IMOD

Inclusive Market-Oriented Development

Action towards benefiting the poor

ICRISAT IMOD Exemplars - Volume I

ICRISAT
Science with a human face
International Crops Research Institute
for the Semi-Arid Tropics

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Photo Credits:

Main Photo: A woman in Guidan Gaba, Niger operating a groundnut processing machine; *Abdoulaye Amadou, ICRISAT*.

Picture 1: A farmer carrying chickpea harvest in Myanmar; *Dr PM Gaur, ICRISAT*

Picture 2: A farmer in a sorghum field; *PS Rao, ICRISAT*.

Picture 3: Participants at a training session in a food testing lab; *ICRISAT*.

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2014

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Message from the Director General

ICRISAT's inclusive and market-oriented vision

Markets are the focus of policy initiatives like inclusive growth, as they determine the welfare of consumers and producers. Linking farmers to markets is critical for improved livelihoods of smallholder farmers but they face serious disadvantages in marketing their produce. They have small marketable surpluses that are costlier to trade in distant urban markets due to higher transport and transaction costs and poor bargaining capacity. As a result, smallholders are often bypassed in the process of transformation of agriculture and agri-businesses. Hence, traditional solutions to improve productivity on small farms may not directly result in higher income unless these initiatives are appropriately linked to markets.

At ICRISAT, we believe that farmers should be at the centre of all our research interventions. It is our firm belief that for true development in the agricultural sector, smallholder farmers should be part of the value chain. We need to provide support mechanisms that will help them access the chain and directly enjoy the benefits. Only then will we be able to say that our interventions have made an impact. In this context, the cornerstone of ICRISAT's Vision 2020 – IMOD or Inclusive Market-Oriented Development – becomes even more relevant. IMOD's explicit goal is to include the poor and smallholder farmers in crop value chains. This requires major innovations and partnerships.

The IMOD pathway will contribute to reducing poverty since markets create demand for a wide range of high-value foodstuffs and agro-industrial products. This stimulates agro-enterprises that raise rural incomes and create opportunities to invest in and beyond agriculture. Smallholder farm families have to be empowered and assisted along this development pathway to lead them from poverty to prosperity.

This is the underlying strategy of our research for development (R4D) activities across Asia and sub-Saharan Africa, which is home to 700 million impoverished dryland farmers, who subsist on less than a $1 a day.

The IMOD strategic framework guides our work along the path that leads to our most cherished goals. It prevents us from going astray, and helps us to better help the poor to fulfil their deepest aspiration – not just to be less poor, but to escape poverty altogether. That is the purpose of IMOD. This virtuous cycle of increasing investment and increasing rewards, is what we expect to be the outcome of adopting the IMOD approach.

Therefore it is deeply gratifying to see that ICRISAT along with its partners – NARS, development agencies and the private sector – have demonstrated that IMOD is and will continue to be a viable strategy for a sustainable pathway out of poverty for the farmers in the semi-arid tropics.

I welcome this volume of IMOD Exemplars, which highlights some of our inclusive, market oriented initiatives, across regions in Asia and sub-Saharan Africa. This compilation of "ICRISAT's IMOD Exemplars" is a beacon of hope and motivation to all of us as we continue to enhance our efforts to increase prosperity for the dryland poor and the smallholder farmers in the semi-arid tropics of the world.

William D Dar
Director General

Introduction

Smallholder farmers are locked in a vicious cycle of subsistence production and poverty, which limits the impact of national and international research in reducing poverty and hunger worldwide. Imperfections in agriculture commodity markets undermine the participation of smallholder farmers and hinder the ability of the poor to benefit from policy reforms. Furthermore, underdeveloped markets diminish the farmer's incentive to invest in improved agricultural technologies. For markets to serve smallholder farmers and the rural poor effectively, it is critical to develop institutions and strategies that promote market coordination and reduce transaction costs. Addressing this challenge requires developing innovative mechanisms that make markets and institutions work for the poor.

There is an urgent imperative to identify how best to engage the rural poor in markets and in producer organizations to increase productivity and incomes. This requires (i) an aggressive Inclusive Market-Oriented Development (IMOD) strategy for inclusion of the smallholder farmer; and (ii) a broader approach to identify bottlenecks at different stages and to develop innovative market institutions to reduce market failures. This calls for identification of best practices in markets and institutional arrangement at different levels, spanning micro, meso, macro, and international dimensions.

This volume exemplifies a set of case studies, which demonstrate the impact of research for development at ICRISAT through its interventions. There are eight case studies – four each from sub-Saharan Africa and South Asia.

These case studies illustrate the stimulation of market-oriented development through: a) understanding the factors that promote market-oriented agricultural and rural transformation; (b) adopting best practices in engaging small farmers and the rural poor in markets and profitable value chains; (c) rigorously evaluating pro-poor innovations in market institutions; (d) developing knowledge support systems for evidence-based decision-making; and (e) establishing research-to-policy platforms to facilitate pro-poor transformation.

These exemplars cover various innovations like micro-dosing and agri-business innovation platforms; and crops grown by smallholder farmers such as pigeonpea, chickpea, sorghum and pearl millet across the crop value chains. The case studies in this volume show the effective application of cutting-edge science to generate knowledge on socio-economic mobility, innovation, and agricultural transformation in different geographical, political, and socio-cultural settings. This illustrates strategies for enabling markets and institutions to work for the poor, thereby stimulating agricultural transformation and upward socio-economic mobility in rural areas of sub-Saharan Africa and Asia.

I would like to thank all the ICRISAT focal scientists in West and Central Africa, Eastern and Southern Africa and South Asia, and their partners, who have contributed to this volume and my colleagues in Markets, Institutions and Policies Program and the Strategic Marketing and Communication team for their support.

Cynthia Bantilan

Research Program Director - Markets, Institutions and Policies

IMOD in ICRISAT – Implementing the Vision

Inclusive Market-Oriented Development (IMOD) is a market-cum-science-led strategy, which helps increase productivity of smallholder farmers by bridging the large yield gaps and generating marketable surpluses. The next critical step is inclusive and innovative market interventions to ensure that farmers get a fair price for their produce. This allows them to enhance their incomes and gives them the option to either re-invest or diversify. Thus, IMOD helps smallholder farmers move towards a prosperous market-oriented farming.

The ICRISAT Strategic Plan 2020 document lays out the IMOD vision, while the Business Plan document highlights the critical focus areas and on how to catalyze and integrate them into the annual work plans of scientists. The ICRISAT Medium Term Plan 2011-2013 provided a three-year roadmap of specific actions to achieve its strategic objectives. This covers the mission goals of reducing poverty, hunger, malnutrition, gender, and environmental degradation in dryland tropics that contribute directly to IMOD.

To implement IMOD, ICRISAT has developed and is developing partnerships with stakeholders such as government outreach departments, NGOs, development agencies and the private sector to achieve its research for development objectives. This “common vision” approach calls for scaling-up models to achieve economies of scale and collective action as integral parts of the IMOD strategy

To integrate and mainstream the IMOD approach within ICRSIAT and its stakeholders and partners, numerous workshops and capacity building programs covering topics such as markets, value chains, inclusiveness, empowering gender, agri-business, value addition, etc, are being conducted and supported with a lot of strategic communications on IMOD linked material. Specific IMOD activities are brainstormed and formulated and integrated into work plans during global, regional and annual planning meetings, research program workshops and linked to ICRISAT mission goals and development outcomes.

The ICRISAT Director General has a blog on IMOD, on which he shares his views on inclusiveness, markets and development pathways. The Director General and key senior ICRISAT scientists and managers are brand ambassadors of IMOD at various regional and international fora and seminars.

In 2014, ICRISAT appointed a panel of experts from Asia, Africa and the USA to undertake a Center Commissioned External Review (CCER) to evaluate the IMOD implementation in ICRISAT. The CCER panel has unequivocally endorsed this vision of IMOD and its activities and has recommended measures to strengthen and enhance it further.

With the publication of the first set of case studies, ICRISAT has shared and demonstrated exemplars of how such inclusive and market-oriented approaches can sustainably transform the lives of small and disadvantaged farmers in the semi-arid tropics. By making IMOD core to its strategic vision, ICRISAT is demonstrating how science and markets can converge in a “win-win” manner to create economic wealth for the smallholder famers and quality produce for the consumers.

M Srinivas Rao
Specialist, Markets, Research and Innovation and
P Parthasarathy Rao
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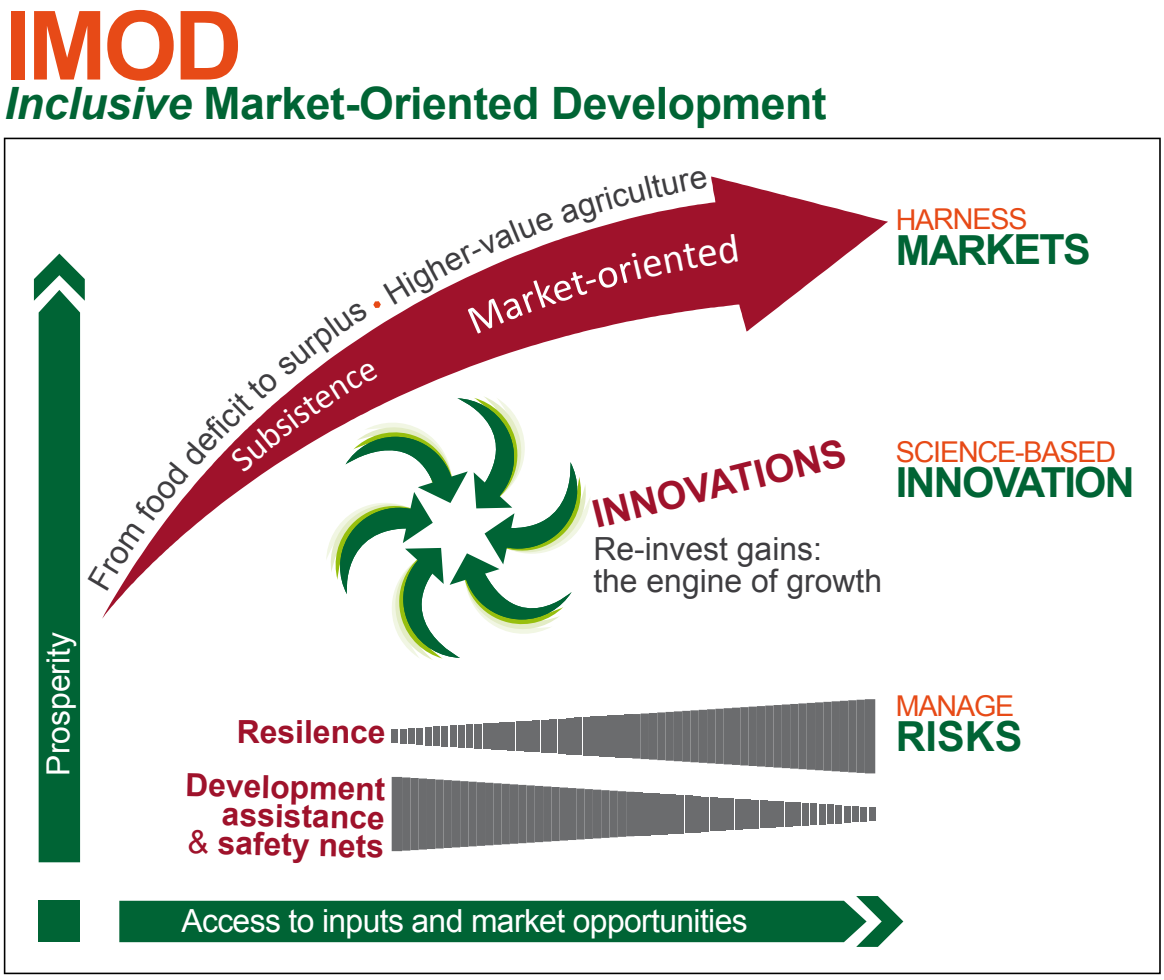
Markets, Institutions and Policies Program

Inclusive Market-Oriented Development (IMOD)



Inclusive Market-Oriented Development is a development pathway in which value-adding innovations (technical, policy, institutional and others) enable the poor to capture larger rewards from markets, while managing their risks. The larger rewards motivate the adoption and impact of these innovations.

The IMOD development pathway is a progression of development states in which the poor move from subsistence agriculture – characterized by poverty, food insecurity, malnutrition and land degradation - to market-oriented agriculture, characterized by prosperity, food and nutritional security, resilience and sustainable land management.

Acronyms

ABI	Agri-Business Incubator
ACIAR	Australian Center for International Agricultural Research
AIIC	Agribusiness Innovation and Incubation Consortia
ANGRAU	Acharya NG Ranga Agricultural University
ARS	Agricultural Research Station
ASA	Agricultural Seed Agency
BMGF	Bill & Melinda Gates Foundation
CBO	Community-based Organization
CEO	Chief Executive Officer
COO	Chief Operating Officer
CRP	CGIAR Research Program
CRS	Catholic Relief Services
DANIDA	Danish International Development Agency
DGIS	Directorate General for International Cooperation (The Netherlands)
DRD	Department of Research and Development
DRDA	Direction Régionale de Développement Rural (Extension services)
DR&SS	Department of Research and Specialist Services
EAML	East African Malting Ltd
EU	European Union
EU-IFAD	European Union-IFAD
FAO	Food and Agriculture Organization
FARA	Forum for Agricultural Research in Africa
FCRI	Field Crops Research Institute
FPVS	Farmer participatory variety selection
FPBIC	Food processing business incubators
FTL	Food testing laboratories
GoI	Government of India
HOPE	Harnessing Opportunities for Productivity Enhancement of sorghum and millet
IAFS	India Africa Forum Summit
IARI	Ilonga Agricultural Research Institute
IDM	Integrated disease management
IFAD	International Fund for Agricultural Development
IPM	Integrated pest management
IFDC	International Fertilizer Development Center
IMOD	Inclusive Market-Oriented Development
INRAN	Institut National de la Recherche Agronomique du Niger
INP	Innovations and Partnership
INM	Integrated nutrient management

IRR	Internal rate of return
ISO/IEC	International Organization for Standardization/ International Electrotechnical Commission
IS-SI	ICRISAT South-South Initiative
KVK	Krishi Vignan Kendra (farmer knowledge center)
LAAS	Liaoning Academy of Agricultural Sciences
LWR	Lutherian World Relief
LZARDI	Lake Agricultural Research and Development Institute
MAFSC	Ministry of Agriculture, Food Security and Cooperatives
MAU	Marathwada Agricultural University
MoFPI	Ministry of Food Processing Industries
NAFDAC	National Agency for Food and Drug Administration and Control
NARI	Naliendele Agricultural Research Institute
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organization
NPK	NutriPlus Knowledge
NPV	Net present value
OCPF	Office Cherifien des Phosphates Foundation
PMG	Producer Marketing Group
PPP	Public Private Partnership
PSC	Project Steering Committee
PVS	Participatory Variety Selection
QDS	Quality Declared Seed
RARI	Rajasthan Agricultural Research Institute
RBS	Rwanda Bureau of Standards
RKVY	Rashtriya Krishi Vikas Yojana
SARI	Selian Agricultural Research Institute
SHG	Self-help group
SHP	Soil Health Program (of AGRA)
SIMLESA	Sustainable Intensification of Maize-Legume Systems for Food Security in Eastern and Southern Africa
SKRAU	Swami Keshwanand Rajasthan Agricultural University
SSA	Sub-Saharan Africa
SVVU	Sri Venkateshwara Veterinary University
SWOT	An approach analyzing strengths, weaknesses, opportunities and threats
UniBRAIN	Universities, business and research in agricultural innovation
USAID	United States Agency for International Development
VS	Variety Selection
WAARI	West African Agri-Business Resource Incubator
WCA	West and Central Africa
ZFC	Zimbabwe Fertilizer Company

General Information

1,267,000 km²
Niger (Area)

17,138,707
Niger (Population in 2010)

$11.63 billion
Niger (GDP, 2011 est.)

31,002 km²
Dosso (Area)

2,016,690
Dosso (Population in 2010)

- Rainfall (Dosso): 400 to 900 mm (annually)
- Cultivated land (km²): 144,911 (2005)
- Cultivated land (%): 11.44. (2005)

Crops grown

- Rainfed crops: Millet, sorghum, cowpea, peanut and bambara nuts
- Irrigated crops: Rice, vegetables and fruit trees are grown in river valley and flood plains

Issues related to poverty

- Periodic droughts, desertification, high population growth, poor education and health care, lack of infrastructure, and environmental degradation

Percentage population in agriculture

- Nearly 53% of the population is actively involved in crop production

Photo: Dr Jupiter Ndjeunga, ICRISAT

Women groundnut seed producers' associations of Sambera, Niger.

