fertilizer applied in the right place at the right time – is leading to dramatic improvements in yields and incomes of smallholder farmers.

Inclusiveness is about bringing life-changing innovations to millions of smallholder farming families who have the biggest needs – techniques that are adapted to smallholder, resource-poor farmers.

The President of the International Fund for Agricultural Development (IFAD) Dr Kanayo Nwanze, speaking at the 6th Africa Agriculture Science Week opening ceremony in Accra, Ghana, said “We have seen good results from a fertilizer microdosing

technique developed by ICRISAT and its partners, using a bottle cap system so farmers can measure out small, affordable amounts of fertilizer.” Dr Nwanze believes that there is huge potential to increase yields using low-cost and existing technologies.

Escaping subsistence farming

Crop yields in the semi-arid areas of Zimbabwe have been declining steadily over the years, mainly due to a decline in soil fertility and droughts. Research results show that between 75 and 90% of cropped land in Zimbabwe is unfertilized each season, and average application rates for nitrogen fertilizer by smallholder farmers is only 3 kg per hectare.

But how can resource-poor farmers get the highest returns from the fertilizer quantities they are able to afford? Resource poor farmers are likely to adopt lower rates as these are what they can afford. With

By 2012, close to 300,000 farmers were practising the technology and have achieved productivity gains of up to 100%. This intervention has improved household food security, and saved US\$ 7 million in food imports annually.

positive results, they will be encouraged to invest more in fertilizer, which will trigger a process of movement from impoverished subsistence farming to prosperous market-oriented farming.

Since 2003, ICRISAT has been promoting microdosing – targeted application of small, affordable quantities of fertilizer directly where the plant needs it – at the roots. Farmers apply 6 g doses of fertilizer, about a full bottle cap of ammonium nitrate (AN) fertilizer per two to four plants, in the hole where the seed is placed at the time of planting. Microdosing is equal to about 8-10 kg of nitrogen per hectare, approximately a fifth of the recommended application rate.

Partners and nongovernment organizations (NGOs) began establishing on-farm trials across Zimbabwe in 2004 to demonstrate the microdosing approach. In each trial, the farmer selected a cereal crop, and compared results with and without fertilizer.

Despite poorer than average rains during the 2005-2006 season, grain yield increases of 30-50% were recorded in areas with widespread adoption of microdosing, and almost every farmer achieved a significant yield gain. During this same season, over 170,000 households increased cereal production levels by an estimated 40,000 tonnes, significantly improving household food security.

Documenting impacts

In 2013, an extensive impact assessment study titled “Impact of Fertilizer Microdosing Research and Development in semi-arid Zimbabwe” was conducted to assess and document the impacts of microdosing research and technology transfer undertaken by ICRISAT and partners in eight districts of the country.

The picture painted by the results – a sustainable and inclusive growth within the participating districts, proving that innovations designed for the poor farmers help them move from subsistence to progressive farming.

Promotion of microdosing has raised the adoption of the technique by about 30%. In Zimbabwe’s Natural Region IV, microdosing increased maize yields by 80% under conditions experienced in 2012 in low rainfall regions of the country.

By 2013, adoption of microdosing technology by smallholder farmers in the semi-arid regions of Zimbabwe had generated a net present value (NPV) of US\$ 26 million with an internal rate of return (IRR) of 36%. At the household level, survey results show that microdosing has contributed to intensification by facilitating use of fertilizer, while enhancing food sufficiency by generating higher yields in maize and small grains.

Microdosing adoption has been enhanced by fertilizer subsidies, but promotion has had a large impact distinct from the effect of fertilizer subsidies. By increasing household cereal yield and contributing to food security, microdosing has supported women’s empowerment within male or joint-headed households. Households in wards that received microdosing training report higher levels of food security, consistent with higher food yields.

An inclusive and participatory approach

Since 2003, microdosing implementation in Zimbabwe has involved training, extension and promotion facilitated under a consortium of donors, working with nine international NGOs and a number of local NGOs.

During 2003-2006, more than 160,000 resource poor households received at least 25 kg of nitrogen fertilizer and a simple flyer in the vernacular explaining how to apply the fertilizer to a cereal crop. This was followed by ICRISAT linking with the Zimbabwe Fertiliser Company (ZFC), from which 12 trade stores received small fertilizer packs to sell to farmers.



Photos: ICRISAT

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Microdosing uses a bottle capful of fertilizer per three plants.

Until 2013, ICRISAT continued to conduct microdosing training to different stakeholders, now outside the consortium. More than 650 lead farmers, 241 government extension officers and 119 extension officers from 16 local and international NGOs have been trained.

The way forward

“Our impact assessment study shows that smallholder farmers’ investment in microdosing has really unlocked the power of chemical fertilizers in some of the low-rainfall areas of Zimbabwe,” said Dr Alex Winter-Nelson, Agricultural Economist,

University of Illinois at Urbana Champaign and lead investigator of the impact assessment study.

“Sustaining and expanding the benefits of microdosing technology will require efforts to ensure that private agro-dealers are able to stock the small fertilizer packs in a timely manner and to package it in a manner that smallholder farmers find useful,” he said. “This is complicated by the financial capacities of agro-dealers and by difficulty in projecting fertilizer demand, which varies with rainfall.

“We also need to work on extending training to underserved areas and to train extension personnel in low-rainfall areas. Female-headed households were significantly less likely to adopt microdosing than others, possibly reflecting labor shortages or difficulties accessing fertilizer. Understanding the particular constraints that female farmers face and adapting the methods or the training to their circumstances could also help extend adoption of the technique.” ■



Photo: KSI, ICRISAT

Sheri Manjula, a woman farmer from Telangana, India, receiving a voice message on weather forecast from her Green SIM-powered mobile phone.

The power of Green SIM

Digital inclusion through Green SIM brings the best of affordable technology and knowledge solutions at the doorstep of smallholder farmers, helping them build a resilient and food secure future.

“Last time, our whole groundnut crop was destroyed due to unexpected rain, but this season a voice message received on my mobile phone on weather forecast saved our crop as we were able to harvest three days ahead of the original harvest date. It saved us our season-long efforts and hard work,” said Chandrakala, a woman farmer from Addakal, Mahbubnagar district in Telangana, India.

“We used to take advice and recommendations from agricultural input dealers and received mixed results. But now with ICRISAT’s information advisory services we are getting precise application recommendations in our farms. It saves money and gives us better yield and income,” says Narmadamma, another woman farmer from Addakal.

Their stories illustrate the importance of inclusiveness – of bringing the best of affordable technology and knowledge solutions at the doorstep of smallholder farmers through appropriate information and communications technology (ICT)-mediated tools and value chain approaches, anchored on public-private partnerships.

The Green SIM

Chandrakala and Narmadamma are just two of the 40,000 farmers in 171 villages of the Indian states of Telangana and Karnataka benefiting from the Green SIM project of ICRISAT and its partners. Green SIM provides personalized and generic advisory services on correcting soil health deficiencies, fertilizer and pesticide recommendations, credit and insurance advice, information on availability of quality agricultural inputs, weather, market and nutrition advisories, livestock and 16 other categories in local dialects.

The Green SIM project is unique, as it is a sustainable ICT business model for agriculture and rural development, which has gained enormous success in just less than one year, setting it apart from other mobile phone or tablet agro-advisory services. It was launched in 2013 by ICRISAT's Center of Excellence in ICT Innovations for Agriculture, and has two systems – the *Krishi Gyan Sagar* and the *Krishi Vani*.

Krishi Gyan Sagar, an android-based application, gives personalized advisory to smallholder farmers through the concept of info-entrepreneurs (farm facilitators/para extension workers), and features an intelligent decision support and monitoring system.

The application makes use of geographic information system (GIS) to provide soil fertility maps. Farm facilitators can register farmers in a module with basic information on his/her landholding and cropping practices. In the state of Karnataka, it is backed by a soil test-based fertilizer recommendation database for each taluk (a group of villages), linked with the ICRISAT-Karnataka program on Bhoochetana (land rejuvenation). The application was designed and developed by ICRISAT and Nunc Systems (a private software and application development organization).

Krishi Vani is a mobile phone/phablet (phone with tablet) based application. Through this application, generic advisories are delivered to groups of farmers in a location through the mobile phone/phablet enabled by the Green SIM. The services are in the form of free voice messages – 35 per week per farmer in 16 categories delivered in multiple languages. ICRISAT along with the Indian Farmers Fertiliser Cooperative Limited (IFFCO) - Kisan Sanchar



Green SIM's Krishi Gyan Sagar, an android-based application that provides personalized agro-advisories to smallholder farmers.

Limited and Bharti Airtel developed this platform. Green SIM farmers get value-added agro-advisory services in addition to the regular services they receive from a regular SIM card.

Both systems were piloted in three different experimental hubs in partnership with the Government of Karnataka in that state; with the Rural Development Trust, a nongovernment organization, in Anantapur, Andhra Pradesh; and with the Adarsha Mahila Samaikya, a women federation organization, Mahbubnagar, Telangana.

Digital inclusion

The primary goal of the Green SIM system is to promote digital inclusion by providing resource-poor smallholder farmers with access to information, and enabling them to effectively use appropriate tools and knowledge to significantly raise their agricultural productivity, be more resilient to shocks, and seize opportunities to increase their incomes.

It was also in response to the often inadequate public-funded agricultural extension, in terms of infrastructure and human resources, to meet the needs of smallholder farmers. There is just one Agricultural Extension Officer for every 2000 farmers in India, and on average a farmer receives less than 40 minutes of advice a year from the officer.

The earlier array of ICT tools (mostly internet based or computer mediated) and services through village knowledge centers have limitations in reaching out to the poorer and more remote regions of India. Now the Green SIM system ensures that smallholder farmers in these areas have access to, and skills to use ICT, and are therefore able to participate in and benefit from knowledge and information to improve their yields, incomes and resilience.

The public-private partnerships in the Green SIM project work well in understanding the various dimensions and dynamics of government, nongovernment, and civil society organizations in developing this financially sustainable ICT-mediated knowledge dissemination system.

Benefits from the power of ICT

The impact of Green SIM on the lives of participating farmers has been significant, and has made extension more efficient and farmer-friendly, with real-time advice.

With the information they receive on their mobile phones, farmers can now verify offers that local pesticide dealers and grain traders make. Nearly everybody using the services in the villages has managed to save money while making such deals. Women farmer members of the Adarsha Mahila Samaikya are now applying for loans at their bank to buy mobile phones, while some have made enquiries on how they can convert their regular SIM into Green SIM to receive the advisory services.

The benefits for the community extend beyond monetary gains. Each day, farmers using the Green SIM mobile application receive two voice messages pertaining to area-specific agricultural needs, one on dairy and animal husbandry and another on health and nutrition in rural areas. The messages cover issues in 16 different categories and consist of timely solutions provided by scientists from ICRISAT. These short voice messages also contain information on farming practices of seasonal crops, weather forecast, and agricultural related schemes.

Farm facilitators in the pilot villages have now emerged as info-entrepreneurs, living off the revenues from Green SIM distribution to farmers. Airtel agreed to pay ₹ 10 (US\$ 0.166) to farm facilitators for each SIM card distributed, and to replace their commission agents with info-entrepreneurs who will be paid commissions for selling mobile talk time. This has shown a new direction – enabling virtual financial transactions while providing quality inputs and advisory services to farmers. This would also lead to reforms in the supply chain and provide win-win situations to producers and receivers by eliminating intermediaries/middlemen through direct virtual transactions.

Last mile connectivity

The Green SIM is an effective tool in providing last mile connectivity to smallholder farmers. With useful information inputs in the local language and voice format, the system is improving the quality of farmers' decision making.

The system successfully demonstrates a digital inclusion approach to improve farm productivity, promote sustainability and resilience of farming systems, directly improve income, livelihoods and household food security, and indirectly, of health and nutrition.

Plans are underway to replicate and expand this model in other parts of the world. The rise of new ICT devices such as tablets, phablets and other handheld devices will certainly create new opportunities for user-friendly information tools for better agricultural advice services, along with access to information on quality inputs and markets. It will also create job opportunities for info-entrepreneurs involved in Green SIM distribution, bringing important additional incomes to rural communities.

The Green SIM system recently received the prestigious Flame Award 2013 from the Rural Marketing Association of India (RMAI), for 'showcasing innovative use of technology' of the decade among 209 entries from big corporate entities and non-profit organizations. ■

Regaining ground for Malawi's groundnut

Three decades of investment in groundnut research for development have moved smallholder farmers in Malawi from subsistence to inclusive market-oriented agriculture.

In the 1980s and early 1990s, Malawi's groundnut production was in decline, due to lack of improved varieties, poor availability of good quality, affordable seed in sufficient quantities, and lack of grades and standards to enable smallholder farmers to access better markets.

A more holistic research effort aimed at strengthening the groundnut value chain in the country was implemented in the past three decades to arrest this decline, and create dynamic development options that lifted resource poor farmers from a state of poverty, to a state of prosperity.

The formula – an inclusive market-oriented approach to research for development (R4D) where poor, smallholder farmers not only gain improved production and productivity, but are also included in market opportunities. Ensuring that they gain access to markets has moved them from subsistence to commercial farming, allowing them to capture their fair share of the benefits.

Groundwork for groundnut

Esnart Ngwinji, a woman farmer from Nkhotakota, a lakeshore district in Malawi, shares her story:

“I started growing the improved groundnut variety Kakoma (JL 124) in 2008. The yield was tremendous; I quickly paid back the seed given to me by the community seed bank established by ICRISAT and replanted the rest following practices taught to me and other farmers by ICRISAT scientists, raising even more money. Today, I live in a tin sheet-roofed house compared to the grass-thatched house I was living in. I also now have enough funds to purchase fertilizer to grow maize, improving food availability in my home, and have sufficient funds to send my children to school.”