Sowing the seeds of prosperity

Market-linked innovation to empower women groundnut seed producers and seed companies

Contributed by:

Dr Jupiter Ndjeunga, Principal Scientist, Markets, Institutions and Policies, ICRISAT, Niger

Groundnut is a major source of income, protein and calorie intake for rural households in West and Central Africa (WCA). It is considered a woman's crop, as women farmers play a major role in the groundnut seed value chains – they are the major groundnut seed producers, major groundnut seed processors and seed marketers. However, not enough institutional, policy and market support has been provided to women to improve seed value chain efficiencies. A SWOT analysis on the performance of the groundnut seed sector showed that women farmers were not exposed to modern varieties, had little knowledge of seed production technologies, and were facing seed marketing constraints.

Women in Guidan Gaba operating a groundnut processing machine.

They were therefore stuck in a vicious cycle of low access to quality inputs, low productivity, low value addition and poor access to markets, resulting in low incomes.

Since 2007, ICRISAT, through the Tropical Legumes II (TL II) project, has been working with more than 27 farmer association seed producers, totaling 870 members (90% women) in the Dosso region of Niger to evolve and develop these 3 major upgrading options: (1) access to modern varieties, (2) training in seed production technologies, and (3) access to inputs (such as varieties, good quality seed and fertilizers) and production market for groundnut seed by linking women seed producers to the market.

The Solution

To overcome the key problems mentioned above, ICRISAT developed a set of interventions, components of which were critical for success.

a) Engaging with farmers to assess their preferences for varieties (2007-2009)

As a first step, ICRISAT felt that any intervention had to be farmer-led and participatory in nature. This would eventually lead to a higher level of commitment and ownership. For the first two years, ICRISAT fostered partnerships among the traditional extension services and the farmer associations, and was engaged in participatory variety selection trials with 5 groundnut varieties

(4 modern varieties - RRB, J11, ICG9346 and Fleur 11, and a local check, 55-437) in a unique "mother and baby" trial approach. The "mother trials" were randomized in a complete block design with 5 varieties and 5 replications, and the "baby trials" consisted of incomplete designs with 2 modern varieties and a local traditional check provided to the farmer. Depending on the villages, 2 to 3 modern varieties were eventually preferred by women. In the Guidan Gaba region for example, the modern variety RRB and the local check 55-437 were preferred. The selected varieties were then used to build up seed supply systems, which were acceptable to the community.

b) Capacity Building as a key game changer: Training in seed production technologies (2009-2010)

Following the choice of preferred varieties by women farmers, the women were trained in seed production technologies by traditional extension services with support from ICRISAT. Seed quality assurance and quality control were monitored by the traditional extension services under the National Seed Service scheme of the Department of Agriculture. This made the farmers confident enough to accept and adopt new varieties. In fact, during the last 5 years, more than 2500 women farmers were trained in seed production technologies in their respective villages.

c) Developing management of small business/ training in small-scale business and management skills (2011-2012)

It was important to develop the skill sets of the women farmers to the next level, ie, to develop and manage small businesses in a value chain approach. ICRISAT therefore organized 2 major training programs in small-scale business and marketing skills for women farmers in the Mairie of Gaya region. The training programs were customized to their context and each training workshop involved about 50 women seed producers.

d) Engaging stakeholders

As a next step, ICRISAT organized a critical Stakeholder meeting with the groundnut seed value chain actors in the Dosso region. This involved the seed producers and seed companies in a discussion on the types of contractual arrangements and traits they preferred. There was a good exchange of ideas and the needs were explained for better understanding and transparency among the parties. This resulted in the drafting, testing and implementing of contracts that are likely to be sustainable between producers and processors with both accountability and transparency.

Pilot testing seed marketing strategies proof of concept

To resolve the marketing constraint, and after much deliberation, two marketing strategies were experimented with – (1) the sale of seed in small packs, and (2) the interlinked contracts with seed companies. A pilot experiment to assess the potential demand for small packs of seed by smallholders was conducted in the Dosso region. Seed was packed in different sizes (5 kg, 2 kg, 1 kg and 0.5 kg), besides which, half of the seed was treated against pests and diseases. Results showed that more than 64% of groundnut seed stocks were sold in 5 kg packs, 1 kg packs, 2 kg packs and 0.5 kg packs. Sixty-nine percent of the treated seed was purchased but not significantly different from the untreated seed estimated to 57%. There were however significant differences between selling points, based on the positioning of the selling points, the level of knowledge of agro-dealers and small-scale retailers on marketing and business skills and the agro-ecological zone. All selling points located in the local markets sold, on average, 79% of the seed stocks, significantly more than selling points located far from the local markets estimated to 40%. The levels of sale in selling points located in drier areas was lower (48%) compared to less drier areas estimated at more than 78%. The level of knowledge was not found significant,

though shop managers with better knowledge in marketing and business skills sold 70% of their seed stocks against 55% for those with poor knowledge. This operation had limited profitability due to a range of factors including the poorly accessible location of selling points and the limited knowledge on marketing and business skills of shop tenants. This initial feedback helped in improving the strategy in line with the estimated demand at each selling point for each pack size.

The Success

Following the interventions as detailed above, it was heartening to see the success generated, obvious from improvements in production, livelihoods and the quality of life in the target region.

In 2011/12, the 27 women's associations supplied about 72% of the total groundnut seed produced in the whole country of Niger. These associations had 870 members (including 640 women) from 11 villages (namely Faska, Hankoura, Guidan Gaba, Sambera, Sia, Takoye Bangou, Koma Beri, Karakara, Wassangou, Doula and Tounga). An estimated 50 percent of association members were involved in seed production per se, while others were involved in other activities such as processing, etc. The production of basic and certified seed quintupled from 17 tons in 2008/09 to 92 tons in 2012/13, and more than 2000 tons of quality declared seed were produced (Table 1)

On average, each producer was producing 5.31 bags (of 40 kg each) and was deriving a gross profit of 21,240 FCFA ($45). This income was very important for a woman farmer who can now purchase 3 small goats, which she could never afford in the past.

However, women were still confronted with the problem of commercialization of seed.

Table 1. Trends in seed production of different classes by women farmers in the Dosso region of Niger

Year	Type of seed		Total (Kg)
	Basic	Certified	
2008/2009	4472	12243	16715
2009/2010	7040	26000	33040
2010/2011	10950	25680	36630
2011/2012	13275	22550	35825
2012/2013	20840	71550	92390
Total	56577	158023	214600

QDS: Quality Declared Seed* more than 2000 tons of QDS have been produced

Market Oriented Development

To create market linkages, we referred to past studies, which had indicated that from a small-scale private entrepreneur point of view, the sale of small pack seeds yielded losses estimated at US$0.51/ kg of seed. Profitability of such small-scale seed enterprises would increase significantly with better market positioning, more training in small-scale marketing and business skills and the choice of the size sought by the market (above 1 kg).

During the last 2 years, following a stakeholder meeting of actors along the groundnut seed chain, seed companies had pledged to contract with women associations. At the beginning of cropping seasons, formal contracts were signed between seed companies (MANOMA, AINOMA, Alheri, FUSA'A) and the women's associations. ICRISAT entered into interlinked contracts where inputs were provided on credit to women at the beginning of the cropping season, which would be reimbursed in kind at harvest time. The women would now receive a guaranteed price of 30% above the ongoing grain price in the market at the time of purchase, and the seed companies would purchase the seed in a time bound manner. The quality criteria included in the contracts were of average varietal and physical purities, and with good germination.

In addition, the bags used for the seed would be new and weigh at least 40 kg for shelled nuts. The contracts were made flexible allowing farmers to reimburse the credit in either cash or kind. In 2012/13, the contracted amount of 50 tons was honored by seed companies without delays or any contract failure. This scheme is working well for several reasons – earlier, seed companies were not involved in seed production and thus were not taking any production risks and were also not getting consistent quality. In the present arrangement there are reliable supplies and consistent good quality.

This intervention has generated a high degree of success in terms of impact on women farmers. In 2007, the percentage of farmers knowledgeable about modern varieties was estimated at 9.77%, the proportion of farmers who planted improved varieties was estimated at 6.4% and the proportion of area planted to improved varieties was 2.3%. In 2011, the number of farmers exposed to modern varieties had increased to about 73%, the proportion of farmers planting modern varieties had increased to about 64%, and 49% of the groundnut area was planted with modern varieties.

On average, each farmer was producing 5.31 bags (of 40 kg each) and was deriving a gross profit of 21,240 FCFA ($45). This is very important for a woman farmer who can purchase 3 small goats for fattening or create more assets for household nutrition and security.

A seed company agent of MANOMA weighing a groundnut bag to ensure that it met the norm of 40 kg.

Photo: Dr Jupiter Ndjeunga, ICRISAT

Incorporating Inclusiveness

The success of ICRISAT interventions in the region were not merely seen in the tangible results of increased production and incomes, but was also manifested in a broader perspective, building confidence among farmers, developing leadership qualities, increasing knowhow about natural resource management, diversification and risk management, and inculcating a sense of inclusiveness, ownership and responsibility in the community.

Though groundnut is primarily a woman's crop in the Dosso region, all men who were interested in groundnut production in the villages were also included in the project (640 women and 230 men). Women are very involved and are now playing a major role in taking major decisions at household and village levels. For example, in Guidan Gaba, women have re-built a mosque that had collapsed during a rainstorm, which the men were not capable of doing. Women are now paying the school fees of their children and even taxes for men in certain cases.

Lessons Learned

As we pursue the IMOD approach, we gain useful experience and a clearer understanding of similar challenges encountered, thus

Small groundnut seed packs labelled and conditioned by women in Faska.

Photo: Dr Jupiter Ndjeunga, ICRISAT

facilitating a quicker application of successful interventions. We learned several lessons including, (1) development should be made indigenous and sustainable, (2) many communities are still unaware of modern technologies, (3) women are being empowered and are playing a major role in development activities, and (4) seed companies could easily engage in groundnut seed marketing but will be reluctant to take production risks.

The Way Forward

We are now in a position to plan for the scaling up of partnerships and building more capacity among the farmers, including stronger links with the seed companies. In the 2013/14 cropping season, seed companies signed 10 contracts with women seed association producers based on 80 ha of groundnut. The major goal of the seed companies is to contract with seed producers on 500 ha in the next 2 years.

Key Information

Name of project: Tropical Legumes II project

Key scientists: Jupiter Ndjeunga (ICRISAT), Bonny Ntare (INRAN), Mountari Adamou (INRAN)

Key partners:

Women associations of Faska, Hankoura, Guidan Gaba, Sambera, Sia, Takoye Bangou, Koma Beri, Karakara, Wassangou, Doula and Tounga

Seed companies: MANOMA, AINOMA, FARA'A, ALHERI

INRAN Seed Unit: The Seed Unit of the **I**nstitut **N**ational de **R**echerche **A**gronomique du **N**iger

DRDA: Direction Régionale de Développement Rural (Extension services)

ICRISAT: Managing the entire project.

LWR: Lutherian World Relief

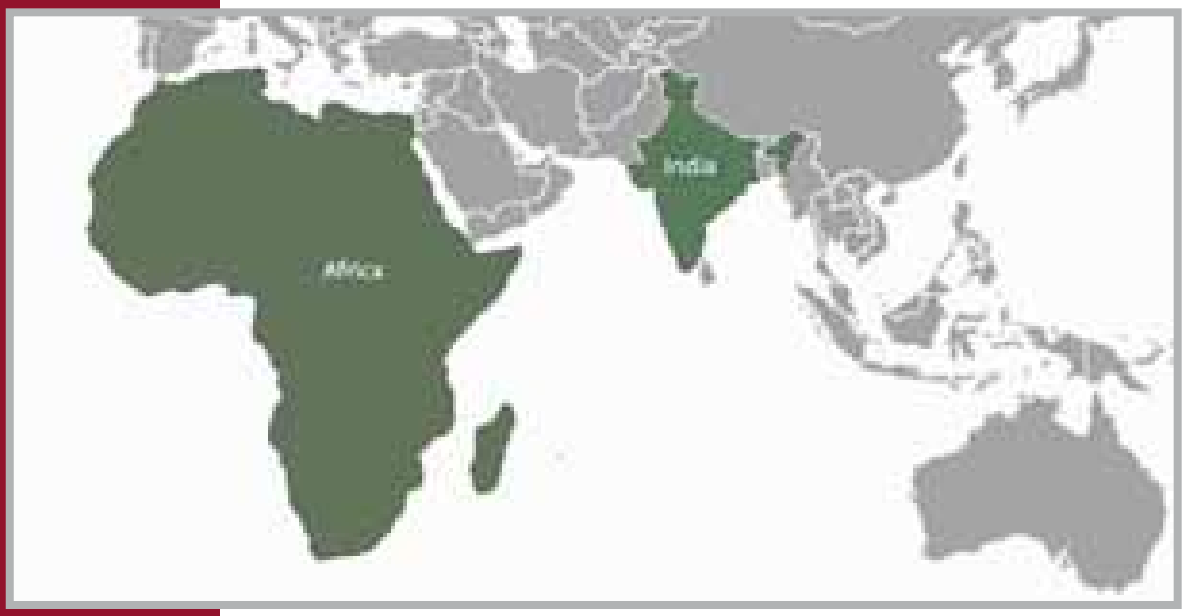
FAO: Food and Agricultural Organization in their seed programs

- Women associations are involved in groundnut basic and certified seed production and marketing.
- Seed companies have interlinked contracts with women associations. Seed companies provide seed and fertilizers, buy back the seed produced, then recover input costs.
- The DRDA are also involved in training women farmers on seed production techniques. They are tasked with monitoring seed production through field inspections. Other agents of the DRDA are involved in seed quality testing and provide quality certificates.
- INRAN seed unit and ICRISAT are responsible for the supply of breeder and foundation seed to women farmers and seed companies.
- ICRISAT manages the entire project and provides support in breeder and basic seed production as well as training in small-scale business and marketing skills.

Project duration: June 2007-2013

This work was undertaken as part of the following two CGIAR Research Programs:

General Information



3,287,000 km²
India (Area)

1,124 million
India (Population in 2011)

$7,256,571 billion
India (GDP, 2011)

30,221,532 km²
Africa (Area)

1.1 billion
Africa (Population, 2011)

30.51/km²
Africa
(Population density, 2011)

INDIA

- Per Capita Income (current) Rupees ($) per annum: 61,185 (1,340)
- Density of Population: 342 per km²

AFRICA

Country	Population (in thousands)	Per Capita GDP (Euro dollars)	Agricultural and Food Production Index (2004-2006=100)	Human Poverty Index (HPI-1) Value (%)	Human Development Index (New 2014 Estimates for 2013)
Angola	20,163	5,777	187.58	37.2	0.526
Cameroon	20,469	1,290	144.57	30.8	0.504
Ethiopia	86,539	461	135.96	50.9	0.435
Gambia	1,825	511	85.91	40.9	0.441
Ghana	10,481	1,467	128.61	28.1	0.573
Kenya	42,749	952	121.73	29.5	0.535
Malawi	15,883	291	162.03	90.5	0.414
Mali	16,319	659	142.59	54.5	0.407
Niger	16,644	400	137.56	55.8	0.337
Nigeria	166,629	1,727	101.85	36.2	0.504
Republic of Congo	69,575	261	114.41	24.3	0.564
Rwanda	11,272	599	156	32.9	0.506
Uganda	35,621	665	115.35	28.8	0.484
Zambia	13,884	2,003	138.23	35.5	0.561
Zimbabwe	13,014	659	105.04	34.0	0.492

Source: Department of Economics & Statistics – Statistics of India (Data: 2011-12)
Ten Facts about Africa - African Development Indicators 2011
African Statistical Yearbook 2013

Photo: Bhubesh Kumar, ICRISAT

Dr William Dar, DG, ICRISAT examining agri-products on display developed by the women cooperative groups of WAARI in Mali.

Taste of success

Agri-business Innovation Platform - India and Africa

Contributed by:

Kiran K Sharma, Chief Executive Officer, Agribusiness and Innovation Platform, ICRISAT, India

In the globalized world, imports and exports are playing a major role in determining the economic growth of a country. Major economies of the world have been importing significant amounts of food and agricultural products from developing and under-developed countries. Although, this seems like a win-win situation, importing countries are only importing produce/products that meet the stringent safety norms set forth by their nations. Even developing and under-developed countries are placing a greater importance on the production of quality and safe food that is being either imported into their respective countries or exported from their countries. To ensure that food and agricultural products are certified as safe, they need to

Dr Kiran Sharma, (2nd from right) with clients and staff at the "Global Symposium on Ready-to-Eat Foods: Opportunities for R&D, Entrepreneurship and Markets".

undergo exhaustive testing using high to very high-end testing equipment and technologies coupled with skilled manpower to perform the testing operations. Optimal food processing production facilities also need to be made available to enable entrepreneurs to carry out production of quality food products as per requirements of the markets. Most African nations lack such production and testing facilities and skilled manpower to operate them.

The Solution

The solution lies in setting-up food processing business incubators (FPBICs) and food testing laboratories (FTLs) that are accredited with internationally accepted accreditations, and in providing training to operate and manage such incubation and testing facilities. Thus, in order to address the need for infrastructure and support towards promotion of agribusiness and food processing in African countries, the Agribusiness and Innovation Platform (AIP)-ICRISAT has undertaken the following interventions:

- AIP has partnered with the Forum for Agricultural Research in Africa (FARA) for handholding and mentoring its UniBRAIN (Universities, Business and Research in Agricultural Innovation) initiative, under which **six Agribusiness Innovation and Incubation Consortia (AIICs) are being supported in five African countries** (Ghana, Mali, Uganda, Kenya and Zambia). ICRISAT, and FARA along with its local African partners, are helping in setting-up of these incubator consortia addressing value chains for sorghum, banana, mango, livestock and agroforestry. The project is funded by DANIDA.
- The Ministry of Food Processing Industries (MoFPI), Govt. of India, under the India-Africa Forum Summit-II, is **establishing five Food Processing Business Incubation Centres** in Mali, Ghana, Uganda, Cameroon and Angola, for which ICRISAT has been selected as an Implementing Agency. The host institution in Uganda is NARL, and in Cameroon it is the Douala Chamber of Commerce. This initiative will help the local entrepreneurs enhance their business skills for scaling-up in the business of food processing. The purpose is the development of innovative entrepreneurs contributing to higher production of quality food products, which in turn will help to increase the economy of Africa by way of meeting the livelihood concerns and increased foreign exchange earnings.
- AIP has received the MoFPI-GoI project on "**Establishment of Food Testing laboratories "**, in Africa (Rwanda, Nigeria, Republic of Congo, Zimbabwe and The Gambia) to help the local entrepreneurs promote their business prospects by entering the national and international markets with products meeting the stringent nutritional and food safety standards. The FTLs shall be set up in the Department of Research and Specialist Services (DR&SS), Zimbabwe; Ministry of Commerce & Supplies, Republic of Congo; Rwanda Bureau of Standards (RBS), Rwanda; National Agency for Food and Drug Administration and Control (NAFDAC), Nigeria and Ministry of Health and Social Welfare, The Gambia. The purpose is to establish state-of-the art FTLs for promoting entrepreneurs in the area of food processing by providing them access to the latest food testing facilities, thus enabling production of quality and safe food products meeting international standards.

Setting-up a testing facility involves a high cost, primarily because of the high cost of instruments that are required in the testing industry. It is very important that the stakeholders be part of the process of establishing the FTLs, such that the testing laboratory can develop testing competency for the products that are exported and imported. Regulatory agencies, another key stakeholder, should work very closely with the testing facility in setting-up the benchmarking standards and providing regulatory inputs to the testing laboratory. Other significant stakeholders whose involvement is critical to the success include importers, exporters, trade unions, farmers and manufacturers. The laboratory should keep in mind the needs of all these stakeholders and must involve and serve them to be successful.

The Success

The above interventions are ongoing and have already shown success in terms of having the relevant infrastructure setup being established and capacity building having been successfully undertaken. The following capacity building programs and incubator facilities have already been completed:

i. "Knowledge and Skill development of Food Testing Laboratory personnel from African countries under IAFS – II" from 30 March to 12 April 2013, for 24 participants from nine African nations.

ii. "Management of Food testing laboratory and ISO/IEC 17025:2005" on 17 December 2013 for 26 participants from Ministry of Agriculture, Mechanization and Irrigation Development, Harare, Zimbabwe.

iii. "Advanced training on Analytical techniques and ISO/IEC 17025:2005 for Food testing laboratory personnel from African countries under IAFS – II" from 3 to 18 March 2014, for 24 participants from 10 African nations.

iv. "Development of Agribusiness and Food Processing Business Incubation Centers in Africa under IAFS – II" from 17 February to 1 March 2014, for 24 participants from eight African nations.

The success of any food testing laboratory can be measured in two ways – direct and indirect. Direct effect can be seen when there is an increase in the volume of food and agricultural products that are regulated by an importing country. Export of quality products that meet the requirements of importing countries results in significantly higher income for the people resulting in improvement of their livelihoods. Increased incomes can result in circulation of more money into the country's financial system, thereby improving economic stability of a nation.

Dr Saikat Datta Mazumdar interacting with the stakeholders as part of the scoping study towards the establishment of Food Testing Laboratories in Africa under IAFS-II.

(L to R) SM Karuppanchetty, Dr William Dar and Dr Kiran Sharma interact with an entrepreneur at an exhibit stall.

Indirect benefits far outweigh the direct benefits as it stems from provision of safe and quality food for the citizens. Food testing ensures that the food and water being consumed by the citizens is of the quality that meets the norms set by the regulatory agencies. This would result in fewer epidemics, protecting the lives of the poor and needy. It would also ensure that people consume food that is devoid of added adulterants, thereby resulting in an improved quality of life. Improved quality of food – food that meets the requirements laid down by the government or regulatory bodies, food that meets the nutritional claims as made on the product labels – becomes a reality for the poor and down-trodden.

Market Oriented Development

Like any other business, agro- and food processing, including the business of food testing, is market driven. The primary beneficiaries would be the exporters, since the incubators will produce quality products and the products will be tested and certified by the newly established internationally accredited laboratory. Since the products are tested and certified by an accredited laboratory, the importing countries in most cases will accept the food products without further expense on testing. Since exports include both direct food and agricultural products and processed foods, all stakeholders, including farmers and manufacturers, will get immensely benefited, thus ensuring "inclusive market-oriented development". People involved in livestock and marine foods will also get benefited. A majority of these beneficiaries would be women and small-scale farmers, since they comprise the bulk of those involved in agricultural operations.

For example, the Agri-Business Incubation (ABI) Program under ICRISAT's AIP has facilitated the establishment of the first ever full-fledged agribusiness incubator in West Africa. The West African Agri-Business Resource Incubator (WAARI) was officially inaugurated on 23 January 2014 in the Selingue province of Mali. WAARI is one of the six agribusiness incubators being established under the FARA-UniBRAIN project where ABI is the handholding and mentoring partner. This Agribusiness Incubation Center is expected to create agro-enterprises and jobs that will ultimately benefit the smallholder farmers in Mali.

Incorporating Inclusiveness

While the ICRISAT team conducted a feasibility study tour prior to preparing the business plan, stakeholder meetings were organized at each FTL to sensitize stakeholders on different aspects of the project. Stakeholders – farmers, entrepreneurs, manufacturers, importers, exporters, regulatory bodies, personnel from the ministry, and institutes housing FTLs – attended the meetings and expressed their needs. During discussions, they spoke at length expressing the need of such a food testing laboratory and the services envisaged. The key focus while interacting with the stakeholders was to understand their expectations from the food testing laboratory in terms of the services to be provided.

Each country formed a Project Steering Committee (PSC) to make decisions regarding the FTL, and the PSC invariably consisted of members from a wide range of stakeholders. The primary reason for their inclusion is to give them an opportunity to have a voice throughout the life of the project, and to ensure that the services of the laboratory are in tune with the dynamic needs and requirements of the industry. Stakeholders from the industry are expected to be more amenable to the changes that are needed on a regular basis in a fast changing global market.

Lessons Learned

The IMOD approach has been used in all the planning phases of this project. Compared to ICRISAT's experience with other projects, the IMOD approach has always yielded better results in empowering smallholder farmers and other weaker sections of the society. Since the project is an ongoing one, key factors influencing success cannot be discussed at this stage. However, the key factor of IMOD that has significantly influenced the project so far is the "inclusiveness" approach, which primarily focuses on the economic development of the weaker sections of society.

The Way Forward

Keeping in view ICRISAT's mandate of capacity building, and within the broader framework of "ICRISAT South-South Initiative (IS-SI)", AIP will continue to engage in strong and successful India-Africa partnerships to replicate these successful initiatives, and to ensure prosperity and economic opportunities in other countries of Africa as well.

Key Information

Name of project:

- Setting up of Food Testing Laboratories (FTLs) in five African countries under the India-Africa Forum Summit – II (September 2012 to August 2015).
- Setting up of Food Processing Business Incubators (FPBICs) in five African countries under the India-Africa Forum Summit – II (September 2012 to August 2015).
- FARA-UniBRAIN project on setting-up six AIICs in Africa under funding from DANIDA.

Key scientists: Dr Kiran K Sharma CEO, AIP-ICRISAT; Dr Saikat Datta Mazumdar, COO, NPK/AIP; Mr S Karuppanchetty, COO, ABI/AIP; Mr Aravazhi Selvaraj, COO, INP/AIP; Mr Bhubesh, Manager ABI/AIP; Mr Jonathan Philroy, Manager, ABI/AIP.

Key partners: Ministry of Food Processing Industries, Government of India; Ministry of External Affairs, Government of India; Forum for Agricultural Research in Africa (FARA); Governments of the respective African countries.

Project duration:
India – ongoing since 2003
Africa – ongoing since 2012

General Information

945,203 km^2
Area

44,928,923
Population (2012 census)

$79.388 billion
GDP (PPP) 2013 estimate

355,000 km^2
Agricultural land

788,000 metric tons
Sorghum cultivation (2010)

225,000 metric tons
Finger millet cultivation (2010)

- Average rainfall: 900-1000 mm.
- Sorghum is the third most important cereal in Tanzania. Sorghum is cultivated in an estimated area of 650,000 hectares per annum.
- Finger millets are the fourth most important cereals. They are produced in smaller quantities but they are widely consumed and traded nationwide. It is cultivated in an estimated area of 250,000 hectares per annum.
- Sorghum (yield, 2010): 9738 kg/ha
- Finger Millet (yield, 2010): 6818 kg/ha
- Crops grown: Cash crops, which are grown specifically for sale, include cotton, coffee, tobacco, and cashew nuts. Food crops are maize, cassava, beans, millet and bananas
- Agriculture accounts for 27% of the GDP.
- The agricultural sector is the main source of employment and livelihood for about 77.5 percent of the population.
- UN (United Nations poverty rankings): On the Human Development Index of the United Nations Development Programme, the United Republic of Tanzania ranked 163 of 170 countries in 2000, and 152 of 187 countries in 2013
- Human Index: Tanzania's HDI value for 2012 is 0.476—in the low human development category—positioning the country at 152 out of 187 countries and territories.

DRD researcher leads farmers in Participatory Varietal Selection for sorghum.

HOPE for the future

Sorghum and finger millet in HOPE Project, Tanzania

Contributed by

Henry Ojulong, Scientist,
Dryland Cereals, ICRISAT-Kenya

Eric Manyasa, Scientist,
Dryland Cereals, ICRISAT-Kenya

Agriculture, contributing to 25% of GDP and employing more than 75 percent of the population, is the mainstay of the economy in Tanzania and has potential to be a key driver of economic growth in the country. Nationally, the poverty level is estimated at 40%, with access to modern technologies cited as a constraint, as only 50% of the demand for improved seed and fertilizers are met. ICRISAT's HOPE project on productivity and profitability improvement for sorghum and finger millet has project sites in five semi-arid districts of Tanzania namely, Kondoa, Singida Rural, Iramba, Kishapu and Rombo, with a combined population of about 1.5 m people. Of these, 95 percent are directly employed in agriculture with 50 percent of

A finger millet farmer using a mechanical thresher.

them being women. There are about 300,000 households in the five HOPE mandate districts with average household size of 5 persons who own and cultivate about 1.2 to 3.2 ha (3-8 acres) of land. Female headed households are estimated to be about 10 percent. The major general agricultural constraints in these districts are unreliability of rainfall, pests and diseases, inaccessibility to modern inputs (including mechanization) and information on crop agronomy and markets. The impact of these factors is low labor and land productivity, and uncompetitive crop enterprises.

Although sorghum and finger millet, compared to maize and beans, are better adapted to semi-arid conditions of Tanzania, their productivity at the start of the HOPE project in the 2009-2010 season was estimated to be as low as 0.5 tons/ha. The low crop yields and attendant subsistence incomes realized by farmers in the HOPE districts were mainly due to inaccessibility to low-risk crop, soil and water management technologies, and inadequate participation in product and input markets. With limited skills in production and product marketing, the farmers operated at subsistence level with little or no surplus to sell, leading to endemic food and income insecurity. The synergies between the Department of Research and Development (DRD) and other segments of the finger millet and sorghum value chains, were minimal due to weak public and private partnerships and general inadequacy in input and product marketing infrastructure, leading to high and prohibitive marketing transaction costs. A low level of farmer participation in technology development, evaluation and dissemination had also contributed to low adoption of improved sorghum and finger millet technologies. Hence the HOPE project's R4D thrust used an integrated value chain approach to identify constraints and opportunities towards upgrading the efficiencies of the value chains. An upgrade of the value chains means improvement of productivity, profitability and the competiveness of these two crop enterprises, which would in turn drive up the demand for sorghum and finger millet technologies. Hopefully, with improved profitability, household incomes, food security and general welfare.

R4D Interventions

The key to improving the finger millet and sorghum productivity and profitability under the HOPE project was the strengthened linkage between ICRISAT, DRD, farmers, seed companies (and their retail outlets) on one hand, and the product markets (the driver of the R4D process) on the other hand. At the beginning of the project, representatives of key stakeholders in sorghum and finger millet research (DRD and ICRISAT), production (farmer groups, individual farmers, extension), input supply (Suba-Agro, NACO Seeds and Agro-dealers) and product markets (EAML, Nyirefarm, farmer groups and EAML Agents) held two workshops – one for inception and for sensitization and bonding of partners, and the second for participatory research and technology delivery techniques to define the challenges, opportunities, and technology preferences and delivery channels by zones. Resulting from the workshops, technical action plans and roles of

various partners were defined. Furthermore, ICRISAT and DRD did a baseline survey to delineate the existing status of production and marketing, constraints and potential solutions, which then helped the project to set target and indicators for monitoring the progress in the project and to set farm level strategies for improving productivity. DRD and ICRISAT, in partnership with farmers and extension services, undertook Participatory Variety Selection (PVS) in which a number of finger millet and sorghum varieties were test-evaluated on farmers' fields, enabling breeders, farmers, East African Malting Ltd and grain processors (such as Nyirefarm) to select varieties with desirable agronomic and market traits. Microdosing, integrated *Striga* and blast management and water management (tied ridging) technologies were test-adapted and disseminated to farmers as a package, together with improved finger millet and sorghum varieties in the five project districts during field days.

The project worked closely with three private seed companies (Suba-Agro, SeedCo and NACO Agricultural Seed) and the Government to supply farmers with subsidized certified seed (50% cost reduction) of the market preferred sorghum varieties. In addition, the project facilitated production of Quality Declared Seed (QDS), which was affordable to majority of the farmers as it was sold in small seed packs at half the price of certified commercial seed. In the five project districts, over 5,000 mini-seed packs of QDS were produced by extension services and accessed by farmers each year.

Through training in improved crop management and better post-harvest handling techniques, farmers increased their grain yield and quality. Each of the five districts trained at least 1000 farmers (with 60 percent being women) annually. In each district at least one farmer group was trained in agri-business. The five groups were each supplied with tarpaulin to be used as a threshing platform, and mechanical threshers in order to produce clean and high quality grain for the market and to reduce demand for threshing labor.

Veronica, a smallholder beneficiary in her finger millet field.

Photo: Eric Manyasa, ICRISAT

ICRISAT and Department of Research and Development (DRD) scientists in a sorghum QDS field in Central Tanzania.

Impacts Define the Success

ICRISAT's HOPE project's main R&D thrust in Tanzania was to enhance sorghum and finger millet productivity and household incomes by improving farmers' access to production technologies and markets in five districts in semi-arid Tanzania. The PVS resulted in identification of about 10 promising sorghum and finger millet varieties, from which one variety (NACO Mtama I) and two hybrids (IESH 22012 and ATX 623 x Macia) of sorghum, and two finger millet varieties (U15 and P224) were officially released in 2012-2013. Driven by market pull, by the second year of the project (ie, the 2011-2012 cropping season+, the activities had spilled over to five non-project semi-arid districts of Same, Mwanga, Moshi Rural, Kongwa and Serengeti. In the spillover districts during the 2012-2013 season, 11,000 farmers, accessed 62 t of QDS seed of Macia and NACO Mtama I sorghum, which, in combination with other recommended agronomic practices, raised the yield from 0.7 tons/ha to 2.5 tons/ha. Farmers from these spillover districts sold 10,000 t of grain to EAML agents and earned 40% more income from the sale of sorghum grain than in the previous year.