The groundnut R4D program benefiting Esnart and hundreds of thousands of smallholder farmers in Malawi spans over 30 years of ICRISAT's partnerships with several international and national organizations and farmers' groups in Eastern and Southern Africa. It started with support from the heads of states of the Southern African Development Community (SADC), initially funded by the International Development Research Centre (IDRC), subsequently by the German Government and in later years, by the United States Agency for International Development (USAID), McKnight Foundation, and Irish Aid.

Photo: S Sridharan, ICRISAT

The key – innovations inclusive of the poor, smallholder farmers, namely (1) Development of high-yielding and stress-resilient groundnut varieties and improved crop management options; (2) Providing access to quality seeds of improved varieties through better seed systems; and (3) Affordable product quality and food safety systems linking farmers to local and international markets.

Better varieties, enhanced livelihoods

Between 1982 and 2013, the Malawi national program released six groundnut varieties, bringing a marked improvement in groundnut production and boosting food and income for smallholder farmers.

A 2013 impact assessment study of the groundnut R4D investment in Malawi has shown that 56% of farmers cultivate improved varieties CG7 (ICGV-SM 83708) and 28% grow Nsinjiro (ICGV-SM 90704), accounting for 84% of groundnuts produced in the country. The current average yield of groundnut is 800 kg/ha, showing a marked increase from 450 kg/ha recorded in the early 1990s.

Majority of smallholder groundnut farmers in Malawi are women. The improved varieties, particularly CG7, are of the “bunch” type and easier to harvest, reducing women’s burden at harvest and leading to reduced drudgery and time saved that can be invested in other economic activities.

In terms of benefits to households, farmers sell an average of 684 kg per household, with an average income of about US\$ 140 per household from groundnut sales. About 77% of farmers attribute their improved incomes and food security to improved groundnut varieties developed by ICRISAT and the Malawi national program.

Income from groundnut sales was used to buy food, pay school fees, buy farm inputs such as labor and seed, acquire household items, start a business, buy clothes or improve dwellings. This income has greatly empowered women groundnut farmers in Malawi in terms of decision making and contributing to the well-being of their families.

Quality seeds and seed business in the hands of farmers

Efforts to produce certified seeds of groundnut took off in 2003, when the National Smallholder Farmers Association of Malawi (NASFAM) and ICRISAT formed a partnership to implement a groundnut seed production program – at a time when there was a high demand for groundnuts in the domestic, regional and international markets.

Through the Malawi Seed Industry Development Project funded by Irish Aid from 2008, the Malawi Seed Alliance (MASA), a consortium of small-scale seed companies dedicated to production and distribution of improved seed was established. Today, the MASA brand accounts for about 54% of legume seed sown annually in the country. More than 700 metric tons of groundnut certified seeds under the brand (98% certified seed) were supplied to the subsidy market, benefiting around 395,000 farmers.

In the 2011-2012 cropping season, ICRISAT scientists supplied an additional 6.5 tons [5.5 tons of Nsinjiro (ICGV-SM 90704) and 1 ton of a new variety Chatala (ICGV-SM 99568)] of certified seeds in partnership with NASFAM and the Department of Nutrition and Soil Fertility, to Mzimba district in northern Malawi. This investment initially targeted 560 farmers and 80 community seed banks, generating 40 tons of seed in one year. Over 20 tons of seed was sold back to the ICRISAT seed revolving fund for further distribution to farmers.

Affordable aflatoxin testing links farmers to international market

The increasingly strict maximum allowable levels (MALs) of aflatoxin contamination in the European Union (EU) have prevented smallholder producers from accessing the European high-value markets. According to the World Bank, the reduction of MALs to 4 parts per billion of aflatoxin has resulted in annual losses of over US\$ 670 million for African countries.

The Mchinji Smallholders Farmers' Association (MASFA) in central Malawi was just one group of farmers (a member of NASFAM) shut out of the groundnut exports trade due to the EU trade regulations on aflatoxins. However, ICRISAT's ELISA technique for aflatoxin detection has revitalized their business.

ICRISAT designed and instituted a system for quality assurance and standards, involving low-cost sampling and estimation of levels of aflatoxin contamination in groundnuts. The ELISA technique has given smallholder farmers an opportunity to participate in markets that they would otherwise have never accessed, particularly the high-value markets in the EU.

The ELISA technique for aflatoxin detection has cut the cost of testing groundnut crops from US\$ 25 to US\$ 1 per sample.

Over 4,000 MASFA farmers have again begun to export high-quality groundnuts to Europe under a fair trade agreement. Moses Siambi, Director, ICRISAT Eastern and Southern Africa, said: "We've seen a very positive impact. Malawian groundnuts are now available in the biggest supermarkets in Britain." Many small farmer cooperatives across the African continent could be following soon.

By leveraging the right partnerships and including smallholder farmers in building a market-driven solution through years of R4D investments, the Malawi groundnut industry has successfully regained its rightful place. ■

The work reported in this article is continuing under the CGIAR Research Program on Grain Legumes.

Mrs Frances Chavula of Mzimba district shows a subsidy voucher and a packet of MASA brand groundnut certified seed.

Proof of impact

Results of the study "Socio-economic Impacts of Groundnut Research and Development Investments in Malawi 1982-2013" have strengthened the case that an inclusive market-oriented approach to R4D can be a real economic and social driver in poorly developed rural communities.

Investments in groundnut R4D in Malawi yielded a Net Present Value (NPV) of US\$ 205 million between 1982 and 2013, with a **Return on Investment (ROI) of US\$ 22 per dollar invested.**

At the household level, domestic human consumption of shelled groundnuts rose over time from **11,000 tons in 1990 to 68,000 tons by 2013.** Per capita consumption of groundnut rose by three-fold from less than **1.5 kg/capita in 1990 to 4.7 kg/capita in 2013.**

Today, about 35% of the total groundnut production is used as an input in the agro-processing industry for production of groundnut cake, oil and peanut butter. **Groundnut exports from Malawi in 2012 generated US\$ 42 million,** contributing to the country's foreign exchange earnings and several spillover benefits to the producing communities and the broader economy.



Photo: ICRISAT



Photo: AS Mousa, ICRISAT

West Africa: Time-traveling through future climates

ICRISAT and partners work with local farmers, communities and organizations to fight and win the climate change war, through farmer-to-farmer local knowledge exchange, looking into the future with modeling tools, and creating supportive policies and institutions.

First cornerstone: A female farmer visitor from Kampa Zarma (south-west Niger) learns to dig a zai hole (small planting pits) from a host farmer in Tajaé (center-east Niger).

West Africa is home to the hottest rainfed agricultural systems of the world. The region's climates have been historically unpredictable, especially on inter-annual timescales, fuelling complex stress patterns through their interactions with soils and pests.

Present coping strategies to buffer against effects of unpredictable rainfall include avoiding risk and developing tools to ensure yield stability. However, they often fail to exploit the positive opportunities of the hardly predictable 'average' and 'better than average' seasons.

Over time, crop plants and farmers alike have developed adaptation traits and techniques to cope with these constraints. West Africa is actually a treasure of indigenous adaptation measures that are of global significance, and a primary center of agrobiodiversity.

Gaps in climate change preparedness are driven by poverty, inequality and lack of political will. And so people must be empowered – with all the tools available – if the war against climate change is to be fought and won.

The three-pillar approach

In West Africa, ICRISAT and its partners have mapped out an ambitious, multi-pronged approach to take advantage of the region's untapped knowledge resources, while empowering communities and leaders on strategic foresight and decision making. This approach is based on three pillars: harnessing and capitalizing on local knowledge through direct farmer-to-farmer exchanges; looking into the future with integrated assessment tools; and creating an enabling environment to cope with and address climate change through supportive policies and institutions.

ICRISAT and partners are working with local farmers, communities and organizations along these three pillars to build an inclusive, powerful solution to win the climate-change war – collective time-traveling through future climates.

First cornerstone: Farmer-to-farmer approach

Under the “Farms of the Future” program, more than 100 farmers and agriculture innovation stakeholders traveled from 13 villages in Burkina Faso, Ghana, Mali, Niger and Senegal to villages with current climate conditions comparable to their own future. This is the first cornerstone – farmer-to-farmer exchanges of indigenous knowledge, enabling traveling farmers to build a mental picture of what their climate and farming systems might look like in the future and to better comprehend, analyze and identify adaptation strategies and technologies potentially adaptable to their local conditions (physical, socio-economic, and institutional).

Second cornerstone: Dr Ibrahima Hathie of the Initiative prospective agricole et rurale (IPAR), Senegal explains to fellow AgMIP scientists from the University of Ghana how smallholder livelihoods will be impacted by climate change around 2050 in Nioro du Rip, Senegal.

In each country, visiting farmers were exposed to a wide spectrum of climate-smart agriculture practices and technologies. Direct interaction and learning among farmers allow for exchange and sharing of adaptation-related ideas and techniques. Participatory videos were used to support farmers' learning, and for them to share their findings from the tour with their own communities.

Mrs Bierinkuu Kuubaar, a woman farmer from Ghana said, “I'm very glad that I'm one of the participants in this program. I learn how Burkinaabe are fighting the negative impacts of climate change. Growing trees, using organic matter from crop residue and household waste as demonstrated by Mr Aziz is what I'll start with when I return to Ghana.”

Second cornerstone: Looking into the future with modeling tools

The Agricultural Model Inter-comparison and Improvement Project (AgMIP: www.agmip.org) provides the second cornerstone that will allow us to actually view, well ahead of time, the minute effects of tomorrow's climate on future crops and livelihoods using a set of never seen before lenses called trans-disciplinarity and ensemble modeling. In West Africa, the AgMIP Regional Research Team is led by ICRISAT and the University of Ghana and marries scientists, researchers and stakeholders into an inclusive and dynamic knowledge co-production think tank.



Photo: S Lifson, AgMIP

Thanks to AgMIP, we now understand better that aside from warming, West African drylands may be wetter in many places (up to +20%), while at the same time dry up in others (up to -30%) as early as 2050. In countries like Senegal, production of a moisture-sensitive crop such as maize may then become a challenge.

In these areas, simple adaptation measures such as a longer grain filling duration and improved root distribution can erase climate change effects and even bring significant benefits, up to +80% income. In other places like Ghana's Upper East Region, we are now a bit more certain that peanut, often a woman's crop, may actually be spared the blunt impact, even without adaptation.

Says Dr Dilys Maccarthy, AgMIP scientist with the University of Ghana: "One of AgMIP's remarkable strengths lies in its systems modeling approach that represents the full spectrum of households (rather than just a generic farm) and provides socially differentiated economic implications of biophysical change (eg, income, poverty) for different population strata that can include minority groups, smallholders, and female-led households."

Third cornerstone: Mainstreaming climate change into policies

Bringing climate adaptation to scale finally requires a robust policy and institutional foundation. The third cornerstone of ICRISAT's approach is to capacitate science-policy exchange platforms to mainstream climate change into national agricultural and food security policy plans. In 2013, national platforms were formally established by the CGIAR Research

Program on Climate Change, Agriculture and Food Security (CCAFS, www.ccafs.cgiar.org) in Ghana, Mali and Senegal to help mainstream climate change into agricultural investment and benefit the most vulnerable populations.

"Given that Ghana has to do more especially to enhance food security, we make this commitment to support the Ghana CCAFS Platform in its efforts to promote interactions and synergies among key national institutions. This is to enable us to take informed decisions for the adaptation of agriculture to climate change in our country," says Hon Edem Asimah, Chair of the Parliamentary Select Committee on the Environment, Parliament of Ghana.

The multi-sectoral composition of platforms involving various ministries and technical departments is a game-changing step towards a dynamic policy planning environment based on sound scientific knowledge, participative processes and transformative scenarios.

ICRISAT is engaged in helping national leaders to reach out to local and decentralized stakeholders, by building district-level capacity to visualize their futures. This allows local stakeholders to systematically develop fast-forward narratives that may include both analysis of current trends and creative speculation about what might occur under tomorrow's climate. This is just like replacing astrology with astronomy, warping time to see into the future and building spaceships to change the future. ■

The work reported in this article is continuing under the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Third cornerstone: Training of national partners on scenario visioning to support national climate-smart policy development.



Photo: ICRISAT



Photo: J Ndjeunga, ICRISAT

A visit to groundnut farmers' fields in Fabidji, a village and rural commune in Niger.

Leading the way to rural development in the Sahel

In the villages of Burkina Faso and Niger, development pathways address the dynamics of poverty and land degradation and put priority on scientific and policy interventions to build inclusive prosperity.

In the Sahelian countries of Africa, about 80% of the 100 million inhabitants live and work in rural areas and depend on agriculture for their livelihoods. Poverty and vulnerability are severe in these areas, and in many cases are worsening for millions of people. Land degradation is one of the major causes of poverty and income inequalities in the Sahel. Other underlying factors are many – harsh climatic conditions, rapidly growing populations, prevalence of diseases and pests, poor development of infrastructure and markets, governance failures, conflicts, and more.

Just as the causes of poverty and vulnerability are multi-dimensional, so too is the nature of poverty,

which involves not simply income or consumption poverty, but also lack of secure access to and the poor condition of key livelihood assets particularly land, as well as economic, political and social isolation.

Burkina Faso and Niger are among the many Sahelian countries implementing poverty reduction and rural development strategies on the road to development. But to get there, it is important to first understand factors that help households escape the poverty and land degradation trap. This knowledge is what will drive an inclusive and socially profitable mix of improved institutions, infrastructure and livelihood assets, and a supportive policy and technological environment.

Understanding development pathways

Why do some households escape and others slide into poverty? Knowing the 'development pathways' that these poor rural households traverse to achieve improved livelihoods, food security and a more sustainable natural resource base, given the vulnerable situation they are in, is the key.

An understanding of the challenges and drivers of development must be based on the perspectives of the rural households and communities themselves. Only then can innovative scientific and policy interventions be designed to motivate the poor to move along development pathways.

ICRISAT together with its partners – the Institut de l’Environnement et de Recherches Agricoles (INERA) in Burkina Faso and the Institut National de Recherche Agronomique du Niger (INRAN) in Niger – took the first big leap with the project “Assessing the dynamics of poverty and land degradation in the Sahel” funded by the International Development Research Centre (IDRC), Canada and implemented from 2009 to 2013.

Based on a long-term panel data set for more than 250 farm households in Burkina Faso and Niger, collected in the 1980s, various development pathways (or livelihood strategies, as used in the project study) pursued by the households were identified, and the dynamics of poverty and land degradation were investigated.

Development pathways by households – How they cope

For decades, rural households in Burkina Faso and Niger have designed various livelihood strategies to cope with and achieve livelihood outcomes, given the degraded land, meager assets, government and private sector structures, and laws, institutions, markets and technologies available to them. Based on community and household level surveys in the two countries, several development pathways or livelihood strategies were identified.

These livelihood strategies were largely determined by agricultural potential based on agro-ecological zone, population density, and access to markets and roads. Where agricultural potential is high, development pathways are associated with high value crop production such as cotton and maize, and adoption of soil and land management technologies such as stone bunds and mineral fertilizers. In drier areas with low agricultural potential, production of climate-smart crops like millet and sorghum, and livestock are prevalent and require strong scientific and policy interventions.

In Burkina Faso, gold panning as a poverty escape pathway is not sustainable. Migration targeting the youth and heads of households depletes the

agricultural labor force and has significant impact on feminization of agriculture, especially in the drier areas of both Burkina Faso and Niger. But while women play a major role in agriculture, they continue to have less access to good quality land.

Promising agriculture-based development pathways require technologies such as seeds of modern varieties, fertilizers, pesticides, water and modern equipment. Households are shifting towards the production of high value crops such as vegetables, trees and sugarcane as a result of increased access to shallow water or where the government has built water infrastructure such as a dam.

What determine development pathways?

How households and communities design their development pathways to cope with poverty and land degradation depend on a number of environmental, institutional and policy factors. In Burkina Faso, farmers in the high rainfall zone, with good access to markets, who use stone bunds and mineral fertilizers, and have access to traditional water sources choose the vegetable/sorghum development pathway over the millet/cowpea/gold panning/livestock pathway. Also, households with unproductive soils tend to migrate.

In Niger, households with good road access and markets, source of irrigation water, and where farmers can borrow land and use fertilizers are likely to choose the vegetable/cowpea/peanut strategy over the commerce/sorghum strategy. Those without access to traditional wells and who cannot diversify their activity are likely to migrate.

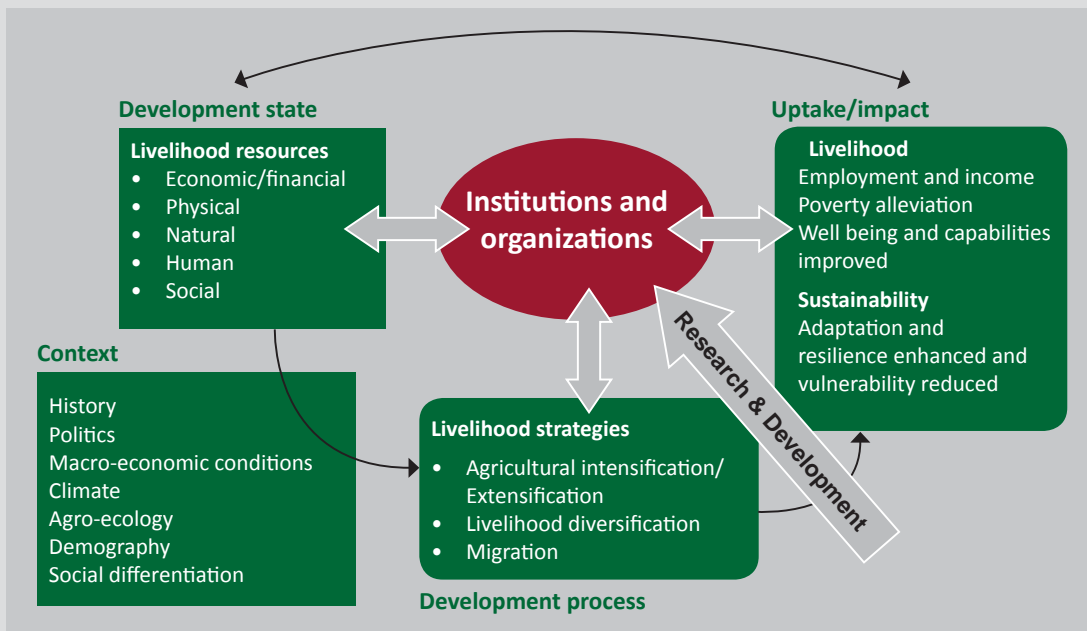
Development pathways identified

Burkina Faso

- Millet/cowpea/livestock/gold panning
- Horticulture/sorghum
- Cotton/maize
- Migration/sorghum/tuber crops
- Groundnut/tuber/cereals

Niger

- Commerce/sorghum
- Horticulture/legumes
- Migration/millet/natron
- Commerce/horticulture
- Rice/migration/millet/livestock



Analytical framework for integrated natural resource management impact assessment on sustainable rural livelihoods (Source: Gottret and White 2001, URL: <http://www.consecol.org/vol5/iss2/art17/>)

These pathways can be associated with different development outcomes, such as cash and higher wages in the cotton/maize pathway in Burkina Faso. Improvement in maize yields has been due to the residual effect of fertilizers applied on cotton or direct fertilizer application. However, this pathway has a negative environmental outcome resulting from pesticide use on cotton. Farmers' shift to cotton production also results in land devegetation. In this pathway, intensification is done by using more fertilizers and improved seeds of cotton or maize.

Promising development pathways require the use of modern technologies and access to water resources. For example, use of zai holes (planting pits) can increase productivity by as much as 24% compared to plots without zai holes. Similarly, the use of mineral fertilizers can increase yields by more than 20% and organic fertilizers by more than 15%.

Policy and program implications

Insights from the study give us a better understanding of the drivers of agriculture and economic transformation to help move the poor out of poverty (see figure on 'Inclusive development pathway framework for the Sahel'). Some promising best-fit

options and policy and program implications are as follows:

1. Promote the use of fertilizers and soil and water conservation measures to improve soil quality, reduce land degradation and increase incomes of the rural poor.
2. Investigate impacts of migration and gold panning to enhance rural livelihoods.
3. Invest in irrigated water infrastructure to enhance farmers' investments on high value crops.
4. Promote investments on improved livestock quality and health.
5. Integrate policies and programs to promote soil and land management with poverty reduction and rural development strategies.
6. Allow women better access to natural resources such as land.

While development prospects in the Sahel may seem daunting to many, hope and optimism rest on inclusive development pathways that put priority on policies and programs that lift the poor from poverty to prosperity. ■

The project reported in this article was completed under the CGIAR Research Program on Policies, Institutions and Markets.

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Jerome Bossuet, Consultant, *France*

Internal Audit

TN Menon, Head, Internal Audit, ICRISAT &
Associate Director (Asia), CGIAR-IAU, *India*

Swati Jain, Manager, Internal Audit, *India*

Human Resources Services

Hector V Hernandez, Director, Human
Resources and Operations, *Philippines*
(until 30 Jun 2013)

SS Sharat Kumar, Director, Human Resources
and Operations, *India*

AJ Rama Rao, Head, Human Resources
Services (NRS), *India*

CN Reddy, Head, Medical Services, *India*

K Mohan Sharma, Head, Human Resources
Services (IRS/SMG), *India*

Surya Kant Sharma, Head, Human Resources
and Operations, *India*

Housing and Food Services

K Ravi Shankar, Head, Housing and Food
Services, *India* (until 30 Apr 2013)

A Vani, Manager, Housing and Food Services,
India

Purchase, Supplies and Disposal Services

PN Mallikarjuna, Head, Purchase, Supplies
and Disposal Services, *India* (until 31 Mar
2013)

TD Peter, Head, Purchase, Supplies and
Disposal Services, *India*

VN Somayajulu, Manager, Purchase, Supplies
and Disposal Services, *India*

Financial Services

Rajesh Agrawal, Assistant Director General -
Finance, *India*

Supriya Bansal, Financial Controller/Head,
Financial Services, *UK*

PV Gopiramanan, Manager, Treasury and
Operations, *India*

MS Raju, Senior Manager, Project Finance,
India

Ch Sridhar, Manager, CRP Finance and MIS,
Financial Services, *India*

Deputy Director General's Office

David A Hoisington, Deputy Director General
- Research, *USA* (until 31 Aug 2013)

CL Laxmipathi Gowda, Deputy Director
General - Research, *India*

B Hanumanth Rao, Senior Manager,
Intellectual Property, *India*

Research Program - Resilient Dryland Systems

Peter Q Craufurd, Research Program Director
- Resilient Dryland Systems,
UK (until 07 Oct 2013)

SP Wani, Acting Research Program Director -
Resilient Dryland Systems, *India*

KH Anantha, Scientist (Watersheds), *India*

Girish Chander, Scientist (Soil Science), *India*

Murali Krishna Gumma, Scientist (GIS/Spatial
Science), *India*

Kaushal Kishor Garg, Scientist (Watersheds)
India

Tsehaye Tesfamariam Habtemichael,
Post Doctoral Fellow, *Eritrea*

Shalander Kumar, Scientist (Dryland Systems
in South Asia), *India*

Tomohiro Kurai, Post-Doctoral Fellow, *Japan*

G Pardhasaradhi, Manager, Soil and
Plant Analytical Laboratory, *India*

Prabhakar Pathak, Principal Scientist (Soil
& Water Management), *India*
(until 28 Feb 2013)

Mukund Dhavaji Patil, Scientist (Soil Physics),
India

AVR Kesava Rao, Scientist (Agroclimatology), *India*
S Raghavendra Rao, Manager (Watersheds),
India

GL Sawargaonkar, Scientist (Agronomy), *India*

Arame Tall, Scientist (Climate Information
Services), CCAFS, Resilient Dryland Systems,
Senegal

Amare Hailelassie Tekle, Senior Scientist
(Crop Livestock), *Ethiopia*

Takeshi Watanabe, Special Project Scientist,
Japan

Impact Assessment Office

Kizito Mazvimavi, Head, Impact Assessment
Office, *Zimbabwe*

Research Program - Markets, Institutions and Policies

M Cynthia S Bantilan, Research Program Director
- Markets, Institutions and Policies, *Philippines*

P Parthasarathy Rao, Assistant Research
Program Director and Principal Scientist
(Economics), *India*

G Basavaraj, Scientist (Economics), *India*
(until 20 Aug 2013)

Madhusudan Bhattarai, Principal Scientist
(Economics), *Nepal*

D Kumara Charyulu, Scientist (Agricultural
Economics), *India*

Shyam Moses Davala, Special Project Scientist
(Agricultural Economics), *India*

Uttam Kumar Deb, Principal Scientist -
Economics (Village Level Studies), *Bangladesh*

Chanda G Goodrich, Principal Scientist
(Empower Women), *India*

Dakshina Murthy Kadiyala, Special Project
Scientist (Spatial Crop Modeling), *India*

Anjani Kumar, Principal Scientist - Economics
(New Delhi), *India*

N Nagaraj, Principal Scientist (Economics), *India*

S Nedumaran, Scientist (Economics), *India*

R Padmaja, Scientist (Gender Research), *India*
Thiagarajah Ramilan, Scientist (Bio-economic
Modeling), *New Zealand*

A Amarendra Reddy, Special Project Scientist
(Economics), *India* (until 5 Dec 2013)

M Srinivas Rao, Specialist (Markets Research
and Innovation), *India*

Research Program - Grain Legumes

Rajeev K Varshney, Research Program Director
- Grain Legumes and Director, Centre of
Excellence in Genomics (CEG), *India*

Pooran M Gaur, Assistant Research Program Director - Grain Legumes & Principal Scientist (Chickpea Breeding), *India*

Gaurav Agarwal, Special Project Scientist (Applied Genomics), *India*

Sarwar Azam, Special Project Scientist (Computational Genomics), *India* (until 11 Nov 2013)

Pooja Bhatnagar-Mathur, Senior Scientist (Cell/Molecular Biology), *India*

K Hima Bindu, Scientist (DST-INSPIRE), *India*

Annapurna Chitikineni, Manager - Center of Excellence in Genomics, *India*

S Gopalakrishnan, Senior Scientist (Bioproducts), *India*

Anupama J Hingane, Special Project Scientist (Pigeonpea Breeding), *India*

Julie M I Hofer, Post Doctoral Fellow, UK/*New Zealand*

P Janila, Scientist (Groundnut Breeding), *India*

Pawan Khera, Special Project Scientist - Genomics and Molecular Breeding (Peanut Foundation), *India*

Dong Hyun Kim, Post Doctoral Scientist (Genomics), *Korea* (until 12 Dec 2013)

CV Sameer Kumar, Senior Scientist (Pigeonpea Breeding), *India*

R Vijaya Kumar, Manager, Field Research Operations (Pigeonpea Breeding), *India*

Vinay Kumar, Special Project Scientist (Applied Genomics), *India*

PT Lekha, Special Project Scientist (Applied Genomics), *India*

Nalini Mallikarjuna, Principal Scientist (Cell Biology), *India* (until 31 Mar 2013)

KAVS Krishna Mohan, Special Project Scientist (Computational Genomics), *India*

Myer G Mula, Scientist (Seed Systems), *Philippines*

Suresh Pande, Principal Scientist (Pathology), *India* (until 30 Apr 2013)