In 2012, farmers in the semi-arid sorghum producing districts accessed 400 tons of improved certified seed at commercial prices, 400 tons at subsidized prices and 200 tons of QDS. The 1000 tons of improved sorghum seed was planted

Photo: Henry Ojulong, ICRISAT

in 100,000 ha of land by an estimated 180,000 farm households. Farmers also received 15 tons of finger millet seed for varieties U15 and P224 from the project. With use of improved sorghum technologies, farmers reported a yield of about 2 tons/ha, up from 0.5 tons/ha for sorghum and about 1.8 tons/ha - up from 0.5 tons/ha for finger millet at the start of the project. Most farmers now have access to quality subsidized or QDS seed of market preferred sorghum varieties at affordable prices.

The mechanical threshers used by farmer groups have greatly reduced labor for threshing and are capable of threshing 8 bags (90 kg per bag) in one hour (about 50 bags per day). Farmer groups with threshers also rent thresher services to non-group members at $1 per bag and the demand for thresher services is more than its availability. The farmers linked to the Serengeti Brewery sold about 80% of their sorghum grain at a price of about $18 per 90 kg bag. On the basis of the yield increase (and all other factors held constant) the gross margin from use of improved varieties and associated management technologies was $288/ha, a 400% increase compared to pre-intervention conditions. Each year, 3000 finger millet farmers from HOPE mandate districts have accessed about 12 tons of QDS, enough to plant about 3000 ha. The increased household income due to better market access has assisted households in paying for their medical bills and school fees, as well as in buying oxen for traction, buying productive cows, purchasing seed and fertilizers, and in constructing better concrete and iron-corrugated houses. Household food security and nutrition has also improved, as sorghum and finger millet grain is now available throughout the year.

Main Drivers of the IMOD Process in R4D

The main driver of this positive change process was the value chain approach to R4D, in which key stakeholders in the various segments of sorghum and finger millet value chains were active participants in identification of challenges and opportunities for implementation. Better access to agronomic information by farmers was made possible by active participation of DRD, ICRISAT, farmers, extension personnel and input sellers through their participation in PVS, annual field days, demonstrations and farmer exchange visits. Improved access to seed was facilitated by the private-public partnerships in which ICRISAT and DRD provided Breeder and Foundation seed, while the Government of Tanzania, Suba-Agro, NACO seeds and SeedCo collaborated in supplying subsidized Certified seed through agro-dealer networks. QDS, produced by extension services in all HOPE mandate districts, and subsidized seed, was bought by farmers at half the price of commercial seed, and these two seed channels made improved seed available and more affordable to resource poor farmers.

Through better access to input and product markets, subsistence farmers increased their productivity, food and nutritional security and household incomes. Active participation of the East African Malting Ltd. (EAML) in organizing the grain marketing by appointing grain buying agents and issuing of contracts to agents to deliver agreed amounts of grain each year together with the assured grain market, helped to spur production of market desired varieties.

Incorporating Inclusiveness

At the start of ICRISAT's HOPE project, a stakeholder's forum, consisting of researchers from DRD and ICRISAT, farmers, extension personnel and input sellers from all the five HOPE mandate districts, as well as representatives from seed companies, grain processors and East African Malting Ltd, was held for participatory identification of constraints and opportunities for interventions at every segment of the sorghum and finger millet value chains. The action plans for implementation at each segment of the value chain was formulated by active participation of the key stakeholders. Researchers, farmers, extension and industry representatives also used PVS to identify varieties with acceptable agronomic and market traits, which were then recommended for the release process. Annual review and planning meetings with the participation of all key stakeholders (40 percent women) along the sorghum and finger millet value chains were held to assess the progress made and identify any challenges and associated solutions for future implementation.

The project, in partnership with regional governments and seed companies, provided subsidized certified sorghum and finger millet seed to the poor or most vulnerable households at half the commercial price through seed vouchers. Additionally, QDS was packed in mini-packs (1/2 kg for finger millet and 1 kg for sorghum) and sold to farmers through agro-vets at half the price of commercial seed. In each HOPE mandate district, grain marketing forums, representing farmer groups, industry agents, extension and urban grain assemblers, were initiated to assess the challenges in grain marketing and to identify interventions for implementation.

Lessons Learned

In HOPE mandate districts three seed models or channels, namely Certified seed sold at market prices, Certified seed subsidized by Government (at 1/2 market price) and QDS (1/2 market price), complemented each other in order to improve seed accessibility to smallholder farmers. The Certified seed from seed companies that are sold through agro-vet at commercial rates, although beyond the reach of most smallholder farmers, serve the richer farmers who require large amounts of seed. The majority of resource poor smallholder farmers have benefitted immensely from subsidized and QDS seed. QDS is an important seed class that facilitates technology adoption of open pollinated varieties and fills gaps by the formal sector while small seed packs/mini-packs are efficient approaches of introducing new crop varieties to farmers.

Grain market pull, by active participation of EAML and their grain aggregation agents, is a major incentive to adoption of improved sorghum technologies. The use of sorghum and finger millet varieties that are preferred and in demand in the market, as well as use of labor saving technologies such as threshers, has made sorghum and finger millet farming attractive, more profitable and less labor intensive, and this has saved time for farmers, especially women, to engage in other productive activities.

The Way Forward

In the last three years, the HOPE project has established the foundation for making sorghum and finger millet important cash and food enterprises for farmers in semi-arid districts of Tanzania. In the future, besides direct support for further release and dissemination of improved finger millet and sorghum varieties, the project should continue to facilitate the strengthening of the established partnerships along the value chains in order to

operate more efficiently and more predictably through holding of regular review and planning forums and to institutionalize past successes of the project, including forward contract arrangements in product and input marketing. Other areas of future focus will be first, in each of HOPE's five mandate and five spillover districts, (and in addition to routine selling of commercial and subsidized Certified sorghum and finger millet seed produced by Suba-Agro and NACO Seeds), 3 t of sorghum and 1 t of finger millet of QDS seed in mini-packs will be produced each year by farmer groups and marketed through local agro-vet. This will sustain affordability and accessibility to quality seed by about 5000 new/old users of improved varieties in each district annually as well as help institutionalize structures to commercialize a QDS seed production and distribution system. Secondly, we need to strengthen the functioning of the EAML agents by providing them with business training so that they not only serve as aggregators of grain, but also offer some basic services such as threshing, cleaning and bagging services to farmers. Thirdly, we should implement regular facilitation of credit forums with local credit institutions, farmers, aggregators and agro-dealers in order to assess sorghum and finger millet value chain credit needs and to link the needs to available credit products.

To increase local demand for sorghum and finger millet grain, interventions to diversify household and community level uses of sorghum and finger millet by developing a variety of value added products as well as promoting their commercialization, should be initiated. Mechanizing the production and post-harvest operations are critical to making finger millet and sorghum value chains more attractive, efficient, profitable and competitive. To improve grain quality, farmers should be encouraged to construct and use concrete threshing platforms as the tarpaulins that had been previously recommended as threshing floors degrade very fast and are unlikely to be adopted by farmers in the long run. The East African Malting Ltd should be encouraged to also invest in sorghum research and Certified seed distribution and marketing. The number of farmer, producer and marketing groups should be increased while at the same time the governance skills and organizational structures of the new and old groups should be improved. The project should also commission an activity to determine the level of early adoption and impact on resource poor farmers, as well as determining dissemination channels and lessons learned that can be used to scale out successes in non-project semi-arid districts of Tanzania.

Key Information

Name of project: HOPE

Key scientists: Henry Ojulong, Eric Manyasa, Alistair Orr, Patrick Audi and Mary Mgonja (currently with AGRA)

Key partners: DRD Tanzania, TOSCI, NACO Seed Ltd, Suba-Agro, EAML, Ministry of Agriculture Food Security and Cooperatives (MAFSC), Farmer Groups

Project duration:
Ongoing since 2008

This work was undertaken as part of the CGIAR Research Program on Dryland Cereals

Farmer group in a marketing forum.

Photo: Patrick Audi, ICRISAT

General Information

275,068 km²
AP (Area) 2011

8,45,80,777
AP (Population) 2011

$1.842 trillion
India (GDP-2012)

754,409 cr
AP (GDP, 2012-13)

61,120,000
Myanmar
(estimated population, 2012)

$51.92 billion
Myanmar (GDP-2011)

Andhra Pradesh (AP)

Rainfall-AP (5-year average): 908 mm annually
Rainfall-Kurnool (avg. 2008-09 to 2012-13): 668 mm
Total cultivated land (India) 15.78 million acres
Total GCA (Andhra Pradesh): 14.51 million hectares
Total chickpea cultivation (India): The area under chickpea has increased from 6.45 million ha in 1992-93 to 8.52 million ha in 2012-13.

Chickpea cultivation (area)	The area under chickpea in Andhra Pradesh has increased from 60,000 ha in 1992-93 to 680,745 ha in 2012-13.
In Kurnool:	0.21 million hectares
In Prakasam:	0.11 million hectares
% Earnings from agriculture	60% of population engaged in agriculture and related activities

Myanmar

Rainfall: In the delta region about 2,500 mm of rain per year (Yangon 2,700 mm), while the average annual rainfall in the dry zone in the center of Myanmar is less of 1,000 mm (840 mm Mandalay).
Total cultivation (area): 1,109,840 km² approx. (2007)

- Total chickpea cultivation in Myanmar is mainly in the central dry zone of the country, on an estimated area of 200,000 hectares.
- The major agricultural product is rice, which covers about 60% of the country's total cultivated land area.
- Agriculture in Myanmar is the main industry in the country, accounting for 60% of the GDP and employing about 65 percent of the labor force

Source: 1) Directorate of Economics and Statistics and 2) Agricultural Statistics at a glance--2013

A chickpea farmer with improved chickpea cultivar in Myanmar.

Song of the season

Enhancing adoption of improved chickpea cultivars in India and Myanmar

Contributed by

Pooran M Gaur, Assistant Research Program Director and Principal Scientist, Grain Legumes, ICRISAT, India

Fifteen years ago, chickpea was a subsistence crop in the state of Andhra Pradesh in India and in Myanmar. The chickpea area was comparatively small (133,000 ha in Andhra Pradesh and 141,000 in Myanmar) and the average yields were low (714 kg/ha in Andhra Pradesh and 663 kg/ha in Myanmar). Farmers were growing old varieties and landraces, which had low productivity and were susceptible to the devastating fusarium wilt disease. Because of low yield levels, farmers were reluctant to invest in improvements by providing inputs to the crop that could ensure optimum crop growth and management of insect-pests.

ICRISAT and Government scientists examining chickpea fields in Myanmar.

The Solution

ICRISAT, in partnership with the research institutes in India and Myanmar, developed early maturing chickpea varieties, which were well adapted to the short-season environments of Andhra Pradesh and Myanmar. These varieties had high yield potential, high resistance to fusarium wilt and seed quality preferred by markets. Because of their early maturing characteristic, these varieties could escape end-of-season (terminal) drought and heat stresses. Concerted efforts were made by ICRISAT and partners to enhance adoption of these cultivars by enhancing awareness of farmers and availability of seed.

The Success

Andhra Pradesh: A desi chickpea cultivar, Annigeri-1, developed in 1940 (officially notified in 1978) has been the ruling chickpea variety in Andhra Pradesh for over six decades. It is estimated that Annigeri-1 covered over 90% of the chickpea area in Andhra Pradesh up to 2001. Though short duration chickpea cultivars ICCC 37 and ICCV 2 were released in 1989, these varieties could not replace Annigeri-1. Later, two short-duration, high yielding varieties were released, JG 11 (a desi variety) in 1999, and KAK 2 (a kabuli variety) in 2000. ICRISAT and ANGRAU started promoting the new chickpea cultivars JG 11 and KAK 2 from the 2002-03 crop season. As a result, the area grown to Annigeri-1 reduced to 45% in Kurnool district and 24% in Prakasam district by 2007. The Tropical Legumes II (TL II) project, which started during the 2007-08 crop season, boosted promotion of improved chickpea cultivars in Andhra Pradesh. Large numbers of farmer-participatory varietal selection (FPVS) trials were conducted and JG 11, KAK 2, JAKI 9218 and Vihar were identified as farmer-preferred cultivars. Concerted efforts made under the TL II project on knowledge empowerment of farmers on improved cultivars, production technologies and enhancing seed availability accelerated adoption of improved cultivars by farmers. An early adoption survey was conducted in 2009-10, which indicated that the area under improved cultivars (JG 11,

KAK 2, JAKI 9218) had increased from 55 to 90% in Kurnool and 67 to 97% in Prakasam district during 2007-08 to 2009-10.

During the past 15 years (from triennium 1996/97-1998/99 to 2010/11-2012/13), chickpea recorded an increase of 7.2-fold (93,000 to 667,000 tons) in production, because of a 4.6-fold increase in area (133,000 to 615,000 ha), and a 1.5-fold increase in yield (714 to 1091 kg/ha).

Myanmar: Four varieties, Yezin 3 (ICCV 2), Yezin 4 (ICCV 88202), Yezin 6 (ICCV 92944) and Yezin 8 (ICCV 97314) released in the period 2000 to 2009 were preferred and adopted rapidly by farmers. These varieties have early (Yezin 4, Yezin 6 and Yezin 8) to extra-early (Yezin 2) maturity, fusarium wilt resistance and high yield potential. Yezin 6 is a heat tolerant cultivar released as JG 14 in India. Yezin 8 is a large-seeded kabuli chickpea variety that receives premium prices in the international market. During the 2011-12 crop season, these varieties covered 87% of the area in Myanmar. The adoption of these varieties along with improved crop production practices led to a 2.4-fold increase in area (141,000 ha to 332,000 ha), doubling of the productivity (663 to 1419 kg/ha) and a 5.3-fold increase (90,000 to 472,000 tons) in production of chickpea in Myanmar during the past 15 years (from triennium 1996/97-1998/99 to 2010/11-2012/13). Myanmar restarted export of chickpea in 2001 after almost no export for over two decades. Chickpea exports were on an average 50,000 tons (valued at US$ 24.0 million) per year from 2001 to 2011. Chickpea is currently a commercial crop in Myanmar and has helped smallholder farmers in linking to markets and enhancing incomes.

Market Driven

The farmers in Andhra Pradesh and Myanmar found chickpea to be a very remunerative crop because of good market prices and reduced labor requirements

Distribution of chickpea seed to farmers in Andhra Pradesh.

Photo: L Vidya Sagar, ICRISAT

At a farmers field day in ICRISAT campus, Patancheru, India.

due to increased mechanization. Grain storage facilities are available to farmers in Andhra Pradesh at the local level and at an affordable tariff, which helps the farmers avoid distress selling at harvest and thus getting a better price for their produce. Kabuli chickpea varieties promoted in Andhra Pradesh fetch premium prices in both, the domestic and international markets. Indian export of chickpea enhanced substantially in recent years and the kabuli chickpea grown in Andhra Pradesh has significantly contributed to this. The increased chickpea production in Myanmar helped the country in restarting export of chickpea in 2001 after almost no export for over two decades.

Incorporating Inclusiveness

The chickpea farmers in Andhra Pradesh and Myanmar are smallholders. Inclusion of all sectors of farmers and women farmers was ensured in FPVS trials. In addition, selection of farmers in seed production and participation in training programs, field days, farmers' fairs and other activities ensured inclusiveness.

Lessons Learned

There were several lessons learned from the IMOD-led chickpea success stories of Andhra Pradesh and Myanmar. It was evident that the farmers' awareness of the improved varieties and availability of the seed of improved varieties are the key factors in the spread of improved chickpea cultivars. FPVS trials and distribution of seed samples are very effective in enhancing awareness of farmers to improved varieties and rapidly spreading demand for the new varieties. The seed traits preferred by the market, price in the domestic and international market, and linkages of farmers with the market influence the adoption of improved cultivars by farmers.

The Way Forward

The farmers in Andhra Pradesh are now demanding varieties that can be harvested by combine harvesters and in which weeds can be controlled by application of post-emergence herbicides. This is because of the increasing cost and decreasing availability of labor. Thus, ICRISAT and partners are now working on development of chickpea cultivars suitable for mechanical harvesting and tolerant to herbicides. Similarly, new heat tolerant varieties are being developed for Myanmar. The efforts on adoption of improved cultivars are being made through Tropical Legumes II and the OCPF project in Andhra Pradesh and an ACIAR project in Myanmar.

Linked Projects

Most of the earlier efforts in Andhra Pradesh and Myanmar were without any externally funded project. The efforts in Andhra Pradesh were enhanced in 2007 by the Tropical Legumes II project funded by Bill & Melinda Gates Foundation. Later, further support was received from the EU-IFAD and OCPF projects. Similarly, in Myanmar, the efforts were strengthened by an ACIAR project in recent years.