Santosh K Pattanashetti, Scientist (Genetic Resources), *India*

Manish K Pandey, Scientist (Groundnut Genomics), *India*

GV Ranga Rao, Special Project Scientist (IPM), *India*

Abhishek Rathore, Senior Scientist (Biometrics), *India*

B Venkateswara Rao, Manager - Field Research Operations (Chickpea Breeding), *India*

K Narsimha Reddy, Manager - Germplasm Conservation, *India*

D Srinivas Reddy, Special Project Scientist, *India*

VS Arun Kumar Sama, Special Project Scientist (Molecular Breeding), *India* (until 28 Aug 2013)

DVSSR Sastry, Manager - Genebank Seed Laboratory, *India*

KB Saxena, Principal Scientist (Pigeonpea Breeding), *India*

Rachit Kumar Saxena, Scientist (Applied Genomics), *India*

HC Sharma, Principal Scientist (Entomology), *India*

Mamta Sharma, Senior Scientist (Legumes Pathology), *India*

Santisree Parankusam, Scientist (DST-INSPIRE), Patancheru, *India*

Shivali Sharma, Scientist (Genetic Resources), *India*

Vikas Kumar Singh, Special Project Scientist (Applied Genomics), *India*

Pallavi Sinha, Special Project Scientist (Functional Genomics), *India*

S Srinivasan, Scientist (Chickpea Breeding), *India*

Hari Kishan Sudini, Senior Scientist (Groundnut Pathology), *India*

Mahendar Thudi, Scientist (Applied Genomics and Genotype Service Laboratory), *India*

Hari D Upadhyaya, Principal Scientist and Head, Gene Bank, *India*

K Mohan Vishnuvardhan, Special Project Scientist - Pigeonpea Breeding (Durgapura, Rajasthan), *India* (until 7 May 2013)

M Vetriventhan, Scientist (Genetic Resources), *India*

Research Program - Dryland Cereals

Stefania Grando, Research Program Director - Dryland Cereals, *Italy*

Vincent Vadez, Assistant Research Program Director - Dryland Cereals & Principal Scientist (Plant Physiology), *France*

Thammineni Chakradhar, Special Project Scientist, *India*

Santosh P Deshpande, Scientist (Molecular Breeding), *India*

M Govindaraj, Scientist (Pearl Millet Breeding), *India*

SK Gupta, Senior Scientist (Pearl Millet Breeding), *India*

Jana Kholova, Associate Scientist, Cereals Physiology, *Czechoslovakia*

A Ashok Kumar, Senior Scientist (Sorghum Breeding), *India*

Punna Ramu, Special Project Scientist, *India*



ICRISAT Management and senior staff members from headquarters, Eastern and Southern Africa, and West and Central Africa.

P Srinivasa Rao, Senior Scientist (Sorghum Breeding), *India*

Ch Ravinder Reddy, Senior Scientist (Technology Exchange), *India*

P Sudhakar Reddy, Scientist (DST-INSPIRE), *India*

Trushar Shah, Scientist (Bioinformatics), *Kenya*

Rajan Sharma, Senior Scientist (Cereals Pathology) & Head, Plant Quarantine Lab, *India*

Rakesh K Srivastava, Senior Scientist (Molecular Breeding), *India*

KN Rai, Consultant, Pearl Millet Breeding, *India*

AG Bhasker Raj, Manager - Field Research Operations (Pearl Millet Breeding), *India*

B Ramaiah, Manager - Field Research Operations (Sorghum Breeding), *India*

BVS Reddy, Consultant, Sorghum Breeding, *India* (until 31 Jul 2013)

Manish Roorkiwal, Special Project Scientist (Agricultural Genomics Network), *India*

Agribusiness and Innovation Platform (AIP)

Kiran K Sharma, Director, PTTC and Chief Executive Officer, Agribusiness and Innovation Platform, and Principal Scientist (Cell Biology), *India*

S Aravazhi, Manager - Agri-Business Incubation Program & Chief Operating Officer - Innovation and Partnership Program, *India*

SM Karuppan Chetty, Chief Operating Officer, Agri-Business Incubation Program, *India*

R Bhubesh Kumar, Assistant Manager, Agri-Business Incubation Program, *India*

Saikat Datta Mazumdar, Chief Operating Officer, NutriPlus Knowledge Program, *India*

Jonathan Philroy, Deputy Manager, Agri-Business Incubation Program, *India*

CGIAR Research Program on Dryland Cereals

Sobhana Sivasankar, Director, *USA*

Satish Nagaraji, Communication Manager, CGIAR Research Program on Dryland Cereals & Grain Legumes, *India*

CGIAR Research Program on Grain Legumes

Thomas Henry Noel Ellis, Director, *UK*

Farm, Engineering and Transport Services (FETS)

M Prabhakar Reddy, Program Leader - Farm, Engineering and Transport Services, *India*

Suresh C Pillay, Assistant Program Leader - Farm, Engineering and Transport Services and Senior Manager (Engineering Services), *India*

Mohd Aslam Shariff, Senior Manager, Transport Services, *India*

C Buchappa, Senior Manager, Engineering Services, *India*

Bijoo Davis, Manager, Electrical and Airconditioning, *India*

K Hanmanth Rao, Senior Manager, Farm Services, *India*

Knowledge Sharing and Innovation (KSI)

Dileepkumar Guntuku, Principal Scientist/Global Leader, Knowledge Sharing and Innovation, and Coordinator for South-South Exchange, *India*

VV Sumanth Kumar, Scientist (ICT4D), *India*

Rosana P Mula, Coordinator, Learning Systems Unit, *Philippines*

M Madhan, Manager, Library and Information Services, *India*

Pradyut J Modi, Head, Information Systems Unit, *India*

Chukka Srinivasa Rao, Senior Manager, Data Management, *India*

NT Yaduraju, Principal Scientist (ICT4D), *India* (until 5 Dec 2013)

Eastern and Southern Africa (ESA)

Nairobi, Kenya

Said N Silim, Director, ESA, *Uganda* (until 31 Aug 2013)

Moses Siambi, Director - ESA, *Kenya*

Emmanuel S Monyo, Project Coordinator, TL-II, Grain Legumes, *Tanzania*

Alastair William Orr, Assistant Director for ESA and Principal Scientist (Economics), Dryland Cereals, *UK*

Lieven Claessens, Principal Scientist - Natural Resources (Water and Soils), Resilient Dryland Systems, *Belgium*

Albert Johannes Gierend, Agricultural Marketing Economist, Markets, Institutions and Policies, *Germany*

David Harris, Principal Scientist (Agroecosystems/Climate Change), Resilient Dryland Systems, *UK*

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Photo: PS Rao, ICRISAT

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Masikati Patricia, Post Doctoral Fellow,
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Swathi Sridharan, Editor - ESA, Strategic
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Lilongwe, Malawi

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Grain Legumes, *Uganda*

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Economics, Innovation Systems and Markets),
ESA, Markets, Institutions and Policies, *Japan*

Maputo, Mozambique

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Resilient Dryland Systems, *Ethiopia*

West and Central Africa (WCA)

Bamako, Mali

Farid Waliyar, Director, WCA, *France*

BR Ntare, Assistant Director, WCA, and
Principal Scientist (Breeding), Grain
Legumes, *Uganda* (until 30 Nov 2013)

Amadou Bila Belemgoabga, Manager,
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Birhanu Zemadim Birhanu, Scientist - Land
and Water Management (WCA), Resilient
Dryland Systems, *Ethiopia*

Agathe Diamo, Regional Information Officer,
WCA, *Mali*

Hailemichael Shewayrga Desmae, Scientist
- Groundnut Breeding, Grain Legumes,
Australia

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Dryland Systems, *Niger*

Baloua Nebie, Junior Professional Officer
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Burkina Faso

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Project for Sorghum and Millets, Dryland
Cereals, *Kenya*

Moses Osiru, Senior Scientist, Legume/Cereal
Pathology (WCA), Grain Legumes/Dryland
Cereals, *Uganda*

Vera Lugutuah, Associate Professional Officer
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(until 3 Jan 2013)

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HOPE Project, Resilient Dryland Systems,
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Breeding & Genetic Resources), Dryland
Cereals, *USA*

Eva W Rattunde, Principal Scientist (Sorghum
Breeding & Genetic Resources), Dryland
Cereals, *Germany*

PCS Traore, Senior Manager, GIS, Resilient
Dryland Systems, *France*

Robert B Zougmore, Regional Program
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Burkina Faso

Niamey, Niger

Mahamadou Gandah, Project Coordinator,
AGRA Microdose Project and Country
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Niger

Malick Niango Ba, Senior Scientist, Entomology
(WCA), Grain Legumes/Dryland Cereals,
Burkina Faso

Fatondji Dougbedji, Scientist (Agronomy),
Resilient Dryland Systems, *Niger*

Bakary Djaby, Senior Scientist, Dryland Systems
and Livelihood Diversification (WCA), *Burkina
Faso/ Belgian (TBC)*

Falalou Hamidou, Regional Scientist
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CT Hash, Principal Scientist (Breeding), Dryland
Cereals, *USA*

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WCA, *Niger*

Sapna Jarial, Scientist, Crop Livestock (WCA),
Resilient Dryland Systems, *India*

Rodolfo Martinez Morales, Senior Scientist
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Dryland Systems, *Mexico* (until 31 May 2013)

Jupiter Ndjunga, Principal Scientist, Markets,
Institutions and Policies, *Cameroon*

Patrice Savadogo, Joint Agroforestry System
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Systems, *Burkina Faso*

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Policies, *Benin*

Gaston Sangare, Regional Farm Manager, WCA,
Mali

Kano, Nigeria

Hakeem Ayinde Ajeigbe, Principal Scientist
(Agronomy) and Country Representative,
Resilient Dryland Systems, *Nigeria*

Collaborative Staff

International School of Hyderabad

Helge Gallinger, Principal - International School
of Hyderabad (Patancheru, India), *Germany*
(until 30 Jun 2013)

Oli Tooher-Hancock, Head of School (Principal),
UK

New bilateral projects funded in 2013

Addressing phytophthora blight disease: An emerging threat to pigeonpea expansion and production

Donor Agency: Department of Agriculture and Cooperation, National Food Security Mission, Ministry of Agriculture, Government of India, India

Partners: Banaras Hindu University (BHU), Varanasi, India; RAK College of Agriculture (RAKCA), Sehore, India; Punjab Agricultural University (PAU), Ludhiana, India.

Advancing the productivity frontier for sorghum

Donor Agency: USAID through the University of Georgia, Athens, USA

Better targeting of sorghum in West Africa (deputation of Dr Myriam Adam, CIRAD)

Donor Agency: Centre de Coopération Internationale en Recherche Agronomique pour le Développement, France

Bhoochetana, a sustainable productivity enhancement programme – Phase 2 (2013-17) in Karnataka

Donor Agency: Department of Agriculture, Government of Karnataka, India

Biochemical and molecular mechanisms of insect-host plant resistance signaling system to spotted stem borer, *Chilo partellus* in sorghum

Donor Agency: Science and Engineering Research Board (SERB), Government of India, India

Brainstorming Conference on STI Policy 2013

Donor Agency: Department of Science & Technology, Government of India, India

CV Raman International Fellowship for African Researchers' - Visiting Fellowship – Mr Oumarou Halilou

Donor Agency: Federation of Indian Chambers of Commerce and Industry, India

CV Raman International Fellowship for African Researchers' - Visiting Fellowship – Ms Madina Diancoumba

Donor Agency: Federation of Indian Chambers of Commerce and Industry, India

Capacity building for aflatoxin management and control in groundnuts in Malawi

Donor Agency: World Trade Organization (WTO), Switzerland

Partners: Ministry of Industry and Trade, Department of Agricultural Research Services (DARS), Ministry of Agriculture and Food Security, Ministry of Health, Government of Malawi; National Smallholder Farmers' Association of Malawi (NASFAM), Malawi.

Capacity building for the adoption of Bhoochetana principles and approach in boosting agricultural productivity in the Philippines

Donor Agency: Bureau of Agriculture Research (DA-BAR), Department of Agriculture, Government of Philippines, Philippines

Characterization of defensive insecticidal proteins (lectins and serpins) from plants for deployment in transgenic plants for controlling cotton bollworm, *Helicoverpa armigera*

Donor Agency: Science and Engineering Research Board (SERB), Government of India, India

Characterization of novel brown midrib (bmr) sorghum mutants and improving the conversion efficiency for higher biofuels and bioproducts recovery

Donor Agency: Department of Science & Technology, Government of India, India

Crop biofortification of groundnut and pigeonpea for alleviating vitamin 'A' deficiencies in India

Donor Agency: Department of Biotechnology, Government of India, India

Developing and implementing the genomic component of IBP (G8009.11)

Donor Agency: Generation Challenge Programme/CIMMYT, a member of the CGIAR Consortium

Developing chickpea cultivars suited to mechanical harvesting and tolerant to herbicides

Donor Agency: Department of Agriculture and Cooperation, National Food Security Mission, Ministry of Agriculture, Government of India, India

Partners: Indian Institute of Pulses Research (IIPR), Kanpur, UP, India; Indian Agricultural Research Institute (IARI), New Delhi, India; Punjab Agricultural University (PAU), Ludhiana, Punjab, India; Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV) - RAK College of Agriculture (RAKCA), Sehore, Madhya Pradesh, India; University of Agricultural Sciences (UAS), Dharwad, Karnataka, India; Acharya NG Ranga Agricultural University (ANGRAU) – Regional Agricultural Research Station (RARS)-Nandyal, Andhra Pradesh, India.

Development of abiotic stress tolerant millet for Africa and South Asia

Donor Agency: USAID through the University of California, Davis, USA

Engagement for implementation of production and processing of new groundnut varieties and improved cropping system in Nigeria

Donor Agency: Federal Ministry of Agriculture and Rural Development, Government of Nigeria, Nigeria

Ensuring human health, food and nutritional security through novel cereal and fruit based prebiotics

Donor Agency: India-Sri Lanka Inter-Governmental Science & Technology Cooperation Programme, Department of Science & Technology, GOI

Partners: Industrial Technology Institute, Sri Lanka

Farmer seed enterprises development under the Africa RISING project in Mali

Donor Agency: United States Agency for International Development (USAID), Mali.

For organizing meetings of the Project Advisory and Monitoring Committees (PAMC) at ICRISAT, Hyderabad

Donor Agency: Department of Biotechnology, Government of India

For providing training to field staff, technical backstopping for effective implementation of conservation farming in Chipinge District, Zimbabwe

Donor Agency: Action Contre la Faim (ACF), Zimbabwe

Generation Challenge Programme (GCP) Product Delivery Coordinator -- Dr Patrick Okori, ICRISAT-Malawi

Donor Agency: Generation Challenge Programme/CIMMYT, a member of the CGIAR Consortium

Genome-wide association studies (GWAS) of gene-rich regions associated with target traits for peanut breeding using diverse global germplasm collections

Donor Agency: The Peanut Foundation through the University of California, Davis, USA

Genotyping Services with regard to fingerprinting of 115 groundnut samples with 90 SSR markers

Donor Agency: Generation Challenge Program/CIMMYT, a member of the CGIAR Consortium

Groundnut improvement for smallholding farmers in Asia

Donor Agency: The OPEC Fund for International Development, Austria

Harnessing the role of aquaporins in water conservation and drought tolerance improvement in pearl millet

Donor Agency: Science and Engineering Research Board (SERB), Government of India, India

Improved livelihoods through community water resources management in community watersheds

Donor Agency: SABMiller India Ltd., India

Improving post-rainy sorghum varieties to meet the growing grain and fodder demand in India

Donor Agency: Australian Centre for International Agricultural Research (ACIAR), Australia

Partners: University of Queensland, Australia; Directorate of Sorghum Research, India.

Improving rural livelihoods in benchmark through integrated watershed management in Bellary district in Karnataka

Donor Agency: Jindal South West Foundation, India

Partners: Pranathi Rural Development Society, Karnataka, India

Improving the robustness, sustainability, productivity and eco-efficiencies of rice systems throughout Asia

Donor Agency: The University of Tasmania, Australia

Improving widely grown groundnut cultivars by introgressing genes for resistance to foliar fungal diseases (LLS and rust) and high oil quality (O/L ratio)

Donor Agency: Mars Chocolate North America, LLC., USA

Partners: Directorate of Groundnut Research, Junagadh, India

Increase and enhance chickpea and pigeonpea production technologies in the farmers fields of two districts of Andhra Pradesh and Karnataka under Morocco-India Food Legume Initiative

Donor Agency: OCP Foundation, Morocco

Partners: Regional Agricultural Research Station, Palem and Nandyal, India; University of Agricultural Sciences, Raichur, India

Increasing irrigation water productivity in Mozambique, Tanzania and Zimbabwe

Donor Agency: Australian Centre for International Agricultural Research (ACIAR), Australia

Partners: Australian National University, Australia; CSIRO Land and Water, Australia; University of South Australia, Australia; Food, Agriculture and Natural Resources Policy Analysis Network, South Africa; University of Pretoria, South Africa; National Institute of Irrigation, Mozambique; Ardhi University, Tanzania.

Integrating crop and livestock production for improved food security and livelihoods in rural Zimbabwe

Donor Agency: Australian Center for International Agricultural Research, Australia through ILRI, a member of the CGIAR Consortium

Partners: Department of Irrigation in the Ministry of Agriculture, Mechanization and Irrigation Development, Zimbabwe and Department of Water Resources Planning and Management in the current Ministry of Environment, Water and Climate, Zimbabwe.

Integrating GUI for genomic selection in IBP Tool Box

Donor Agency: Generation Challenge Programme/CIMMYT, a member of the CGIAR Consortium

Partners: Cornell University, USA; Roslin Institute at the University of Edinburgh, UK.

Intensification of maize-legume based systems in the semi-arid areas of Tanzania (Kongwa and Kiteto districts) to increase farm productivity and improve farming natural resource base

Donor Agency: USAID through IITA, a member of the CGIAR Consortium

Partners: CIMMYT; ICRAF; Agricultural Research Institute-Hombolo, Tanzania; Agricultural Research Institute-Naliende, Tanzania; Sokoine University of Agriculture, University of Dodoma, Tanzania.

Intercropping of banana and sweet sorghum in marginal lands of Gujarat, India to demonstrate socio-economic and environmental benefits

Donor Agency: Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (BMZ)/Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Germany

Partners: Technische Universität Berlin, Germany; Abellon Clean Energy Ltd., India.

Maintenance of genetic resources collections (genebank) of ICRISAT

Donor Agency: Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (BMZ)/Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Germany

Placement of Esther Lechevallier as trainee in the project “Phenotyping drought adaptation traits in sorghum and pearl millet”

Donor Agency: National Agronomics Engineering Post Graduate School Toulouse (INP/ENSAT), France

Production of sorghum breeder seed under the West Africa Seed Program

Donor Agency: Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles (CORAF)/West and Central African Council for Agricultural Research and Development (WECARD), Senegal

Programme d'Appui à la Sécurité Alimentaire des Ménages-Tanadin Abincin Iyali (PASAM-TAI) (Support Program for Household Food Security, Tanadin Abincin Iyali)

Donor Agency: USAID through Catholic Relief Services, Niger

Reference genome sequence for pearl millet [A high quality reference genome sequence of pearl millet (*Pennisetum glaucum* L.) for accelerated breeding of improved cultivars]

Donor Agency: Bill & Melinda Gates Foundation, USA

Partners: Beijing Genomics Institute, Shenzhen, China; Institut de Recherche pour le Développement (IRD), France; All India Coordinated Pearl Millet Improvement Project (AICPMIP), ICAR, India; Aberystwyth University, UK; University of Georgia, USA; Pioneer Overseas Corporation, USA; University of Florida, USA.

RegenIntro: Introduction of accessions from the regeneration initiative into the international collections held by ICRISAT

Donor Agency: Global Crop Diversity Trust, Germany

Research based support and facilitation for boosting sorghum production, commercialization and utilization in Nigeria

Donor Agency: Federal Ministry of Agriculture and Rural Development, Government of Nigeria, Nigeria

Services in organizing a Workshop on Community Seed Production (CSP), 9-11 December 2013, Addis Ababa, Ethiopia

Donor Agency: Food and Agriculture Organization of the United Nations (FAO), Italy

Smart cereals for management of stemborer pests in staple cereals in Africa

Donor Agency: Rothamsted Research Ltd., Biotechnology and Biological Sciences Research Council (BBSRC), UK

Supporting the establishment of joint platform

Donor Agency: Chinese Academy of Agricultural Sciences (CAAS), China

Supporting collaborative projects in China

Donor Agency: Chinese Academy of Agricultural Sciences (CAAS), China

Partners: Khon Kaen Field Crops Research Center (KKFCRC), Thailand; Plant Protection Research Institute (PPRI), Vietnam; Research Institute for Oil and Oil Plants (IOOP), Vietnam.

Training Program for Chinese young scientists

Donor Agency: Chinese Academy of Agricultural Sciences (CAAS), China

Training Program on Knowledge and skill development of food testing laboratories personnel from African countries

Donor Agency: Ministry of External Affairs, East and Southern Africa Division, Government of India, India

Training Programs for (i) Development of agribusiness and food processing business incubation centres in Africa; (ii) Advanced Training on Analytical techniques and ISO 17025: 2005 for food testing laboratory personnel from African Countries

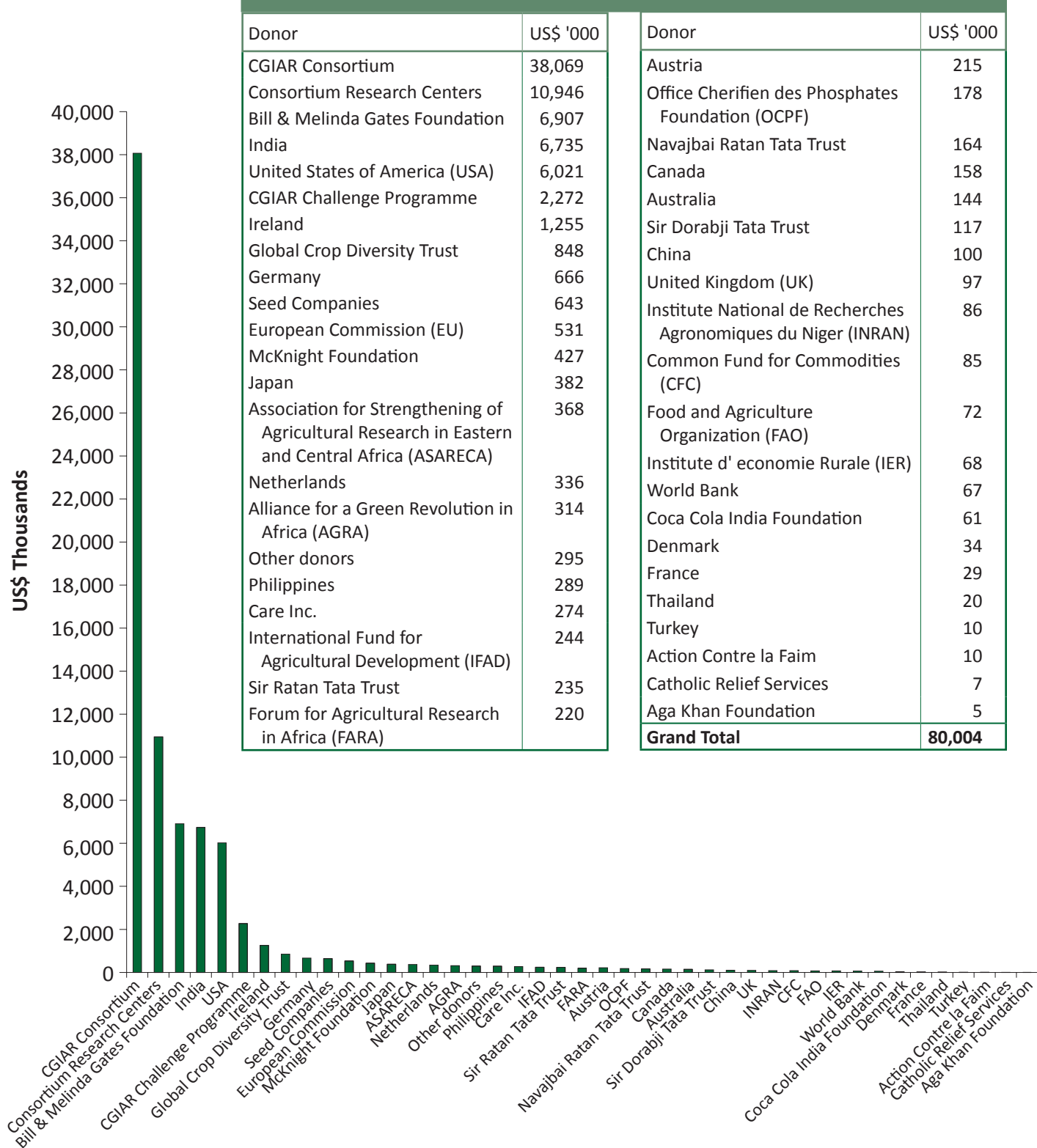
Donor Agency: Ministry of External Affairs, East and Southern Africa Division, Government of India

Financial summary

Balance sheet		
	US\$ thousands	
	2013	2012
Assets		
Cash and cash equivalents	19,260	10,393
Investments	51,239	56,916
Accounts receivable	13,842	24,234
Inventories	920	821
Prepaid expenses	435	436
Property and equipment - net	7,585	6,349
Other assets	3,921	4,753
Total Assets	97,202	103,902
Liabilities		
Accounts payable	19,808	22,937
Accruals and provisions	2,595	3,781
Payments in advance from donors	27,660	30,793
Long-term liabilities	11,352	13,023
Total Liabilities	61,415	70,534
Net Assets		
Unrestricted		
Undesignated	16,431	19,064
Designated	15,113	10,113
Restricted	4,243	4,191
Total Net Assets	35,787	33,368
Total Liabilities & Net Assets	97,202	103,902

Operating results and movements in Net Assets		
	US\$ thousands	
	2013	2012
Operating results		
Revenue	82,995	69,128
Expenditure	80,718	65,373
Surplus	2,277	3,755
Net Assets - Unrestricted		
Undesignated		
Balance, beginning of the year	19,064	17,345
Operating surplus for the year	2,277	3,755
Gratuity/Pension charge	90	(1,036)
Transfer to Designated	(5,000)	(1,000)
Balance, end of the year	16,431	19,064
Designated		
Balance, beginning of the year	10,113	9,113
Transfer from Undesignated	5,000	1,000
Balance, end of the year	15,113	10,113
Total Unrestricted Net Assets	31,544	29,177
Restricted	4,243	4,191
Total Net Assets	35,787	33,368