Key Information

Name of project:1) Tropical Legumes II

Key scientists: PM Gaur, CLL Gowda

Project duration: Ongoing since 2007

Key partners: (1) Acharya NG Ranga Agricultural University (ANGRAU), Hyderabad, (2) Andhra Pradesh State Seed Development Corporation (APSSDC), Hyderabad, (3) State Farms Corporation of India Limited (SFCI), Regional Office, Hyderabad 500 029, India; (4) National Seed Corporation (NSC), Regional Office, Secunderabad

2) IFAD-European Commission Project "Improving farmers livelihoods and food security through enhanced legume productivity in India and Myanmar"

Key scientists: GV Ranga Rao, PM Gaur, CLL Gowda

Project duration: January 2011 to December 2012

Key partners (Andhra Pradesh): Acharya NG Ranga Agricultural University, (ANGRAU), Hyderabad

Key partners (Myanmar): (1) Department of Agricultural Research (DAR) , Yezin, Nay Pyi Taw; (2) Myanma Agriculture Service (MAS)

3) OCPF project "Morocco-India Food Legumes Initiative (MIFLI)"

Key scientists: Ch Ravinder Reddy, PM Gaur, GV Ranga Rao, CLL Gowda

Project duration: Ongoing since April 2013

Key partners: Acharya NG Ranga Agricultural University, (ANGRAU), Hyderabad

4) In Myanmar, ACIAR Project "Multidisciplinary legume based farming systems in the central dry zone of Myanmar to improve food security and farmer livelihoods"

Project duration: Ongoing since July 2013

Key scientists: GV Ranga Rao, PM Gaur, CLL Gowda

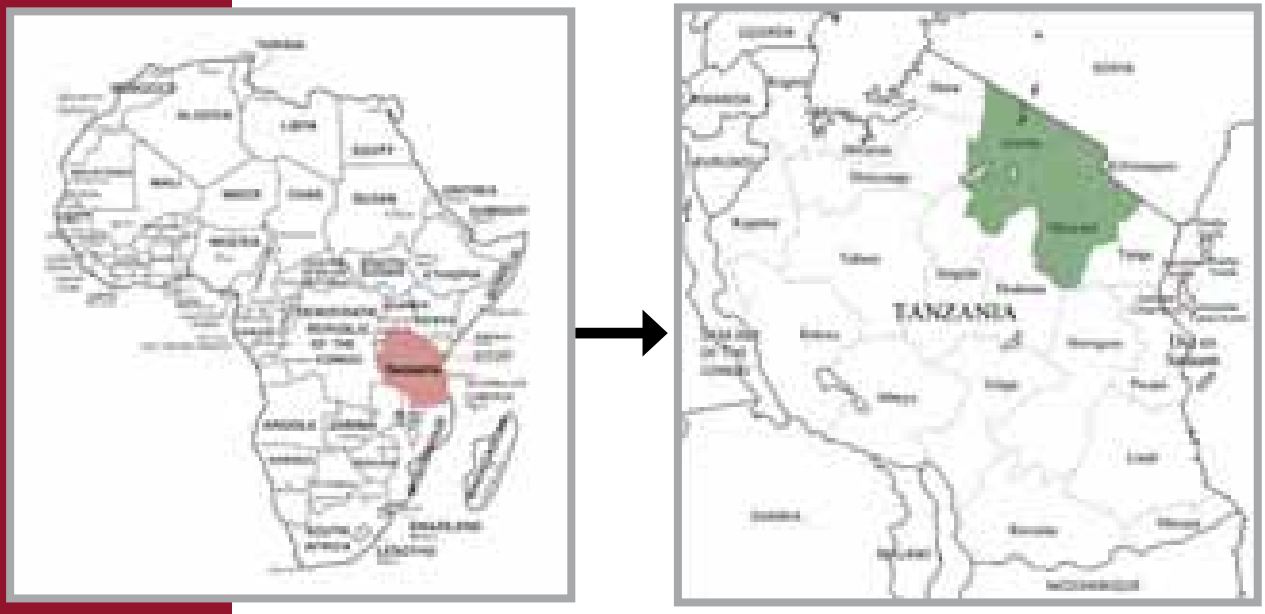
Key partners: (1) Department of Agricultural Research (DAR); (2) Myanmar Agricultural Services (MAS); (3) Yezin Agricultural University (YAU).

This work was undertaken as part of the CGIAR Research Program on Grain Legumes

A farmer transporting chickpea harvest in Myanmar.

Photo: Dr PM Gaur, ICRISAT

General Information



945,203 km²
Area

44,928,923
Population (2012 census)

$79.388 billion
GDP (PPP) 2013 estimate

355,000 km²
Agricultural land

900-1000 mm
Average rainfall

Pigeonpea Cultivation: Fusarium wilt-resistant, seasonally-adapted varieties of pigeonpea adopted on 25,000 hectares in northern Tanzania have tripled yields and created a thriving export market, producing an additional 1.3 tons per hectare or 33,000 total extra tons – delivering approximately US$33 million in extra value to impoverished farmers.

A nationally representative survey in Tanzania found an adoption rate of 19% for improved pigeonpea. Adopters tended to be farmers who were exposed to the varieties through participatory variety selection trials, and smallholders attempting to intensify their farming to make ends meet.

Crops grown: A variety of food and cash crops are grown in Tanzania. Cash crops, which are grown specifically for sale, include cotton, coffee, tobacco, and cashew nuts. Food crops grown are maize, cassava, beans, millet and bananas.

Earnings from Agriculture

1. The country's economy is heavily dependent on agriculture, which accounts for 27% of the GDP.

2. The agricultural sector is the main source of employment and livelihood for about 77.5 percent of the population.

Issues related to poverty:

1. Food insecurity and poverty are the main challenges Tanzania faces today.

2. Environmental issues such as deforestation, desertification, soil erosion and air pollution have led to increasing poverty, food insecurity and stalled development.

Farmers harvest bumper yields through adoption of high yielding varieties and improved management practices including fertilizer use in Tanzania.

Collectively we prosper

Adoption of high yielding and wilt resistant pigeonpea in Tanzania and creating new markets

Contributed by

NVPR Ganga Rao, Senior Scientist, Grain Legumes, ICRISAT, Kenya

Until recently, pigeonpea was not an important crop in Tanzania, and the national agricultural research system and the government paid very little attention to varietal development and dissemination. The area occupied by pigeonpea was only 65,000 ha (2001-03) and farmers grew traditional long duration and low yielding varieties that are susceptible to pests (pod borers, pod fly, pod sucking bugs) and diseases (fusarium wilt). Small-seeded varieties failed to meet market requirements; market linkages were underdeveloped; and farmers could not access seed of improved varieties because of poor input and technology delivery systems. These factors effectively deprived farmers in

Tanzania of the benefits of a sizable regional and international export market. Yet, pigeonpea is one of the major food legumes in Tanzania with its multiple benefits to cropping systems, smallholder farmers, consumers and traders.

The Solution

ICRISAT and the Department of Research and Development under the Ministry of Agriculture and Food Security (DRD) in Tanzania have been working together to develop suitable varieties that fit the pigeonpea growing regions and institutional innovations for seed production, delivery and grain marketing to help dryland farmers benefit from pigeonpea. This began with the development of high-yielding, slightly early-maturing, cream-colored, large-seeded and fusarium wilt-resistant varieties for cultivation by smallholder farmers. Many farmer participatory varietal selections and demonstrations were conducted to get feedback on existing/pipeline varieties and also to create awareness/demand for promising varieties and proven technologies. To address constraints in output marketing and utilization, ICRISAT and DRD developed partnerships with private (Dodoma Transport, Kilimo Market, Kamal Agro, Export Trading Group) and public sector institutions (Tanzania Investment Bank, Community Rural Development Bank) to link up farmer cooperatives such as *Gendi* and *Gallapo* Cooperative Societies for credit facilities and better market prices. The adoption of improved pigeonpea varieties (Komboa, Tumia and Mali) has catalyzed a process of livelihood transformation for many dryland smallholder farmers. The increasing availability of improved varieties, along with institutional innovations, has enabled farmers to reduce the cost of product marketing, spurring commercialization of the crop. Recognizing the huge demand for improved seeds, local agro-dealers (called agro-vets), contract trained farmers to multiply high quality seeds, with the support of the local extension system for training and farmer organization. The commercial produce is marketed through producer marketing groups (PMGs). This collective action enabled smallholder farmers to sell quality grain at higher prices.

The Success

ICRISAT has had a long and fruitful collaboration with Ilonga Research Station in Kilosa and the Selian Agricultural Research Institute (SARI) in Arusha, to identify high yielding (up to 2.5 tons/ha) and fusarium resistant lines (three varieties, Komboa, Tumia and Mali, were released and six varieties, ICEAPs 00554, 00557, 00053, 00932, 00850 and 00936 are in the pipeline for release). The other key partners were extensionists, local government authorities, Sasakawa Global 2000, TechnoServe, contract farmers, farmers' groups, private seed companies/estates, NGOs, the Agricultural Seed Agency and Catholic Relief Services. The main focus in the research was participatory variety selection, establishing sustainable seed supply systems through private sector contract farming, screening for fusarium wilt, improved management practices, and initiatives to enable farmers to access local and external markets through formation of PMGs. Recent donor support in the form of Tropical Legumes II, IFAD-Treasure Legumes, AGRA soil health program, EU-IFAD project and SIMLESA focused on development of new breeding populations, seed systems research and training, 568 Farmer-and consumer-Participatory on-farm Variety Selections (PVS), dissemination of new varieties and/or micro-doses of fertilizers in 2061 demonstrations and beyond, maize-based cropping systems, capacity building on crop improvement, seed systems and collective marketing by participation of 21,964 farmers and 792 extension personnel.

The area under pigeonpea has increased from 60,000 ha in 1995 to 290,000 ha, and productivity from 0.5 tons/ha to 0.9 tons/ha in 2012. In Babati district – famous for quality pigeonpea production – adoption of improved pigeonpea varieties has reached 60%, and pigeonpea alone contributes to more than 50% of the cash incomes for smallholder farmers. Arumeru, Babati, Karatu and Kondoa districts in Tanzania are famed for their production of bold cream-colored pigeonpea. Pigeonpea consumption has soared, as the regular bean crop has largely succumbed to pests and the changing weather patterns that the hardy pigeonpea takes

in its stride. The fruitful collaborations contributed to increased pigeonpea yields (80% increase), farmers' income, increased utilization/nutrition and improved livelihoods through availability of improved germplasm that is high yielding and tolerant to fusarium wilt, increased dissemination, up-scaling and adoption of the improved germplasm, infrastructure and capacity building, and increased linkages and partnerships.

How this was Market Driven

Pigeonpea is an important source of cash for smallholder farmers. Research was conducted to determine the structure and functioning of markets along the supply and value chain, identify market impediments and develop innovative strategies that add value and improve competitiveness in domestic and export markets. In order for farmers to get the benefit of high prices, the project used existing farmer groups who were trained in the importance of collective action and business skills, and formed producer marketing groups. Working through PMGs resulted in better products for sale (grain had less foreign matter and pest infestation, uniform size and color) and received between 25 and 40% premium when compared to sales to middle-agents. Grades and standards on grain and quality have increased due to availability of improved varieties and training. Among pulses, pigeonpea is now fetching the highest price. Large traders (Mohamed Enterprises, Fida Hussein, Dodoma Transporters, Export Trading Group) are involved in buying grain for export to India and Europe, and in 2010 about 76,000 t were exported. A dehulling factory was established in 2009 in Arusha for making dhal (split pea). The farm gate price of quality pigeonpea grain has increased from Tsh 20/kg in 2000 to Tsh 800/kg at present due to better quality of ICRISAT bred varieties grain that meet the market preference.

Incorporating Inclusiveness

ICRISAT forged partnerships by establishing links between 6000 smallholder farmers and other village level traders working along the value chain. Policy makers are now aware of the importance of pigeonpea, and have begun to fund research. Donor funding has increased substantially and major donors now funding research include the Bill & Melinda Gates Foundation; USAID-Feed the Future, and Alliance for a Green Revolution in Africa. Strategic partnerships for improving access to seed were facilitated. Twenty-one thousand nine hundred and sixty-four (21,964) farmers and 792 extension agents were trained in seed production, safe storage, processing and marketing functions through training programs, field days and farmer group meetings. In addition, farmer cooperatives, local seed enterprises, and input stockists were trained on marketing and seed business skills, and then linked to seed farmers and other service providers. An important strategy was in promoting the marketing of mini-packs (100 g to 1 kg) of improved seeds. This made access equitable, and allowed poor farmers to adopt improved varieties. ICRISAT and NARS work closely with seed enterprisers to promote their involvement in varietal dissemination through

Mrs E Mollel of Kikatiti, Tanzania in front of her house of 1988 (left), and in her present improved house (right).

Photos: Ganga Rao, ICRISAT-Kenya

quality seed production, on-farm demonstrations and demand creation.

These innovations stimulated and strengthened private and local seed enterprises to ensure continuous seed supply and access to seeds by smallholder farmers without external support, resulting in adoption of improved varieties. Private seed companies (Kilimo Markets, Zenobia, Krishna Seed) in Tanzania are now investing in producing commercial seed of pigeonpea and selling through agro-dealers to farmers. Agro-dealers are also involved in seed retail trade. The Agricultural Seed Agency (ASA) reduced the area for growing common beans by half in order to increase pigeonpea seed production this year. About 1174 MT of various seed classes including 300 t of Quality Declared Seed were produced and used in the seed production cycle.

The yields under smallholder farmers remain low, typically under 1.0 tons/ha. This can, however, be raised to 1.5 - 2.5 tons/ha under improved management. All legumes fix nitrogen (N) in the soil in varying degrees, and in northern Tanzania, studies showed that pigeonpea provided 100% of its own N requirement and left behind about 40 kg of N/ha in the fields for subsequent crops. In the AGRA-funded project, and through 120 on-farm demonstrations, we found that maize and pigeonpea yields from the phosphorus (P) fertilizer microdosing treatments were double those obtained from the farmers' practice/control. The benefit and cost ratio from the maize and pigeonpea fertilized treatments was 2.2 and much higher when compared with farmers' practice (1.4) and fertilized sole maize (1.1).

ICRISAT and partners held field days each year to elicit inputs from farmers and other stakeholders. Feedback from farmers and results from on-station trials were used to select superior varieties for participatory on-farm evaluation. ICRISAT evaluated the identified varieties through participatory on-farm evaluation in multiple locations and agro-ecologies to determine their adaptation and yield potential, and involved farmers, market agents and agri-business enterprises, to determine their suitability to meet diverse consumer needs and processing requirements. The best bet varieties were promoted for large-scale dissemination in collaboration with NARS, NGOs, and the private sector. More than 2 million farmers were exposed to pigeonpea varieties /technologies through mass communication (both electronic and print media), annual *Nane-Nane* agriculture shows organized during August (means 8th of August in Swahili) and on-farm demonstrations and going beyond demonstrations.

The capacity of all partners was strengthened by participation of ICRISAT and national partners from DRD. Farmers were trained in production, seed multiplication, collective action, business planning and in processing and utilization. Extension staff members have been trained in participatory on-farm work. Private seed companies have received training in seed production including descriptors of varieties and rouging. Scientists have been trained through degree and non-degree training. ICRISAT was in close collaboration with NARS for technical backstopping, identification of resource persons and involving key stakeholders during training programs.

Lessons Learned

Pigeonpea areas and production are fast increasing in Tanzania due to export demand, availability of promising varieties and technologies. Development of climate resilient medium duration varieties results in spreading of the pigeonpea to new niches. Inclusion of all partners and other key actors in the pigeonpea value chain empowered them to implement project activities. Capacity building of extensionists, agro-dealers, farmers' organizations,

Table 1: Pigeonpea area, production and productivity trends in Tanzania

Year	Area (000 ha)	Production (000 t)	Productivity (kg/ha)
2001-03	65.9	49.4	750
2004-06	155.6	112.2	719
2007-09	165.7	127.1	767
2010	187	166.1	888
2011	288.2	272.6	946
2012	290	206.1	710

district and village leaders, and individual farmers created more awareness and demand for input and output markets. Communication and dissemination of good technology through field days, agricultural shows, radio, TV channels, local newspapers, and participation of policy makers in various events, increased awareness and adoption of the technology. Financial profitability of the technology increased farmers' confidence and readiness to practice the technology.