Grant income from donors for 2013



Capacity strengthening

a. Number and diversity of degree students trained/being trained at ICRISAT

ICRISAT location	Interns		Scholars				Fellows		Countries
			Master's program		PhD				
	M	F	M	F	M	F	M	F	
South Asia									
	36	47	9	7	28	30	19	12	South Asia (India)
	-	-	-	-	-	-	3	1	Southeast Asia (Philippines)
	1	1	-	-	-	-	2	-	East Asia (Japan, Korea, Taiwan)
	-	-	-	-	-	-	-	1	South America (Brazil)
	-	2	-	-	-	-	-	-	North America (United States)
	1	-	-	-	-	-	-	-	South Africa (Zimbabwe)
	-	-	-	-	2	-	2	-	East Africa (Kenya, Tanzania, Uganda)
	-	-	-	-	-	-	4	3	West Africa (Mali, Burkina Faso, Ghana, Niger, Senegal)
	1	-	-	-	-	-	-	3	Europe (France, Norway, Italy, Spain, United Kingdom)
	-	-	-	1	-	-	-	1	Oceania (Australia)
Total	39	50	9	8	30	30	30	21	217
	89		77				51		
<i>(Joined and completed in 2013)</i>	60		0				18		
<i>(Joined before 2013 and completed in 2013)</i>	12		15				13		
<i>(Joined in 2013 and continuing onwards)</i>	17		39				17		
<i>(Continuing from previous year)</i>	0		23				3		
West and Central Africa	18	13	21	5	10	-	-	-	West Africa (Niger, Mali, Burkina Faso, Nigeria)
Total	18	13	21	5	10	0	0	0	67
	31		36				0		
<i>(Joined and completed in 2013)</i>	20		2				0		
<i>(Joined before 2013 and completed in 2013)</i>	1		13				0		
<i>(Joined in 2013 and continuing onwards)</i>	10		16				0		
<i>(Continuing from previous year)</i>	0		5				0		
Eastern and Southern Africa	5	5	1	1	2	1	-	-	East Africa (Kenya, Uganda, Tanzania)
Total	5	5	1	1	2	1	0	0	15
	10		5				0		
Grand total	130		118				51		299

b. Number of training courses, scientific visits conducted in all ICRISAT locations

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
Patancheru, India	Training in Integrated crop management in grain legumes, ICRISAT, Patancheru, 18–20 February 2013	10		10	India
	Scientific visit of research managers and extension workers, ICRISAT, Patancheru, 3–9 March 2013	4	6	10	Philippines
	Training of field staff on HH survey and handling GPs, ICRISAT, Patancheru, 4–5 March 2013	11	1	12	India
	Capacity building workshop on Agropedia and Open Access institutional repository, ICRISAT, Patancheru, 11–12 March 2013	25	5	30	India
	Training in Integrated crop management in grain legumes, ICRISAT, Patancheru, 11–14 March 2013	7	1	8	India
	AgMIP multiple crop model training program, Kathmandu, Nepal, 18–22 March 2013	11	1	12	Australia, Pakistan, Nepal, USA and India
	AgMIP multiple crop model training program, ICRISAT, Patancheru, 25–29 March 2013	27	11	38	Australia, Bangladesh, Burkina Faso, Botswana, Ethiopia, Ghana, India, Kenya, Malaysia, Mozambique, Niger, Nigeria, Philippines, Sri Lanka, South Africa, Tanzania, Uganda, USA and Zimbabwe
	Scientific visit of research leaders/managers, ICRISAT, Patancheru, 23–27 March 2013	4	1	5	Philippines
	Short-term training program on Knowledge and skill development of food testing laboratory personnel from African countries under the India Africa Forum Summit (IAFS)-II, initiative of the Government of India, ICRISAT, Patancheru, 30 March–12 April 2013	12	12	24	Zimbabwe, Gambia, Republic of Congo, Zambia, Nigeria, Senegal, Mozambique, Ghana and Tanzania
	International training program on Detection and management of aflatoxin contamination in crops, ICRISAT, Patancheru, 29 April–10 May 2013	6	2	8	Niger, Niamey, Malawi, Zambia, Sri Lanka and Bangladesh

A participant receives a certificate after completing the AgMIP multiple crop model training program.



Photo: PS Rao, ICRISAT

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Training course on Principles of GIS and remote sensing for natural resource assessment, ICRISAT, Patancheru, 5–10 May 2013	8	2	10	India
	Training course on R software, ICRISAT, Patancheru, 6–8 May 2013	22	6	28	India
	Statistics training course on Agricultural field trial designing and data analysis, Philippines 11–14 June 2013	17	20	37	India, Philippines
	Exposure-cum-training program for officers of Odisha, ICRISAT, Patancheru, 26–28 June 2013	16	3	19	India
	Training on Business incubation, TNAU, Coimbatore, 18–21 June 2013	18	4	22	India
	Agropedia 2.0: Capacity building workshop for new partners, IASRI, Pusa Campus, New Delhi, 15 July 2013	27	5	32	India
	Training course on Modern genomics for crop improvement, ICRISAT, Patancheru, 22 July–9 August 2013	21	9	30	Brazil, Egypt, Ethiopia, Ghana, India, Malawi, Mali, Mozambique, Nigeria, Philippines, Senegal, Tanzania, Turkey, Uganda
	Scientific visit of delegates from the Philippines, ICRISAT, Patancheru, 19–23 August 2013	2	4	6	Philippines
	Training on Conducting multilocation trials of sorghum and pearl millet and data analysis, ICRISAT, Patancheru, 19 August 2013	13	7	20	India
	Capacity building of extension officers of Rubber Board on e-Extension strategies for knowledge sharing, ICRISAT, Patancheru, 20–21 August 2013	25	9	34	India
	Capacity building of extension officers of Rubber Board on e-Extension strategies for knowledge sharing, ICRISAT, Patancheru, 3–4 September 2013	20	10	30	India
	Scientific visit of delegates from the Philippines, ICRISAT, Patancheru, 9–13 September	3	5	8	Philippines
	Third international training course on Pearl millet hybrid parents improvement and seed production, ICRISAT, Patancheru, 10–19 September 2013	25	4	29	Brazil, Burkina Faso, Ethiopia, India, Kenya, Mali, Niger, Sudan, Tanzania, Uganda
	Training program on Seed business, ICRISAT, Patancheru, 30 September–11 October 2013	28	2	30	India
	Fourth international training course on Sorghum hybrid parents improvement and seed production, ICRISAT, Patancheru, 30 September–11 October 2013	20	2	22	Ethiopia, Mali, Nigeria, Senegal, Sudan, Togo and India
	Training program on Plant genetic resources and genbank management, ICRISAT, Patancheru, 7–12 October 2013	14	3	17	India, Ethiopia, Nepal, Tanzania, Niger, Bangladesh, Nigeria, Vietnam, Uganda, Nairobi, Zimbabwe and Malawi
	Short course on Using resilience lens for developing climate resilient agriculture, ICRISAT, Patancheru, 7–18 October 2013	14	0	14	India

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Scientific visit of delegates, media representatives and farmers' leaders of the Philippines, ICRISAT, Patancheru, 15–19 October 2013	4	2	6	Philippines
	Short course on Ecosystem services and integrated watershed management, ICRISAT, Patancheru, 6–15 November 2013	15	2	17	India, China, Senegal and Ethiopia
	Scientific visit of delegates from the Philippines, ICRISAT, Patancheru, 9–17 November 2013	3	0	3	Philippines
	Scientific visit of delegates from the Philippines, ICRISAT, Patancheru, 17–22 November 2013	1	0	1	Philippines
	International training on Application of genetic engineering in grain legumes and its translation, ICRISAT, Patancheru, 18–27 November 2013	11	10	21	Kenya, Ghana, Zambia, Nigeria, Uganda, Vietnam, Philippines, Malaysia, Sri Lanka, Bangladesh and India
	An overview to PRINCE2® – an introductory course for project management, ICRISAT, Patancheru, 21–23 November 2013	17	5	22	Ethiopia, Ghana, India, Kenya, Mali, Niger, Sri Lanka, Zimbabwe
	Capacity building on Gender and equity considerations in the design and evaluation of climate services for farmers adaptation to climate change, ICRISAT, Patancheru, 25–28 November 2013	6	5	11	India, South Africa, Uganda, Senegal, Ghana, Kenya

A training course on pearl millet hybrid parents improvement and seed production in progress.



Photo: ICRISAT

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	ICAR-ICRISAT training program on Adoption and impact assessment of research and development project, ICRISAT, Patancheru, 27–30 November 2013	17	9	26	India
	Training course on Feed resources assessment and prioritization tools organized by ILRI and ICRISAT, ICRISAT, Patancheru, 27–30 November 2013	22	6	28	India
	Scientific visit of delegates from the Philippines, ICRISAT, Patancheru, 27 November - 7 December 2013	7	3	10	Philippines
	ICAR-ICRISAT training workshop on Small farmers value and market linkages, ICRISAT, Patancheru, 2–4 December 2013	30	3	33	India
	Training workshop on Strengthening capacity on impact assessment measurements, ICRISAT, Patancheru, 3–4 December 2013	14	4	18	India and Malawi
	Scientific visit of media representatives of the Philippines, ICRISAT, Patancheru, 4–10 December 2013	3	1	4	Philippines
	Capacity building program on An orientation to innovative agriculture data management platforms, 5–6 December 2013	30	8	38	India, Kenya, Mozambique, Niger, Nigeria, Uganda
	Capacity building program on Appropriate technologies and innovative approaches for agriculture knowledge sharing, ICRISAT, Patancheru, 9–14 December 2013	20	11	31	Ethiopia, India, Kenya, Mali, Philippines, Senegal
	Training course on Pre-breeding and crop improvement in legumes, ICRISAT, Patancheru, 9–20 December 2013	24	1	25	India, Philippines, Bangladesh, Senegal, Ghana, Niger, Kenya, Tanzania, Malawi, Zambia, Mozambique, Lao, Myanmar and Nepal
	Training course on Introduction to application of remote sensing and Geographical Information Systems (GIS) in Semi-Arid Tropics (SAT), ICRISAT, c/o ILRI, Addis Ababa, Ethiopia, 16–20 December 2013	10	0	10	Kenya, Zimbabwe, Malawi, Ethiopia and Mekelle
	Training course on Convergence to unlock the potential of agriculture through scaling-up of research for development (R4D) approach, ICRISAT, Patancheru, 18–27 December 2013	17	1	18	India, Tanzania, Ethiopia
Sub-total (Patancheru)		661	206	867	
Niamey, Niger	Formation en Techniques de production maraîchère, Kallale, 24 January–2 February 2013	7	285	292	Benin
	Formation en Techniques de repiquage de la pomme de terre, Birnin N’Gaouré, January 2013	2	25	27	Niger
	Formation en Maintenance du système d’irrigation goutte à goutte et la fertilisation, Kallale, 16–21 February 2013	5	290	295	Benin, Niger
	Formation en Techniques de maraichage, 24–28 February 2013	10	2	12	Burkina Faso
	Techniques d’extraction des semences maraîchères, February 2013	3	20	23	Niger

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Méthodes d'analyse SEP et recommandation de fertilisation, Niamey, Niger, 4–16 March 2013	7	4	11	Niger, Mali, Burkina Faso
	2 nd International course on introductory, intermediate and advanced remote sensing, TVC, Niamey, Niger, 18–29 March, 2013	18	3	21	Niger, Nigeria, Mali, Zimbabwe, Maputo
	Formation en Techniques de multiplication des semences maraîchères, Kallale, Benin, 8–13 April 2013	5	260	265	Benin
	Formation en Gestion intégrée des ennemies de cultures maraîchères, Kallale, Benin 14–19 April 2013	7	288	295	Benin
	Formation en Techniques de BDL, Mayahi, Niger 15–20 May 2013	17	0	17	Niger
	Formation en Gestion intégrée des nuisibles des cultures maraichères, Birnin N'Gaouré 6–10 May 2013	2	30	32	Niger
	Formation en Techniques de BDL, Matameye, Niger, 21-24 May 2013	17	5	22	Niger
	Formation en Techniques d'extraction des semences du melon, Birnin N'Gaouré, 17–20 June 2013	3	20	23	Niger
	Formation en Techniques de préparation des bio pesticides, Birnin N'Gaouré, 8–12 July 2013	2	30	32	Niger
	Training course on microdosing, warrantage and input shop development, ICRISAT-Niamey, 16–20 September 2013	11	0	11	Benin, Niger, Nigeria
	Formation sur Les techniques culturales de production du moringa et technologie de bio-récupération des terres dégradées (BDL) 25–27 September 2013	16	0	16	Niger

Participants scoring chickpea plants suitable for their respective agroecosystems.



Photo: ICRISAT

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Formation en Techniques de pépinière maraîchère, Birnin N'Gaouré, 14–17 October 2013	2	33	35	Niger
	Formation en Techniques de production maraîchère et de multiplication et stockage de semences, Matameye, Niger, 11–16 November 2013	36	1	37	Niger
	Formation en Techniques de production maraîchère et de multiplication et stockage de semences, Matameye, Niger, 18–23 November 2013	1	29	30	Niger
	Formation en Techniques de pépinières maraîchères, Maradi, Niger, 24–30 November 2013	80	20	100	Niger
	Excel course, 25 September–25 October 2013	20	7	27	Niger
	English Training course, 23 September - 25 November 2013	06	04	10	Niger
Sub-total (Niger)		277	1356	1633	
Bamako, Mali	Formation sur Les tests culinaires des hybrides, Djiguidala, 15 January 2013	20	15	35	Mali
	Formation sur L'enquête de suivi de la diversité variétale, Dioïla, 1 April 2013	9	3	12	Mali
	Atelier de formation sur Les méthodologies de sélection de l'arachide, Samanko, 6–15 May 2013	15	0	15	Mali
	Formation sur L'approche CEP par grappe et essais participatifs, Koutiala, 13–15 May 2013	26	2	28	Mali
	Formation sur La microdose mécanisée et l'utilisation du Gro Plus, Samanko, 28–30 May 2013	29	1	30	Mali
	Formation en Production de semences hybrides de sorgho, Koutiala, 28 May 2013	47	10	57	Mali
	Formation de jeunes producteurs pour la conduite des champs de démonstration hybride de sorgho, Dioïla, 1 June 2013	33	1	34	Mali
	Formation en Production de semences hybrides de sorgho, Dioïla, 2 June 2013	38	10	48	Mali
	Formation sur Microdose mécanisée et utilisation de GroPlus, Koutiala, 4–6 June 2013	26	3	29	Mali
	Formation des partenaires de l'ICRISAT sur la microdose mécanisée, le processus de trempage et d'enrobage des semences avec le GroPlus, Koutiala, 4–11 June 2013	32	2	34	Mali
	Formation sur L'évaluation participative des nouvelles variétés et la diffusion de technologie, Samanko, 1–2 July 2013	38	2	40	Mali
	Formation sur Les techniques agricoles et les techniques de vulgarisation, Samanko, 1–2 July 2013	38	2	40	Mali
	Formation en Production de semences hybrides de sorgho, Siby, 4 July 2013	1	20	21	Mali
	Formation en Production de semences hybrides de sorgho, Samanko, 24 September 2013	7	52	59	Mali

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Training on Groundnut disease screening in West Africa, ICRISAT Samanko, 21–23 October 2013	13	2	15	Mali
	Aflatoxin management, Tiele, Mali, 25 October 2013		155	155	Mali
	Formation sur L'évaluation et la valorisation des champs de démonstration de sorghos hybrides, Koutiala, 1–2 November 2013	40	5	45	Mali
	Training on Pre and post-harvest aflatoxin management using varietal and demonstration plots in collaboration with the extension service (Secteur d'Agriculture de 120, Kolokani), 1 November 2013	120	80	200	Mali
	Formation sur Africa Rising, Samanko, 2–3 November 2013	23	3	26	Mali
	Aflatoxin management, Kita, Mali, 5 November 2013	16	0	16	Mali
	Pre and post-harvest management of aflatoxin, Kita, Mali, 5 November 2013	500	500	1000	Mali
	Training on Peanut transformation and post-harvest aflatoxin management, Kita, 5 November 2013		180	180	Mali
	Training on Pre and post-harvest aflatoxin management using varietal and demonstration plots in partnership with AMASSA-AFRICA GREEN, Koutiala, 13–14 November 2013	300	200	500	Mali
	Training of NGO agents, Koutiala, Mali, 13–14 November 2013	5	13	18	Mali

Trainees in a chickpea field.



Photo: Vidyasagar, ICRISAT

A trainee in a pigeonpea field.



Photo: Vidyasagar, ICRISAT

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Training on Pre and post-harvest aflatoxin management, Koutiala, 13–14 November 2013	10	0	10	Mali
	Training on Integrated aflatoxin management, Sadiola, Kayes, November 2013	3	56	59	Mali
	Training on Integrated aflatoxin management, Ouélessébougo, November 2013	0	155	155	Mali
Sub-total (Mali)		1389	1472	2861	
Kano, Nigeria	Training on Dry season groundnut seed production, Kano, 17 January 2013	56	2	58	Nigeria
	Pre-season training for extension agents and technicians, Ningi, 1 May 2013	17	1	18	Nigeria
	Pre-season training for extension agents and technicians, Kano, 2 May 2013	21	3	24	Nigeria
	Pre-season training for extension agents and technicians, Katsina, 10 May 2013	11	0	11	Nigeria
	Pre-season training for extension agents and technicians, Dutse, 11 May 2013	25	2	27	Nigeria
	Training of enumerators on Household data collection, Bebeji, 21–22 May 2013	12	0	12	Nigeria
	Groundnut value chain stakeholders workshop, 30–31 July 2013	38	4	42	Nigeria
	Groundnut oil extraction machine training, 8 August 2013	9	24	33	Nigeria
	Sorghum survey for farmers in Kano state, 14 August 2013	21	0	21	Nigeria
	Groundnut farmers and stakeholders workshop, 21 August 2013	51	1	52	Nigeria
	EAs and stakeholders mid-season training, Katsina, 28 August 2013	11	0	11	Nigeria
	EAs and stakeholders pre-season training, Dutse, 3 September 2013	23	1	24	Nigeria
	EAs and stakeholders pre-season training, Bauchi, 4 September 2013	17	1	18	Nigeria
	Large-scale farmers meeting and training, 9 September 2013	22	0	22	Nigeria
	EAs and stakeholders mid-season training, Kano, 10 September 2013	24	0	24	Nigeria
	Hammer mill and groundnut oil extraction machine demonstration and training, 10 September 2013	27	22	49	Nigeria
	Training in Dry season groundnut seed production, Kano, 19 September 2013	51	1	52	Nigeria
	Training in Dry season groundnut seed production, Dutse, 19 September 2013	37	2	39	Nigeria
	Training in Dry season groundnut seed production, Bauchi, 20 September 2013	33	4	37	Nigeria
	Training in Dry season groundnut seed production, Katsina, 20 September 2013	31	0	31	Nigeria
	Training for women on Food Security, value addition, entrepreneurship and sustainability of women's cooperative, Zango, 9–10 December 2013	2	29	31	Nigeria

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Training for women on Food Security, value addition, entrepreneurship and sustainability of women's cooperative, Bebeji, 12–13 December 2013	1	32	33	Nigeria
	Training for women on Food security, value addition, entrepreneurship and sustainability of women's cooperative, Tsanyawa, 16–17 December 2013	0	33	33	Nigeria
	Training for women on Food security, value addition, entrepreneurship and sustainability of women's cooperative, Gambawa, 19–20 December 2013	0	30	30	Nigeria
Sub-total (Kano)		540	192	732	
Nairobi, Kenya	Training on Finger millet postharvest handling and value addition, Busia, Kenya, 17–18 January 2013	5	22	27	Kenya
	Data processing using SPSS, Nairobi, 17–26 February 2013	8	5	13	Kenya, Tanzania, Uganda, Eritrea, Sudan
	Assessing the impacts of climate variability and change on agricultural systems in Eastern Africa, Dar Es Salam, Tanzania, 26 February–2 March 2013	22	3	25	Ethiopia, Kenya, Tanzania, Uganda
	Capacity building-cum-training program, Uganda, 18–23 March 2013	20	3	23	India, Ghana
	Training on value links, 8–12 April 2013	8	4	12	Kenya, UK, Germany, Ethiopia, Kenya, Malawi, Uganda
	Training on Protocols for yield gap assessment from local to global scale, Cotonou, Benin, 22–25 April 2013	0	12	12	NARS scientists from India, Bangladesh, Mali, Burkina Faso, Nigeria, Niger, Ghana, Kenya, Tanzania, Uganda, Ethiopia, Zambia

Members of women's groups busy making dishes from finger millet during the training in Busia, Kenya.



Photo: ICRISAT

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Training on Trade off analysis Model for Multi-Dimensional Impact Assessment (TOA-MD), Dubai, 29 April–3 May 2013	15	17	32	NARS scientists from Kenya, Ethiopia, Uganda, Tanzania, Mozambique, South Africa, Mali, India, Pakistan, Sri Lanka
	Statistics workshop on Data analysis, Nairobi, Kenya, 20–29 May 2013	24	2	26	Kenya, Tanzania, Uganda, Ethiopia, South Sudan, Malawi, Eritrea
	Credit linkage forum in western Kenya for finger millet value chain, 19–20 June 2013	13	8	21	Kenya
	Providing effective climate services to farmers in Makueni County, Wote, Kenya, 24–25 June 2013	26	19	45	Extension officers from Makueni, Kenya
	Training workshop on DNA extraction and PCR analysis, 26–28 June 2013	7	8	15	Zambia
	Genotyping-by-sequencing for cereals, 5–8 August 2013	19	12	31	Kenya, Uganda, Tanzania, Ethiopia, Zimbabwe, Zambia, Malawi, Eritrea, South Africa, Niger
	Providing effective climate services to farmers in Machakos County, Machakos, Kenya, 14–15 August 2013	17	13	30	Extension officers from Machakos, Kenya
	Data processing using SPSS, Asmara, 24 August–1 September 2013	16	4	20	Eritrea
	Making the best of climate: Improved planning of farm operations using climate information by farmers, 9–30 September 2013	355	245	600	Farmers from Wote and Kaiti divisions, Makueni, Kenya
	Chickpea agronomic management and germplasm maintenance, Nairobi, Kenya, 10–12 September 2013	18	5	23	Ethiopia, Kenya, Tanzania, Malawi, Mozambique, Uganda, Eritrea

Sharing knowledge on sorghum hybrid parents improvement during a field demonstration.



Photo: PS Rao, ICRISAT

ICRISAT location	Name of the course/scientific vVisit	Participants			Countries
		M	F	Total	
	Phylogenetics workshop for chickpea and pigeonpea breeders, 18–20 September 2013	13	6	19	Zambia, Mozambique, Ethiopia, Uganda, Malawi, Tanzania, Kenya
	Molecular seed purity testing, 23 September–5 October 2013	3	1	4	Malawi
	Gender and value chain analysis, 22–24 October 2013	12	7	19	Zambia
	Training course on Application of biometrics and bioinformatics tools in crop improvement research, Nairobi, Kenya, 4–9 November 2013	17	3	20	Burkina Faso, Eritrea, Ethiopia, India, Kenya, Mozambique, Niger, Nigeria, Philippines, Sudan, Tanzania, Uganda
	Impact Model training and workshop on Foresight and scenario analysis, Nairobi, Kenya, 6–8 November 2013	9	2	11	Zimbabwe, Kenya, Malawi, Niger, India
	Capacity building workshop on Partnering communications – Bringing together communication specialists from different countries in Africa involved in the HOPE project, Tanzania, 25–28 November 2013	10	9	19	Eritrea, Ethiopia, Ghana, India, Kenya, Mali, Nigeria, Tanzania, Uganda, Zimbabwe
	Hybrid pigeonpea technology, seed production and integrated crop management, Nairobi, Kenya, 9–14 December 2013	15	3	18	Kenya, Malawi, Tanzania, Uganda, Ethiopia
Sub-total (Nairobi)		652	413	1065	
Bulawayo, Zimbabwe	Training workshop on Conservation agriculture and fertilizer microdosing, Bulawayo, 17–21 February 2013	5	6	11	Malawi, Zambia, Zimbabwe
GRAND TOTAL		2863	3439	6302	

ICRISAT-HOPE Project Partnering for Communications training workshop in Arusha, Tanzania.



Photo: ICRISAT

ICRISAT Ambassadors of Goodwill

The ICRISAT Ambassadors of Goodwill was launched in 2013, aimed at enlisting the support of outstanding personalities in championing the Institute’s mission, and in helping strengthen awareness of and motivate partner organizations and the public alike to act on the need for science-based agricultural solutions in improving the livelihoods and attaining food and nutrition security of smallholder farmers in Asia and sub-Saharan Africa.

During the visit of Mr Bill Gates, Co-chair of the Bill & Melinda Gates Foundation, to the ICRISAT headquarters in May 2013, he accepted to become the first ICRISAT Ambassador of Goodwill. In the same year, the Institute has been honored with the acceptance of Dr APJ Abdul Kalam, renowned scientist and 11th President of India, and Rt. Hon. James Bolger, former Prime Minister of New Zealand to be named ICRISAT Ambassadors of Goodwill, joining Mr Gates.



Photo: P Panjiar

Mr Bill Gates, Co-chair of the Bill & Melinda Gates Foundation

“ICRISAT crops are great – as they target millions of smallholder farmers globally.”



Photo: PS Rao, ICRISAT

Dr APJ Abdul Kalam, Former President of India

“I have no doubt that the developing world stands to benefit from any technology that can increase food production, lower food prices, and improve food quality.”



Photo: J Kane-Potaka, ICRISAT

Rt. Hon. James Bolger (center), Former Prime Minister of New Zealand

“To overcome poverty, hunger and malnutrition, science is an essential component that must be behind all our efforts. ICRISAT plays an important role in this, particularly in the resource-poor, marginal environments of the world.”

EXPLOREit @ ICRISAT

EXPLOREit @ ICRISAT breaks information management barriers, making scientific information more accessible to the public.

EXPLOREit (<http://EXPLOREit.icrisat.org>) was launched in 2013 giving the general public easy access to ICRISAT's 40 years of scientific information and data.

ICRISAT found that typical websites were too restrictive in providing access to information due to their single navigation structure, and databases or searches did not present the information in ways that were easy for people to scan the detail of the content. EXPLOREit is based on a new information management system called MultiProfiler consisting of **multiple navigations** and **easy-to-scan profiles** on the subject areas.

Information can be found according to the different ways people come looking for ICRISAT's information.

This was identified as: topics (eg, climate change, nutrition and crop improvement); crops; types of farming systems; countries; or resource types (eg, publications or data).

For the first time, ICRISAT also has access to a summary of all its current and past projects, an inventory of all data sources, and a central listing of all stories, videos, and more.

Complex systems behind the scenes also automatically feed the majority of information to all the relevant profiles. To achieve this, ICRISAT has made a momentous leap in its use of technology – moving from a static website to a dynamic site that feeds information from databases using consistent metadata as well as harvesting information from other websites. A range of technologies are used on the platform, adapted depending on the source.

This initiative is supportive of ICRISAT's open access policy to make ICRISAT's information and data available and accessible globally.



Nutrition Profile



Awards 2013

Photo: PS Rao, ICRISAT



Photo: ICRISAT

Dr William Dar receiving the MS Swaminathan Leadership in Agriculture Award for 2013 from Dr K Kasturirangan (2nd right), Member (Science), Planning Commission, Government of India.



Photo: PS Rao, ICRISAT

Dr Hari D Upadhyaya received the prestigious 2013 Crop Science Research Award, as well as the Frank N Meyer Medal for Plant Genetic Resources from the Crop Science Society of America (CSSA).