The Way Forward

The area and productivity trends in Tanzania clearly show that there is a very big potential for the crop to grow and contribute to improve incomes of smallholder farmers. The climate change and good prices offered have pushed farmers to adopt it in many parts of the country. The low rainfall received in many parts of the country leads to low cereal productivity, especially for maize and wheat, resulting in low incomes for the smallholders. Such low productivity and incomes make farmers shift to production of legumes instead, especially to pigeonpea, which is drought tolerant, and in most cases they intercrop it with cereals, mainly maize or sorghum. Studies supported by the Soil Health Program under AGRA in the northern, central and eastern zones of the country have also shown that the yields of maize and pigeonpea can be increased two-fold when farmers apply small amounts of P based fertilizers such as Minjingu fertilizers, which are locally available, at planting. The cost benefit ratios obtained for such farmers were also about two-fold. Such big cost benefit ratios have attracted farmers to adopt the practice and thus further improve their livelihoods. Farmers have recently started selling green pigeonpea in the local markets, while a number of agro-dealers are selling quality seed to farmers. Not only that, but some local restaurants are also serving green pigeonpea along with, or instead of, green peas. These are new avenues that can increase demand and success of the crop. ICRISAT, through on-farm PVS, demonstrations and field days, will get feedback from farmers, consumers and traders to further fine tune the varietal development process. Farmers in Tanzania would like to have market information on export demand from India and existing prices in order to bargain for better market price for their produce. The pigeonpea research and development team operating in Tanzania is planning to introduce stone *chakkies* (hand grinders) at household level and small processing mills at community/village level, along with demonstration of pigeonpea food preparations, to enhance local demand.

Key Information

Name of project: 1) Tropical Legumes II

Key scientists: ICRISAT – NVPR Ganga Rao, Said Silim, Moses Siambi, Emmanuel Monyo Stephen Lyimo, Late Joseph Mligo, Rose Ubwe, Meshack Makenge.

Project duration: Ongoing since 2007. Continuing under new project (proposed for TL III).

2) AGRA project

Key scientists: ICRISAT – NVPR Ganga Rao, Said Silim, Moses Siambi, Stephen Lyimo, Rose Ubwe

Project duration: February 2010 to December 2013

3) EU-IFAD Project

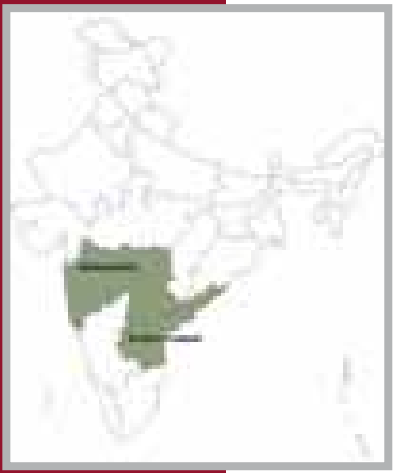
Key scientists: ICRISAT – NVPR Ganga Rao, Moses Siambi, Said Silim and Emmanuel Monyo, Patrick Okori, Omari Mponda, Robert Kileo

Project duration: Ongoing since January 2011

Key partners: Selian Agricultural Research Institute (SARI), Arusha; Ilonga Agricultural Research Institute (IARI), Kilosa; Naliendele Agricultural Research Institute (NARI), Mtwara Lake Agricultural research and Development Institute (LZARDI), Ukiriguru, Extension services staff in Northern, Central and Eastern Zones, Farmers, Farmer groups, Farmers' associations, TechnoServe, Catholic Relief Services (CRS), the Agricultural Seed Agency (ASA), NGOs, CBOs, African Farmers Service Centre, Seed companies (Dodoma Transport, Miombo Estates, Krishna, Kibodya), Grain traders (Kilimo Market, Kamal Agro, Export Trading group), AGRA Soil Health Programme (SHP), SIMLESA

This work was undertaken as part of the

General Information



275,068 km²
AP (Area)

845,80,777
AP (Population 2011)

₹754,409 cr
AP (GDP, 2012-13)

307,713 km²
Maharashtra (Area 2011)

112,372,972
Maharashtra Population (2011 census)

₹1,372,644 cr
Maharashtra GDP (nominal) 2012-13 estimate

513,120 km²
Thailand (Area)

66,720,153
Population

$387.156 billion
GDP (nominal)

9,596,961 km²
China (Area)

1,350,695,000
Population

$10.028 trillion
GDP (nominal)

Andhra Pradesh (AP)

Rainfall (Avg. 2008-09 to 2012-13): (908 mm annually)

Crops grown

Rice, wheat, sorghum, pearl milliet, maize, minor millets, coarse grain, cotton and chillies.

Maize and cash crops compete against pearl millet crop

Maize, soybean and cash crops compete against sorghum crop

Percentage of population engaged in agriculture: 60%

Maharashtra

Crops grown

Coarse cereals, pulses, oilseeds, cotton, sugarcane and horticultural crops are important crops grown in the state. Maize and cash crops compete against pearl millet

Maize, soybean and cash crops compete against sorghum

Source: 1) Directorate of Economics and Statistics, and 2) Agricultural Statistics at a glance--2013

Thailand

Rice is the major crop. Other crops are rubber, vegetables, fruits.

Presently, Lower Northern Thailand is the largest sorghum producing region, accounting for about 56% of the total production, followed by the Central Region with 41%. The Eastern Region accounts for 1.4% leaving 1.7% of the total production for the Western Region. The project was implemented in Suphan Buri, Kanchanaburi, Nakhon Sawan, Lopburi.

China

Heishan County, Liaoning Province, in the North East of Peoples Republic of China.

Agriculture of Heishan is mainly concentrated in the production of primary crops. The county is one of the important grain production bases of Liaoning province with 117,917 hectares (1,769,000 Chinese mu) cultivated area. Main crops in Heishan are maize, sorghum, soybean and groundnut. Heishan is also a poultry and livestock production base.

Photo: Ch Ravinder Reddy, ICRISAT

Farmers in Maharashtra have adopted high yielding sorghum cultivars.

Partnership for synergy

Promoting sorghum and pearl millet in the poultry feed industry

Contributed by

Ch. Ravinder Reddy, Senior Scientist, Dryland Cereals, ICRISAT, India

P Parthasarathy Rao, Assistant Research Program Director and Prinicipal Scientist, Markets, Institutions and Policies, ICRISAT, India

A Ashok Kumar, Senior Scientist Dryland Cereals, ICRISAT, India

The area under sorghum is declining in India, China and Thailand due to several constraints on both production and marketing. Studies documented the constraints in sorghum farming in project areas (India, China and Thailand), and the major constraints found include (i) Availability and access to improved cultivar seeds and other inputs; (ii) Poor access to cost effective technologies to enhance production; (iii) Absence of farm advisory services to help farmers in taking farm level decisions; (iv) Inability to get timely credit from nationalized banks; and (v) Poor market linkages to industry.

A woman farmer in a pearl millet demonstration field at ICRISAT, Patancheru, India.

The Solution

The project adopted an innovative, farmer-centered, farmer-owned and farmer-managed process-oriented approach that ushered hope and ensured participation of communities in the project. Innovative institutional coalition was formulated to bring in expertise and experiences of diverse stakeholders that proved advantageous for implementation of the project. The interventions were implemented through an innovative Coalition Approach ie, coalition of stakeholders. The institutions involved in coalition building included farmer organizations, NGOs, private sector companies (feed manufacturers, seed companies and poultry producers), national research institutions, agricultural universities and financial institutions, along with ICRISAT as the Project Executing Agency. Additionally, the project focused on: (a) Awareness of sorghum utilization in poultry feed; (b) Linkages between farmers and a range of stakeholders such as inputs suppliers, credit agencies and end users/markets; and (c) Engaging farmers and partners in innovative crop production and marketing practices.

The Success

1. Coalition of stakeholders/institutions: The project adopted an approach of coalition of the different stakeholders/institutions. This was based on the principle of mutual synergistic support, which can be defined as the process in which these distinct and independent institutions (partners) from different backgrounds and expertise join forces to carry out various planned activities for a common goal with synergistic effect, and without compromising on their individual goals.

The project comprised more than ten partner institutions involving agricultural and veterinary universities, NGOs, Farm Knowledge Centers (KVKs), Private Companies, Farmers Associations, input and credit agencies and national agriculture research centers in all project countries. The participation of these partners in the project activities has enabled extension of support to the farmers in increasing farm productivity, and ultimately improving their incomes and livelihoods. These partners are continuing to extend handholding support in addressing the needs of the farmers, even after

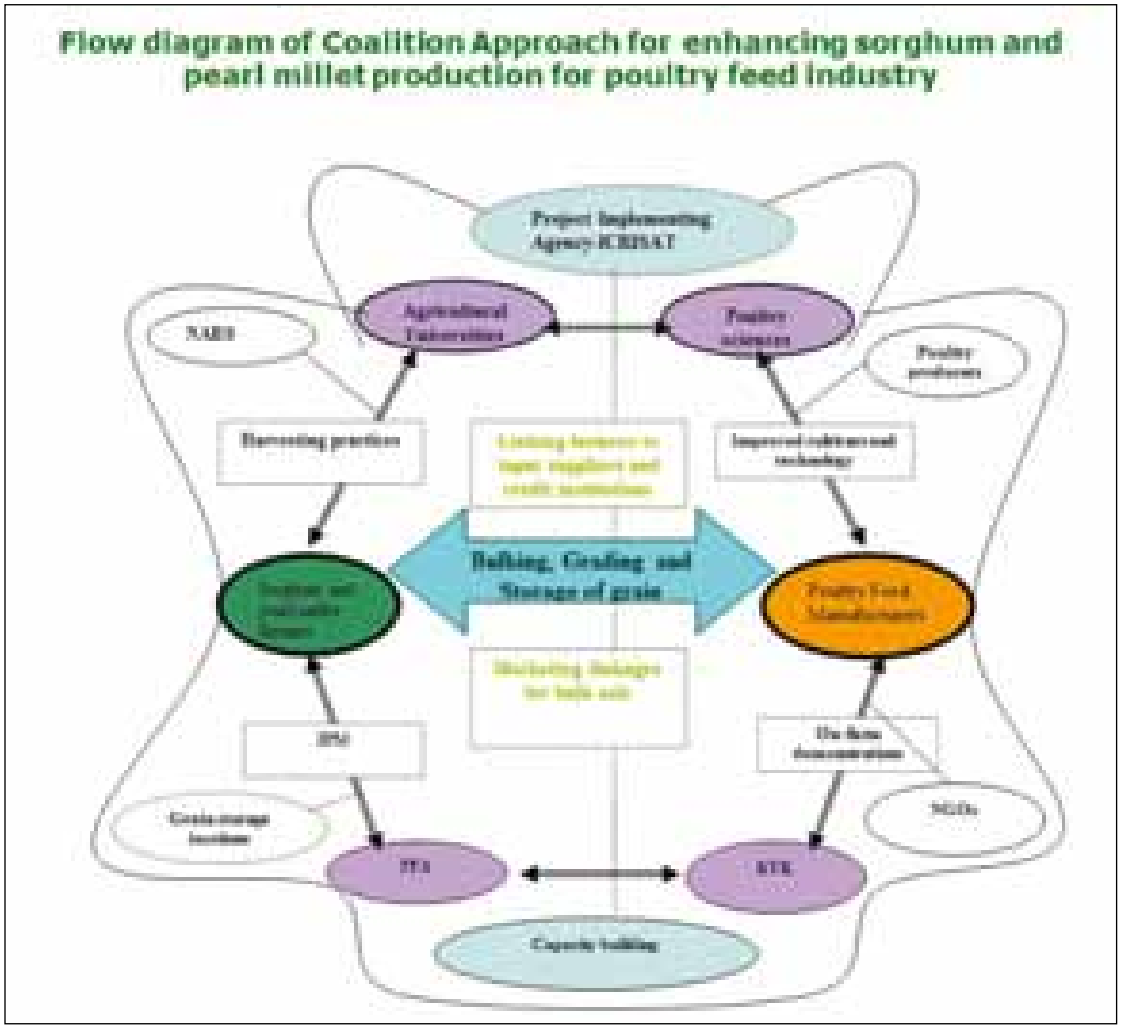
completion of the project period, as the mutual benefits derived are seen as one of the elements in addressing the sustainable issues. The Coalition Approach has proved to be a great success in the project with clear impact.

The flow chart (below) shows the details of the Coalition Approach adopted in the project.

2. Adoption of improved production technologies: More than 5000 farmers in India, China and Thailand have adopted improved, high yielding and disease-resistant cultivars of sorghum and pearl millet, where the farmers had grown mostly local cultivars prior to the project intervention.

Most of the farmers have switched over to the improved cultivars in the three years of project implementation. As a result, the productivity improved significantly in all project villages.

Another important aspect of the improved production was adoption of integrated nutrient management practices by the farmers in the project. Demonstration plots were grown in the farmers' fields to show the impact of nutrient management based on the soil test results. The impact of these practices were clearly visible in terms of reduced fertilizer use (and thus reduced cost) as only appropriate nutrients and dosages that enhanced higher yields were used.



Source: P Parthasarathy Rao et al. 2008.

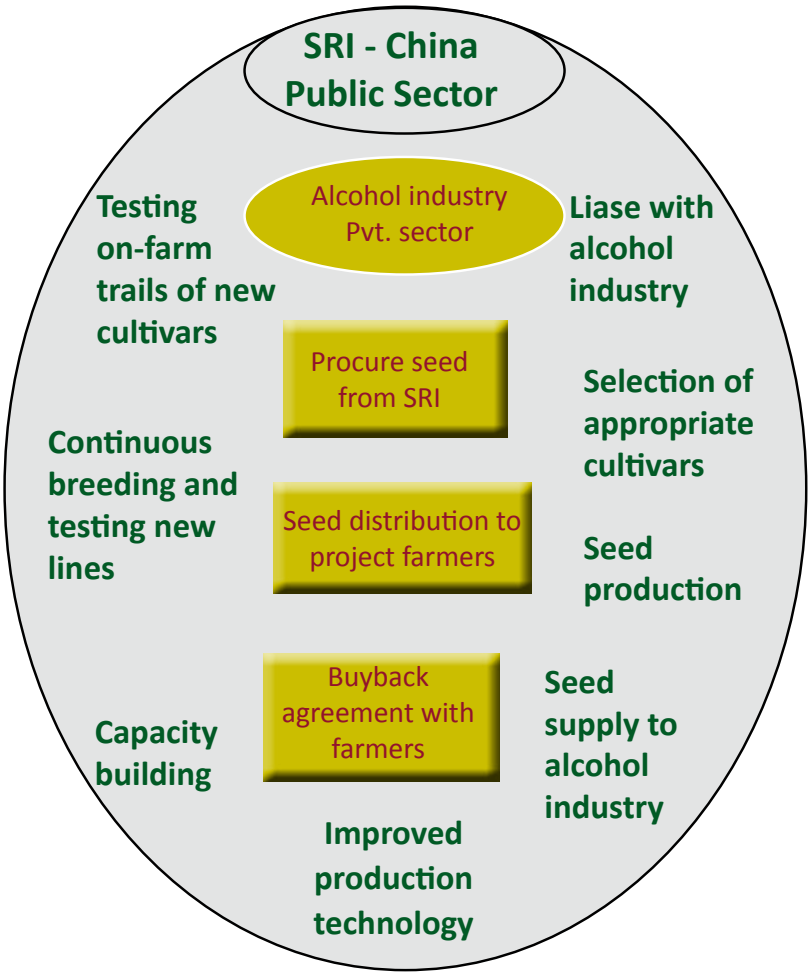
The farmers adopted other improved production practices focusing on integrated pest and disease management with a minimum (or no) use of chemicals.

Integration of all the above practices resulted in significant improvement in the sorghum yields in China (18% productivity increase) and Thailand (23% productivity increase). The productivity increase in India was around 56% in Andhra Pradesh clusters, and 22% in Maharashtra state, where farmers were using the improved cultivars even prior to the project interventions. Similar trends were found for pearl millet, where the productivity increase was 80% in Andhra Pradesh and 20% in Maharashtra clusters.

3. Developing and strengthening input supply and marketing chain: The farmer associations, which were formed in the project clusters, were strengthened through enhanced capacities through a series of need based trainings, exposures and discussions. Construction of grain storage structures (godowns) in target regions was also an initiative of the project, and was implemented by farmer associations successfully in all regions, and proved helpful for various project activities. The farmer associations were linked to different input agencies through direct interaction meetings, and the linkages were institutionalized over a period of three years. The farmer associations are now directly dealing with input agencies for the supply of quality inputs at discounted prices. The bulk purchase of inputs has brought down costs, while the quality of the inputs is assured, and the supply is timely, reaching the villages well in advance of the sowing season.

The farmers' association management committee members were also trained in bulking of the produce and bulk marketing, and the advantages associated with these practices. Awareness was created on market trends in prices, reasons for price variation, relative pricing of sorghum grain, international export influence on local markets, quality of grain (mold affected grain) and pricing. The linkages with various alternative end users

Flowchart of contract farming model adopted in China.



Sorghum is helping the poultry feed industry.

increased the basket of options for the farmer associations for a better negotiated price. This also brought down the transaction costs associated with the sale of the farm produce without any intermediaries. Farmers have realized the benefits of bulking that ranged between 5-22% higher prices by storing and sale to the poultry feed industry.