Photo: AATSEA

Dr Dar receiving the "Excellence in Agricultural Leadership Award" from Prof Kasem Soyong, President of the Association of Agricultural Technology in Southeast Asia.



Photo: ICRISAT

Dr Rajeev Varshney was given the 2013 Young Crop Scientist Award by the Crop Science Society of America (CSSA).



Photo: NAAS

Dr HC Sharma (left) being conferred a Fellowship by India's National Academy of Agricultural Science President Dr RB Singh.



Photo: ICRISAT

Rachit Saxena (right) receiving the Young Scientist Certificate for Plant Genetic Resources Award from Dr Krishan Lal, President, INSA.



Photo: V Suneel, ICRISAT

Mr SM Karuppanchetty, Dr SD Mazumdar and Mr S Aravazhi, receiving the Federation of Indian Chambers of Commerce and Industry FOOD 360° Award for Best Incubator category from Andhra Pradesh Chief Secretary PK Mohanty.

ICRISAT in the NEWS

gatesnotes THE BLOG OF BILL GATES

PEAS AND MILLET

India Day 2: Making a Better Pigeonpea

BY BILL GATES ON JUNE 4, 2013



I have to admit: I'd never given much thought to pigeonpea and pearl millet before last week. But on my second day in India last week I got a fascinating lesson in how work with those crops is helping the livelihoods of some of the world's poorest farmers.

After the meetings in New Delhi that I covered in my [last post](#), we flew to Hyderabad to visit ICRISAT (short for International Crops Research Institute for the Semi-Arid Tropics), an agricultural research center supported by our foundation that focuses on crops grown in semi-arid climates, particularly certain cereals and legumes.

ABS-CBN NEWS.COM

Icrisat names Bill Gates as goodwill ambassador

Published on 06/05/2013 4:51 PM | Updated on 06/05/2013 5:03 PM



Mission
Reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics.

ICRISAT - The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has named Microsoft co-founder and one of the world's richest men Bill Gates as its "goodwill ambassador".

L.A. BIZ

Los Angeles Press Releases

Bill Gates Commends ICRISAT's Work in Reducing Hunger and Poverty

PR Release
HYDERABAD, India, June 5, 2013

HYDERABAD, India, June 5, 2013 /PRNewswire/ --

With food insecurity and malnutrition persisting as the greatest challenges for coming decades, Mr. Bill Gates acknowledged the potential of ICRISAT's work in helping millions of smallholder farmers in the drylands of Africa lift themselves out of hunger, malnutrition and poverty.

BBC NEWS WORLD

In Pictures: Fighting malnutrition



India's National Institute of Nutrition is building an international network of scientists to study the underlying causes of malnutrition, which is a major cause of child mortality and stunting. The institute is also working to improve the nutritional quality of staple crops like rice, wheat, and maize. The institute is also working to improve the nutritional quality of staple crops like rice, wheat, and maize.

philSTAR.com

USAID extends \$4.98-M funding for sweet sorghum production

By Corina Yvonne (The Philippine Star) | Updated October 13, 2012 - 12:00am



THE HINDU

Home News Opinion Business Sport S & T Features Entertainment

TODAY'S PAPER » NATIONAL » ANDHRA PRADESH SANGAREE

Kalam calls for research in agriculture biotechnology



Former President of India and A.P.J. Abdul Kalam has said that breakthroughs in agri-biotechnology have the potential to increase productivity and the resistance of pests and diseases.

Dr. Kalam visited the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) at Patancheru on Thursday as inaugurated the greenhouse containment of the Platform for Translational Research Transgenic Crops (PTTC). He was welcomed by ICRISAT Director General William D. Dar.

Dr. Kalam proposed a list of research aims for ICRISAT. "For PTTC, the first and foremost task should be development of nutritional crops."

Former President A.P.J. Abdul Kalam with ICRISAT Director General William D. Dar at ICRISAT in Medak on Friday.—PHOTO: by arrangement

BusinessLine

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Icrisat-led global team decodes genome sequence of chickpea

VISHWANATH KULKARNI



Breakthrough: GenetiGen Ramesh K. Reddy, Director, CRIS, ICRISAT, William D. Dar, Director-General, ICRISAT, and Rajesh Bangaru, Agriculture Secretary, addressing a press conference in New Delhi on Monday.—Samir Dasgupta

NEWS.COM

CHICKPEA GENOME DECODED

TOP STORY



theguardian

Home World Comment Culture Politics Money Life & Style Books Environment

POVERTYMATTERS BLOG

India farmers think big but grow miero to enrich their soil

Agriculture in India has been struggling to improve productivity as farmers' expenditure has risen over the past few years.



YAHOO! NEWS

ICRISAT launches website for sharing information

Hyderabad, Sep 26 (IANS) The International Crops Research Institute for the Semi-Arid-Tropics (ICRISAT), which conducts agricultural research for development in Asia and sub-Saharan Africa, Thursday launched a website to make large volumes of scientific knowledge and information easily accessible by the public.

ASIAN SCIENTIST

News and information from the asian scientific community

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Chickpea Genome Map May Help Farmers Improve Yields

By Tang Yao-Chung | Featured Research January 29, 2013

An international team of scientists has mapped the genome of chickpea, the second most widely grown legume crop after soybean.




OMAN DAILY Observer


Study stresses need to use results of scientific research

By: Omani Observer | February 2013

The success of scientific research is measured by the successful adoption of the results. The study has also found that efforts in the planning stage are crucial for the success of scientific research.



Impatient Optimists
Bill & Melinda Gates Foundation



How Do You Measure "Empowerment"?
ALINA PAUL BOSSERT, WILLIAM D. DAR
October 21, 2013

India's new Food Security Bill, passed in August this year, entitles an estimated two billion people (75 percent of the rural and 60 percent of the urban population) to heavily subsidized wheat, rice and millet. This program hopes to tackle the alarming rates of malnutrition among children and women in India. India has seen strong economic growth in the last two decades, yet rates of child malnutrition continue to be among the highest in the world.

The study collects new data to examine change over time on key gender-related health, nutrition and institutional metrics. The aim is to try to ultimately measure women's empowerment.

Threshing mills make life less of a grind for West African women
Source: Thomson Reuters Foundation - Mar, 11 Mar 2013 10:28 AM

Author: Agathe Drans and Alina Paul-Bossuet



Using an adapted 100-watt solar engine, about 100 women's groups have been established.

Impatient Optimists
Bill & Melinda Gates Foundation

Nourishing Communities Through Holistic Farming
ALINA PAUL BOSSERT
April 30, 2015

Fighting malnutrition is a complex challenge which on one can claim to solve on their own. We need to consider the agriculture, nutrition, social, and health environment and respond with tailored solutions. Understanding the local context starts by working with farmers as partners as together we can address malnutrition and spread better practices. Engaging the right partners across health and agriculture is also essential to ensure a sustainable impact on nutrition.

The International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), a member of the CGIAR consortium, partners with farmers, governments, researchers and NGOs to help farmers grow nutritious crops like chickpeas, groundnuts, pigeonpea, millet and sorghum. The higher their socioeconomic levels have more balanced diets and become more resilient to pests and drought.



THE FINANCIAL EXPRESS
Today's Paper (E-Paper)

Markets Corporate News Economy Money Industry Mutual Funds

INTERVIEW: WILLIAM D. DAR
DIRECTOR GENERAL, INTERNATIONAL CROP RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

Food security good, but govt should also stress on nutrition



ICRISAT director general William D. Dar says that while food security is a priority, governments must also focus on nutrition. He notes that India's new Food Security Bill is a step in the right direction but emphasizes the need for holistic approaches that include nutrition and sustainable agriculture.

New Agriculturist

Appropriate knowledge and tools for smallholder farmers

Public-funded agricultural extension is often inadequate to meet the information and training needs of smallholder farmers. For a three-year survey, a researcher has looked at various agricultural extension models to identify which are most effective in providing smallholder farmers with the knowledge and tools they need to improve their livelihoods.



AIMS
Openness 'needs both political will and technical skill, fortunately ICRISAT has had both' an interview with Madhan

Horti
The East African Fresh Produce Journal, Horticultural, Agricultural News and the Latest in the field of Horticulture

Partnership and convergence vital in rejuvenating agriculture and livelihoods in the drylands

Each dollar invested in 10 of our major technologies in the last 40 years across crops, regions and technologies - has yielded US\$37.71 in return.

December 11, 2015. The power of sustainable partnership and convergence in pursuing science-led development to benefit smallholder farmers was the highlight of today's 41st annual day celebration of the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) at its headquarters here.

YAHOO! NEWS
ماکتوب

At 41st anniversary, ICRISAT notes partnership with Karnataka

Hyderabad, Dec 9 (IANS) The International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) Monday celebrated its 41st anniversary by underlining the need for sustainable partnership and convergence in rejuvenating agriculture in drylands.

THOMSON REUTERS FOUNDATION
Inform - Connect - Empower

Pigeon pea: A pulse revolution in Padasoli
Alina Paul

On World Food Day, this anniversary highlights how pigeon pea, a drought resistant pulse, has brought a new source of food, fuel and income to poor women in the Indian village of Padasoli.

THE TIMES OF INDIA

'One dollar invested in Icrisat programmes yields \$71'
Ch Sushil Rao, TOI
Hyderabad: The power of sustainable partnership and convergence in pursuing science development to benefit smallholder farmers was the highlight of the 41st anniversary celebrations of the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) at its headquarters here.

THE HINDU
R. AVADHANI February 19, 2013

Dramatic improvement in groundwater levels



O. Setaiah is an elderly farmer of this village. Since the past two years he has been witnessing visible change in the village. The groundwater levels have increased, milk yield by the cattle has improved and some farmers have been able to go in for a third crop.

"I have 4.5 acres of land and cultivate sugarcane and paddy. Since the last two years, the yield has increased thereby allowing us to provide water for the crops. Not only I, but most of the villagers benefited as besides the quality of the milk, the quantity has also increased," Mr. Setaiah told The Hindu.

21CN新闻

国际团队解析90个鹰嘴豆基因组 将加速农业应用

中商网深圳1月20日电(记者 郑小红)由印度国际半干旱热带作物研究所(ICRISAT)、美国加州大学戴维斯分校和深圳华大基因研究院等单位组成的国际鹰嘴豆基因组测序合作组(CGCG)成功对90个鹰嘴豆进行了基因组测序及分析。最新研究结果1月20日在《自然·生物技术》杂志上在线发表。

这项科学突破将有助于提高鹰嘴豆的产量、质量、抗旱及抗病能力,同时也有利于增加鹰嘴豆的多样性。

VANCOUVERDESI.COM
CANADA'S PREMIER SOUTH ASIAN NEWS SITE

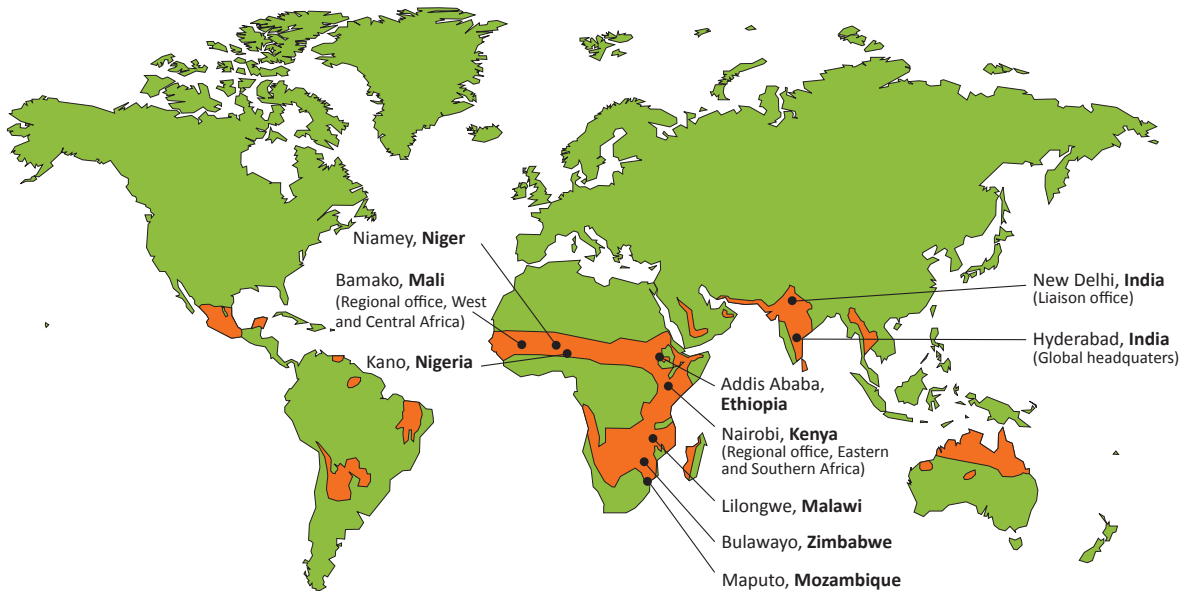
ICRISAT director general conferred leadership award

Hyderabad, Dec 6 (ANS) International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) director general William D. Dar was conferred with the prestigious excellence in agricultural leadership award by the Association of Agricultural Technology in Southeast Asia (AATSEA).

The award was presented to him during the second international conference on integration of science and technology for sustainable development at Bangkok-based King Mongkut's Inst of Technology on Nov 28.

The award was given in recognition of Dar's outstanding achievement, dedicated service, untiring efforts, exemplary vision, unwavering commitment and unselfish support in the field agriculture in southeast Asia and beyond, said a statement by ICRISAT here Friday.

ICRISAT locations in the semi-arid tropics



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**International Crops Research Institute
for the Semi-Arid Tropics**

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru near Hyderabad, Telangana, India, with two regional hubs and six country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

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