The farmer associations also generate extra revenue by leasing out the godown to store other crop grains and other supplies in the off-season, which is then used to maintain the godown. This practice is encouraging to farmers, who appreciate that they are able to sustain the godown with its "own income", besides using it to save their grain in good storage conditions.

In China, an innovative market linkage model developed contract farming linking farmers to alcohol and food industries. A total of 1050 tons of sorghum grain was procured by these industries from 149 project farmers. The farmers benefited by 15-20% more income than from selling to other markets/middle-agents.

4. Institutional linkages for farm credit: The project also facilitated linkages for farm credit, which was one of the major constraints in undertaking all farm activities by the farmers. The linkages developed between farmer and credit agencies for timely availability of farm credit at low interest have been beneficial in several ways, not the least for procuring inputs and financing other agricultural operations. There is no more need for farmers to depend on private money lenders, which means a considerable decrease in the interest rates, and no obligation for the farmers to sell the produce to the private money lender after harvest of the crop. The credit agencies offer easy processing, insurance coverage against crop failure, and issue of credit cards that need to be renewed once in three years. In Thailand 90% of households have availed loans from Bank for Agriculture and Agricultural Co-operatives (BAAC) followed by 77% from the village fund. Most of the farmers obtain credit from more than one source. In China, farmers rely on their own finance, and only a few borrow from banks, or relatives, or private money lenders.

Farmers in a training session on storage and market linkages in India.

Credit facilities availed by the project farmers in Region 1: India

		No. of farmers who availed crop loans					
S.No	Clusters	SBI	SBH	Coop bank	Other banks	Loan applications under process	Total
1	Andhra Pradesh	167	424	240	52	264	1147
2	Maharastra	17	38	55	371	345	826
	Total	184	462	295	423	609	1973

Methods adopted for dissemination of project experiences and findings.

	No. of events						
Clusters	Television	Local daily newspaper	Articles in popular magazines	Radio talks	Journal articles	Seminars/ workshops	Bulletins/ flyers in local languages
Andhra Pradesh	1	9	3	2	2	3	4
Maharashtra	1	3	2	2	1	-	7
Karnataka	1	-	-	-	-	-	-
Total	3	12	5	4	3	3	11

5. Dissemination of experiences: Efforts to improve the livelihoods of small-scale sorghum and pearl millet producers in project areas in region 1 (India) and sorghum producers in project areas of target region 2 (China and Thailand) were undertaken. Several publications for the farmers have been brought out in local languages and the project has also launched a web site for the benefit of project partners, and also for those not involved in the project, to spread information about the project experiences and achievements.

A Market-Oriented Approach

The main beneficiaries of this project or development activity were smallholder farmers with small marketable surplus. Prior to these interventions, farmers were getting a low price for their produce and were not able to tap the new sources of demand. Under this initiative, farmers were directly linked with the new sources of demand for their produce – ie, poultry producers, poultry feed and alcohol manufacturers. Since demand for livestock products was growing above 4% in India, the derived demand for sorghum and millet grain for poultry feed was also rising fast. Similarly, the demand for sorghum grain was from the duck feed industry in Thailand, and Chinese wine in China. The farmers were directly linked to these end users, which was mutually beneficial to both – assured markets and prices for the farmer, and assured supplies of required quality for the industry. Smallholder farmers obtained an average of 20-25% higher income due to the improved varieties of sorghum and linking with the end users. Ultimately the beneficiaries were all stakeholders in the value chain – crop scientists, input and credit suppliers, seed companies, farmer associations, poultry and alcohol manufacturers.

Incorporating Inclusiveness

The coalition model, through its process-oriented planning approach, ensured the highest clarity of roles for partners, and created a system where the farmers and partners in the coalition were made responsible for implementation of cluster level activities under the overall coordination of ICRISAT - (a) Treat the target communities as primary stakeholders and involve them in the project right from the planning stage; (b) Recognize the knowledge and experience of the participating partners and communities and decentralize the project activities to provide opportunities to the members to fully utilize their skills; (c) Encourage community contributions in the form of knowledge and service to the project; and (d) Identify and encourage democratic leadership in the communities.

The coalition of partners and stakeholders functioned in a democratic manner based on a consensus approach rather than a top down approach. Frequent meetings and interaction through e-mails and telephone ensured participation by all and contribution to decision making. Farmer Associations were empowered to take decisions, open bank accounts and handle funds for construction of godowns in each cluster in the three countries (India, China and Thailand) where the project was implemented. Thus, the project was farmer centric and farmer owned, enabling inclusiveness.

The total area of target crops increased by 21-55% and participation of farmers increased significantly in target areas by the end of the project period. This was due to project interventions that changed the mindset towards target crops by demonstrating yield increase and high grain price. Increase in marketable surplus by 51% in Andhra Pradesh and 13% in Maharashtra changed the mindset of farmers from subsistence to commercial sales due to linking of the farmers to the poultry feed industry.

Lessons Learned

The strategic interventions in empowering the resource poor farmers by promoting innovative collaboration of coalition partners with Farmer Associations and its members as the center of action have brought out the following lessons:

Lesson 1: Building strong coherence and trust among the farmers. Building trust and cooperation among stakeholders was an important exercise in sustaining interventions and catalyzing the obstacles. The principal factors that enhanced trust included (i) building confidence among the partners, and (ii) developing trust with rural communities. These were achieved through respecting each other's value systems, avoiding assumptions about the partners, taking time to build relationships and identifying trustworthy leadership in the communities.

Lesson 2: Involving partners and farming communities from the beginning of the project planning and implementation of activities. Thoughtful inclusion of stakeholders in planning at start-up time provided high comfort levels for their active participation in project planning to gain a better understanding of the project objectives, which led t**o** stronger relations and opportunities to test and improve concepts and systems.

Lesson 3: Ensuring role clarity among the farmers and the partners. The coalition model, through its process oriented planning approach, ensured the highest clarity of partner roles and created a system where farmers and partners in the coalition were made responsible for the local cluster level implementation of activities of the project.

Lesson 4: Conducting effective needs assessment. Proper and scientific assessment of the needs and the application of findings in the actual planning and implementation formed an essential part of the capacity-building process. The needs assessment mainly included: (a) establishing strong linkages with the target group prior to the assessment; (b) taking steps to understand the stakeholders background and reflect it in the need assessment process; (c) educating partners and farmers about the project components, their purpose, process and desired outcomes; and (d) verification of the results of needs assessment exercise.

Lesson 5: Maintain effective coordination and communication with partners. The overall success of this initiative depended on effective coordination and communication between the stakeholders, which reinforced the relations and addressed the weaknesses. As a result, partners acquired various skills along with the farmers.

Lesson 6: Build elements of sustainability in the interventions right from the start. Sustaining the project interventions on a long-term basis is more challenging than implementing the project itself. The project built the elements of sustainability from the beginning of the project – ICRISAT (a) treated the target communities as primary stakeholders and involved them right from the planning stage; (b) recognized the knowledge and experience of the participating partners and communities and decentralized the project activities to provide the members with opportunities to employ their talents; (c) encouraged community contributions in the form of knowledge, service to the project; and (d) identified and encouraged democratic leadership in the communities.

The Way Forward

Sorghum and pearl millet are subsistence crops grown predominantly under crop-livestock cropping system on marginal soils in the project areas by resource poor farmers. The project should aim at empowering the resource poor, focused on innovative institutional approaches and participation of the target community right from the planning stage. Some of the important challenges in empowering the poor included (a) clearly demonstrating the improved cultivars suitable

for each geographic region and need to develop sustainable seed systems for supply of selected variety seed on a continuous basis; (b) building faith among the farmers and the participating stakeholders or partners, needs more coordination for strengthening linkages; (c) strengthening linkages with regional research institutes (partner organizations) and the poultry feed industry with the farmers organizations for technical backup and marketing is a win-win situation for both; d) strong farmers linkage with financial institutions for crop loans and bank linkages with the poultry feed industry for routing farmers payments through a bank, needs a strong footage; and e) providing a congenial atmosphere in the initiative to help the farmers and their organizations to be in the forefront of the project and slowly get into the driving seat to take the initiatives forward and keep them sustainable.

Key Information

Name of project: *Enhanced utilization of sorghum and pearl millet grains in poultry feed industry to improve livelihoods of small-scale farmers in Asia*

Key Scientist(s) involved: Belum VS Reddy, Ch Ravinder Reddy, A Ashok Alur and P Parthasarathy Rao (ICRISAT); Regional coordinators of the project are Ms Wanlipa Suchato in Thailand and Dr Zou Jianqiu in China.

Key partners in India: AP Poultry Federation; Venkateshwara Hatcheries Limited; JK Agri Genetics; Janaki Feeds Pvt. Ltd.; Federation of Farmers association; ANG Ranga Agricultural University; Krishi Vigana Kendras (KVK), Marathwada Agricultural University (MAU); Sri Venkateshwara Veterinary University (SVVU).

Partners in Thailand and China: Field Crops Research Institute (FCRI), Thailand, and Sorghum Research Institute, LAAS, PR China.

Project duration: Started in May 2005, ended in 2009.

Undertaken as part of the Global Theme on Crop Improvement (GT-CI).

Farmers sharing their views on improved cultivars with scientists of ICRISAT and partner institutions at Beed, Maharashtra.

General Information

30,221,532 km²
Africa (Area)

1.1 billion
Africa (Population, 2011)

30.51/km²
Africa
(Population density, 2011)

AFRICA

Country	Population (in thousands)	Per Capita GDP (Euro dollars)	Agricultural and Food Production Index (2004-2006=100)	Human Poverty Index (HPI-1) Value (%)	Human Development Index (New 2014 Estimates for 2013)
Kenya	42 749	952	121.73	29.5	0.535
Zimbabwe	13 014	659	105.04	34.0	0.492
Malawi	15 883	291	162.03	90.5	0.414
Ethiopia	86 539	461	135.96	50.9	0.435
Mali	16 319	659	142.59	54.5	0.407
Nigeria	166 629	1 727	101.85	36.2	0.504
Niger	16 644	400	137.56	55.8	0.337

Source: Ten Facts about Africa - African Development Indicators 2011
African Statistical Yearbook 2013

Women's group in Mali at a microdosing training.

Micro doses to security

Microdosing, warrantage and small seed packs for better incomes in Africa

Contributed by

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In the dry, and often barren, semi-arid tropics of sub-Saharan Africa (SSA), the long-term overuse of soil leads to land degradation, decline in soil fertility, and decline in crop yields. Studies show that land degradation in West and Central Africa (WCA) leads to a loss of about $42 billion in incomes, and 5 million hectares of productive land each year. In Zimbabwe, 75-90% of crop land is unfertilized as the average fertilizer application by smallholder farmers, when they can afford it, is a mere 3 kg/ha. Resource-poor smallholder farmers remain poor due to three inter-locking factors:

Capacity building on microdosing in Niger.

i. Low yields due to poor soil fertility and land degradation, leaving no surplus to be sold in the market. This keeps them trapped in subsistence farming;

ii. Farmers have almost no resources to prepare for the next planting season. At the onset of the cropping season, these subsistence farmers have barely enough food to eat and to engage in cropping activities, and almost no money for seed and fertilizer to plant new crops.

iii. Smallholder famers do not have direct access to markets and are dependent on intermediaries for both farming inputs as well as for sale of produce.

Farmers are caught in this vicious circle year after year, and desperately need to find a way out of this situation if they are to survive as farmers and produce enough to feed themselves, with surplus to sell and earn a livelihood.

The Solution

Fertilizer microdosing seemed to be the logical solution to replenishing the soil. This involves the placement of small doses of fertilizer at the base of the young plant (or in the planting pit), thus giving the plant an early boost that allows it to develop a vigorous root system, which captures more water and helps it cope with initial stress, thus ensuring a healthy growth and yield capacity. Another benefit of microdosing is the savings in fertilizer use; about 6 grams of fertilizer in a bottle cap (for 2-4 plants), or a three-finger pinch per plant, is applied directly to the plant, so large amounts of fertilizer, used in the broadcast method, are avoided. Fertilizer microdosing has been used widely in the West African Sahel and also in southern Africa (Zimbabwe) with promising results. The success of the technology, though, was not due to microdosing alone, but to a combination of three solutions to address the three concerns mentioned initially.

To alleviate these concerns, three key activities needed to be implemented

- Building of input stores at the community level for the sale of small (and affordable) packs of fertilizer and seed;
- Building of warehouses to store grain from the farmers. Farmers could then avail credit to buy farming inputs based on the credit allocation proportional to the amount of grain stored (called warrantage); and
- Linkage of farmer groups to finance institutions (banks, microfinance, etc) and markets. Finance institutions are able to offer lower interest rates and market suppliers are able to purchase large quantities of grain at once.

The Success

The success of this technology comes from the changes obtained at the farmer household level.

The use of improved seed and small amounts of fertilizer has increased grain yields by 30 to 100% in both WCA and Zimbabwe. Yield increase is

due to incorporating the fertilizer in the soil and reducing most of the loss to the atmosphere or through runoff. More grain yield allows households to have extra grain for sale in order to improve their livelihoods (better health, education, house and house equipment, etc). Also, by increasing household food security, microdosing has supported the empowerment of women within male or joint-headed households.

The innovation designed for the poor farmers helps them move from subsistence to progressive farming. More than 300,000 farmers in Mali, Burkina Faso and Niger have learned the microdosing technique. Increases in their sorghum and millet yields have led to income increases of 50 to 130%. In Zimbabwe, by the year 2006, over 170,000 households increased cereal production levels by an estimated 40,000 tons, and by 2012, close to 300,000 farmers practiced microdosing. In the Zimbabwe National Region IV alone, maize yields due to microdosing increased by 80%. The success of microdosing saved US$ 7 million in annual food imports.

An ICRISAT commissioned extensive impact assessment study conducted by the University of Illinois in Zimbabwe showed that promotion of the microdosing technique raised adoption levels by 30% in 2013, and that this technique generated a net present value (NPV) of US$ 26 million with an internal rate of return (IRR) of 36%.

ICRISAT's key roles in the success was the scientific expertise used in the technology, advice on which fertilizer to use, the optimum quantities to use, and the where and when to apply the fertilizer. ICRISAT was also responsible for managing several regional projects to upscale the technology.

How this was Market Driven

Subsistence farmers and smallholders with marketable surplus are the sectors benefiting most from microdosing. Rich merchants and intermediaries usually take advantage of these two sectors by giving loans to farmers at the onset of the cropping season when they are most vulnerable, and extracting payment at harvest time when prices are low. This type of deal maintains farmers in a vicious cycle of poverty. The warrantage system allows farmers to store their grain at harvest time (rather than hastily selling it at a low price), and wait for more favorable prices a few months later. In the interim they pursue other income generating activities such as sheep fattening, vegetable growing, and extraction of groundnut oil. Farmers are able to obtain a credit at relatively lower interest rates in order to satisfy their urgent needs (health, education, social activities). Finally, when selling the grain from the

Farmer training and capacity building with stakeholders in Mali.

Alternative vegetable production linked to microdosing in Mali.

warehouse, farmers have a stronger bargaining power and can take advantage of the commodities price increase. The main beneficiaries are the individual farmers who can now bypass the middle-agents. They gain 30% more income through this system. Market linkages are created by farmers through the inventory credit scheme (called warrantage in WCA).

Incorporating Inclusiveness

Microdosing is essentially based on inclusiveness of various stakeholders. All the various components of the technology are based on farmers taking the lead in making choices according to their interests and at the same time managing the system on their own. Managers of input and warrantage stores are elected by their peers. Farmers contribute in the actual building of stores, and as a group, decide on marketing issues for their products.

All farmers (men and women) are encouraged to participate, provided they store grain in the warehouse, no matter how small the quantity is. In WCA, those who do not have enough grain are allowed to store other food products instead (moringa leaves, onions, dry bell pepper, etc).

Resilience and risk management are addressed in microdosing. After the rainfed cropping season, leftover fertilizer is used for vegetable production with seed purchased from input stores. Farmers can therefore take advantage of 2 cropping seasons rather than relying solely on the rainfed crops.

Gender issues, such as participation of women is imbedded in microdosing. Women are quite often in charge of fund management. Their role in many field activities allows them to play an influential part at all times. Even women without a field in which to grow crops, have found ways to be involved. When paid in kind for their labor, they put their “earnings” in the warrantage scheme and at the end are paid in cash.

Several other benefits of microdosing include a reduction of land degradation as a result of low fertilizer use, the reduction of conflicts in highly populated regions where small acreages are able to produce enough food for household use, allowing communities to share their land with others.

During 2003-2006 in Zimbabwe, 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 microdosing. ICRISAT also linked with the Zimbabwe Fertilizer Company (ZFC), from which 12 trade stores received small packs of fertilizer for sale to local farmers.

ICRISAT continued to conduct training for stakeholders (even those outside the consortium). In Zimbabwe, more than 650 lead farmers, 241 government extension officers, and 119 extension officers from 16 local and international NGOs were trained.

Lessons Learned

- The IMOD approach fits well with fertilizer microdosing. Poor Sahelian farmers are able to improve crop productivity and their livelihoods. Farmer capacities are built and they are empowered to manage a more progressive system of farming, and their futures.
- Some key factors leading to the success of microdosing as an IMOD exemplar are:
  - Simple technology for use by all farmers;
  - Responsibility is given to farmers for management and cost sharing;
  - Attractive to private sector and finance institutions who can now do business with clients who
  - Can pledge collateral in the form of stored grains and generate more returns from selling grains when the prices are higher;
  - Markets can deal with large quantities and reduce their charges (a store can supply 40 tons or more as compared to hundreds of sellers with a few kilograms each)
  - Finally, farmers are able to benefit directly from their product while bypassing middle-agents.

The Way Forward

The technology has been scaled up in WCA in several countries. It has been supported by many donors (EU, African development Bank, Islamic Development Bank, USAID, DGIS, and others).

Sheep fattening by women in Mali with small loans from warrantage.

Millet bags in a warrantage store in Tingoni, Mali.

ICRISAT and partners need to ensure that agro-dealers in the vicinity are able to stock small packs of fertilizer and seed in a timely manner.

Although the results are good, farmers have reported that microdosing is time consuming, laborious and difficult to ensure each plant gets the right dose of fertilizer. In an attempt to address these issues, researchers are looking at packaging the correct dose of fertilizer as a tablet that aids in application. ICRISAT is also exploring the use of seed coating as another option of further reducing the quantity of fertilizer to be used as well as the labor constraint.

Seeing that in Zimbabwe women-headed households were slower to adopt microdosing, it would be worth it to understand the constraints of women farmers and adapt methods or training to their circumstances, which could help extend the adoption of this technique.

ICRISAT has played a major role in developing the technology with NARS partners, in building the capacities of stakeholders, and in encouraging partnerships for win-win relationships. They now need to extend the training to underserved areas, and hope to increase the number of farmers using microdosing to 500,000 in the next few years.

Key Information

Since the development of the microdosing technology by the University of Hohenheim, ICRISAT, IFDC, and other development partners, a number of projects have been initiated to promote the technology through farmer field schools, demonstrations, on-farm trials and a series of media support materials such as leaflets and rural radios. In addition, some of these projects have facilitated access to credit through warrantage schemes and/or access to inputs through the establishment or enhancement of input shops in the intervention zones. These include the FAO projet INTRANTS, the CORAF-ADB project, USAID Target project and lately the AGRA project. The cumulative outreach could be estimated to more than 300,000 households as of 2012/2013.

Name of project: 1) CORAF Microdosing: June 2005-May 2008; 2) Target Microdosing: June 2002-December 2004; 3) AGRA Microdosing: June 2009-June 2013

Key scientists: Ramadjita Tabo, Mahamadou Gandah, Moses Siambi, Fatondji Dougbedji, Jupiter Ndjeunga, Saidou Koala, Steve Twomlow, NARS scientists (Burkina, Mali, Niger)

Key partners: Farmers and farmers organizations NGOs, National Extension Service, financial institutions, fertilizer companies

This work was undertaken as part of the

At a demonstration training in Tingoni, Mali

Input and warrantage stores at Ouelesssebougou in Mali.

General Information

342,239 km²
Area 2011

68,621,012
Population 2011

₹459,215 cr
GDP (2012-13)

16,800 ha
Pigeonpea area

879 kg/ha
Pigeonpea productivity

₹70,000 /ha/year
Earnings from pigeonpea

Average annual rainfall	West Rajasthan 313mm East Rajasthan 675mm
Total GCA (India 2010-2011): 198.97 million hectares	
Total GCA (Rajasthan) (2010-2011): 26 million hectares	
Crops grown	Wheat and barley are cultivated over large areas, as are pulses and sugarcane. Rajasthan is also a leading producer of oilseeds and edible oils.
Issues related to poverty	Mostly desert area, draught power shortage, low rainfalls, unemployment, debt, poor access to education, lack of infrastructure.
% Earnings from Agriculture (Rajasthan, 2012-13).	13.7% on overall GDP.

Source: 1)Directorate of Economics and Statistics and 2) Agricultural Statistics at a glance--2013

A farmer in his pigeonpea field in Padasoli village, Rajasthan, India.

The game changer

Pigeonpea for uplifting livelihoods and sustainable agriculture in Rajasthan

Contributed by

CV Sameer Kumar, Senior Scientist, Grain Legumes, ICRISAT, India

Fifteen million hectares of dry areas in Rajasthan cultivated by smallholder farmers have been affected by frequent droughts and land degradation. Years of absent or minimal rainfall, coupled with the fact that soil enhancing legumes had not been grown here for ages, had not surprisingly led to depletion of soil health, making the soil uninviting and unproductive, This in turn has led to low productivity and sometimes abandonment of agricultural lands, causing extreme hardships to millions of farmers who depend on farming for their livelihoods.

Demonstration of dal mill to women farmers.

The Solution

The ability of pigeonpea to improve soil and farming environments has been successfully demonstrated and documented through various projects implemented in China, the Philippines, and other parts of India.

To address the challenges in Rajasthan, pigeonpea has been identified as a potential game changer for 12,000 farmers who grow pigeonpea on ICRISAT's intervention area of 10,000 ha. Cultivation of pigeonpea assures a net income of Rs 30,000/ha under rainfed conditions, and fits well in different cropping systems and patterns of Rajasthan. From the nutritional point of view, vegetable proteins play an important role, especially in rural areas, which house over 70 percent of the population in Rajasthan. The major share of such proteins comes from pulses, which are an integral part of rainfed agriculture in Rajasthan, and pigeonpea is known to produce high protein (20-22%) food and quality fodder. Pigeonpea also yields about 10 tons/ha of dry stem for use as fuel wood in rural areas.

Pigeonpea is capable of fulfilling various social, nutritional, economic, and environmental needs of the smallholder farming communities, and hence it is expected to pave the way for the long-term agricultural prosperity in Rajasthan. It is a crop endowed with the inherent ability to fix nitrogen in the soil, adds organic matter to the soils through fallen leaves, and maintain structural properties of the soil, thus leading to sustainable, eco-friendly and cost-effective agriculture. Initial trials conducted by ICRISAT in Rajasthan have shown that the probabilities of pigeonpea adoption by resource poor farmers would be high. The direct beneficiaries would be the smallholder resource-poor farmers of Rajasthan.

At present, pigeonpea is grown on about 15,000 ha in a few districts of Rajasthan yielding about 700 kg/ha. In order to overcome poverty and ensure food security, it was essential to increase food production in the fragile environments of Rajasthan and restore the natural habitats and ecosystems. To achieve this, we proposed the introduction of appropriate pigeonpea varieties to produce protein-rich food and fodder, besides high quality fuel wood. In fact, this crop is also ideal for a cereal based crop rotation.

ICRISAT, under the project "Enhancing the Livelihoods of Resource-poor Farmers of Rajasthan through the Introduction of Eco-Friendly Pigeonpea Varieties", conducted on-farm trials in four districts – Jaipur, Alwar, Dausa and Karoli, on a total of 343 ha (the initial target was only 70 ha) using ICRISAT's pigeonpea variety ICPL 88039. This was in close partnership and collaboration with the Agricultural Research Station (ARS), Durgapura, Jaipur of the Swami Keshwanand Rajasthan Agricultural

University (SKRAU). The objective was to trigger demand for improved and sustainable pigeonpea production demonstrated with the expansion of the land area covered by the on-farm trials, and promising poverty alleviation and food and nutritional security in the state.

Owing to its short duration and yields higher than that of the prevailing variety, UPAS 120 (which took 140 days to mature and produced 1.5 t/ha), ICPL 88039, which produced 2 t/ha in 120 days, was readily accepted by the farmers. To make this variety popular, in 2013, 800 ha of the on-farm demonstrations were conducted in 43 villages in eight districts of Rajasthan (Jaipur, Dausa, Alwar, Karoli, Sawai Madho Pur, Bharat Pur, Tonk and Dhaul Pur) producing 500 tons of grain with an average yield of 1,140 kg/ha. This was in close coordination with ICRISAT's partnering scientist, Dr SJ Singh, the Scientist-incharge, Agriculture Research Institute, Durgapura. The short duration pigeonpea was introduced and scaled up in these eight districts, where earlier only a cereals based cropping system was followed. The former practice required more inputs and the farmers were able to grow only one crop in a year. ICPL 88039 was attractive to farmers with its potential as a cash crop requiring little input,. and its ability to grow in rainfed conditions These smallholder farmers are now able to grow a second crop, providing additional incomes. The farmers have reported that cultivation of this pigeonpea has also led to increase in yield of the succeeding crop, resulting no doubt from the increase in soil fertility due to nitrogen fixation.

The Success

In a short span of time, ICRISAT's short duration pigeonpea has transformed lives of thousands of smallholder farmers in these regions. Considering the returns gained by pigeonpea, more farmers have shifted to pigeonpea cultivation from the traditional cereals. Given the growing demand for these short duration varieties, it was also essential to develop a good and efficient supply chain for quality seed in the region. Therefore, a large-scale seed production program was undertaken on the fields of progressive farmers and under the strict supervision of scientists. This led to development of an efficient seed system, where farmers can get quality seed right in their village. The farm produce was directly linked to a local market, where middle-agents would collect seed directly from the farm, fetching good returns to the farmer.

At present, pigeonpea has replaced traditional crops such as pearl millet and sorghum in eight districts of north-eastern Rajasthan. To ensure a better value capture and value addition, ICRISAT supported the installation of four mini dal mills in the villages, which not only helped generate

Packing and processing of pigeonpea seed.

Photo: ICRISAT

employment, but also made available nutritious and quality dal to farmers at economical rates. At present the retail prices of dal are around Rs 80/ kg, which is beyond the buying capacity of many farmers. Therefore, under this project, efforts are being made to provide quality nutrition to farmers from their own produce. The four small-scale dal mills and seed graders were installed in the key locations of Padasoli (Bassi taluka); Lalwas (Jamwa Ramgarh taluka) of Jaipur district; and Nadauti (Karouli district) and Ganeshpura, Dudu of Jaipur district). ICRISAT organized a number of village level group meetings and capacity building programs to teach the farmers how to use the small-scale processing machines for making pigeonpea dal. To ensure inclusiveness and gender equity, emphasis was given to encourage women farmers /self-help groups (SHGs) to look after the management of the mini dal mills. The women/SHGs are now confident and successful entrepreneurs, besides having an additional source of income. Seeing this success, a progressive farmer in Ganeshpura Dudu of Jaipur district voluntarily approached ICRISAT with a request to install a dal mill in his farm house and to engage the women of his family in this activity. Women of these villages involved in the dal processing activity will not only get nutritious dal for their families, but can also sell it for a good price in the local market. Besides these benefits, this crop has provided a great relief to rural women by eliminating the drudgery of collecting fuel wood from forest areas, as they now use the dried pigeonpea stalks as fuel wood instead (fuel efficiency 3000 calories/kg). The broken seed from

Prem Devi of Padasoli village, Rajasthan grows pigeonpea and cooks it daily into high-protein dal. She uses the stalks as firewood.

the dal mill is used to feed livestock, thus women farmers in particular, are reaping the benefits from improved and sustainable pigeonpea production, with the promise of food and nutrition security and a better quality of life for their families.

The Magic of Markets

Traditionally, farmers in this region grew cereals such as pearl millet or sorghum, with very low yields, as this region is totally rainfed and farmers in the region are resource poor. Munni Devi, a women farmer from Padasoli village, related that she used to grow, sorghum and mungbean in her 1.62 ha (4 acres) of land, giving returns of only ₹8,000-10,000/year. Now, with pigeonpea she earns about ₹70,000/ha/year. She further added that a small portion of the produce is consumed at home, while most of it is sold in the local market. This highlights both the inclusiveness and market orientation of this activity.

In addition to significant increases in income from pigeonpea production, pigeonpea is considered a *'wonder crop'* by women in the village because of its multi-purpose uses. They use pigeonpea in making pakoda (a snack), dal and other food preparations, while the leaves, pod shells and broken seeds are used to feed livestock, and dried stalks are used for fire wood. Thus the entire produce was put to economically enhancing utility. Yields of around 1,900 kg/ha were recorded in the fields where manure (Neem plus) was used as a basal dose. Pigeonpea producers are now linked to local markets where farm produce is being directly sold at a good price.

ICRISAT's initiative to visit the local markets and link farm produce directly to markets has helped farmers in selling their produce at competitive prices in the open market. This linking with markets has helped farmers to gain confidence and grow more pigeonpea in their farms. With these efforts, a local seed company, KD Seed, contacted the seed growers and now buys the seed directly from the farmers. This is the second successful year of the project, and today most of the farmers are networked with local markets. In fact, some retailers also have shown an interest in purchasing the seed directly from the villages. The network between farmers and local markets has been established very well with the help of ICRISAT efforts and its IMOD orientation.

Incorporating Inclusiveness

The main aim of ICRISAT was to demonstrate and improve the livelihoods of resource poor farmers of Rajasthan through increasing crop productivity, conserving the environment and building a market orientation to enhance incomes. ICRISAT's project is based on an eco-friendly technology that has helped in increasing the livelihoods of many farmers living under the poverty line and facing environmental challenges in the harsh climate of Rajasthan. This technology is primarily based on encouraging the adoption of an early maturing variety that helped to increase the cropping intensity by making it possible to grow another crop in the same field after harvesting the pigeonpea crop. Also, a program of value addition was introduced, such as installation of dal mills, making baskets with dried pigeonpea stalks, and the like. The farmers were trained in identifying production constraints, growing a healthy crop, storage and marketing.

To achieve higher yields at different targeted locations of Rajasthan, a crop management package was developed that included five main components: (i) Variety selection (VS); (ii) Integrated nutrient management (INM); (iii) Integrated pest management (IPM); (iv) Integrated disease management (IDM); and (v) Farmers' participatory seed production (FPSP). An area of 805 ha was covered under this approach, covering 1 ha from each farmer within the target eight districts of Rajasthan.

ICRISAT organized training-cum-field exposure on pigeonpea breeding activities and seed production for personnel under the RKVY Rajasthan Pigeonpea Project during 16-23 September 2013. They also organized a field day in Badwa village of Padasoli

on 11 November 2013, where 150 farmers got an opportunity to interact with scientists and share their queries about pigeonpea production. In all, six "Training Programs on Pigeonpea Production" were organized in Dangarwada, Jamuaram Garh; Padasoli, Bassi; Thali, Jamuaram Garh; Soda, Fagi, Tonk; Ganeshpura, Dudu, Jaipur and RARI Campus Durgapura, Jaipur villages in December 2013. A module on the package of practices for pigeonpea was developed in the Hindi language and distributed among farmers at this time.

Lessons Learned

Key lessons learned included realization that farmers were unaware about short duration high yielding varieties of pigeonpea, lack of storage facilities and access to the markets (even if they had access to the mini dal mills).

The IMOD approach followed in implementing this project is the major factor responsible for its success. Farmers are now trained in all aspects of pigeonpea cultivation with improved varieties, as per requirement of the cropping system of Rajasthan and including post-harvest, value addition and market linkages, demonstrating a full value chain approach

As pigeonpea requires very little irrigation, it can be grown in regions where farmers were growing only one crop a year. So, farmers are now gaining good returns by growing two crops in a year. Farmers are trained in making other value added products and that produce is also directly linked to local markets. Thus, farmers have developed trust in this crop, and consider pigeonpea as a wonder crop.

The Way Forward

- Develop an efficient production system involving pigeonpea
- Produce large quantities of pigeonpea and link the production with marketing
- Meet the protein requirements of poor farmers with locally produced dal
- Manage the degraded soils by growing pigeonpea for food production
- Identify constraints to pigeonpea and sale, distribution and marketing
- Breed new pigeonpea varieties suitable for different agro-ecological zones of Rajasthan.
- Cover an additional area of 5000 ha under this project with maximum participation by women farmers/ SHGs

Key Information

Name of project: Enhancing the Livelihoods of Resource-Poor Farmers of Rajasthan through Introduction of Eco-Friendly Pigeonpea Varieties

Key scientists: Dr KB Saxena and Dr CV Sameer Kumar.

Key partners: Dr SJ Singh, ARS Durgapura; Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan.

Project duration: Ongoing since 2012.

This work was undertaken as part of the CGIAR Research Program on Grain Legumes

About ICRISAT

ICRISAT
Science with a human face

International Crops Research Institute for the Semi-Arid Tropics

ICRISAT is a member of the CGIAR Consortium

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, Telangana, India, with two regional hubs and five 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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