ICRISAT
Eastern and Southern Africa
2011 Highlights

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Science with a human face

International Crops Research Institute
for the Semi-Arid Tropics

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ICRISAT–Nairobi
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Cover: The final touch: A farmer in Malawi sews a bag of rice seed closed getting it ready for sale.

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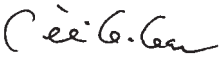
Preface

How can we, our partners and society as a whole spark a transformative dynamic that reaches hundreds of millions of poor? In these times of constant change, how can we change and re-orient ourselves to continue to ask the right questions and find appropriate long-lasting solutions? These are the questions we, as ICRISAT, recently posed when defining our strategic plan for 2011–2020. Our process to answer this question resulted in Inclusive Market-Oriented Development (IMOD) – a unifying conceptual framework that has at its heart the ability to create opportunities for farmers to reinvest in agriculture by harnessing the power of markets.

This year's Eastern and Southern Africa Annual Report goes beyond accounting for our work at the project level. Instead, we show how various themes and work areas across disciplinary and project boundaries merge into a higher level narrative illustrating the processes that drive the creation of sustainable change. We present three examples that have already been started with markets as their core inspiration.

Work done in Ethiopia on chickpea describes highly complex value chains with numerous players and steps between the farmer and the final consumer in countries far from Africa. The core lesson here lies in understanding international market needs, facilitating local markets, and providing farmers with the right germplasm to access these markets. The story on groundnuts in Malawi describes how challenges in market access can be solved through local level collective action and also exemplifies ICRISAT's role and responsibility to find solutions to associated problems such as aflatoxin. Finally, the story on the systems approach followed in Zimbabwe illustrates how livestock markets stimulate technology adoption and reinvestment in both crop and livestock production, resulting in more resilient mixed systems.

This report illustrates IMOD in action. IMOD helps to create market-based incentives for improving technology adoption and facilitating effective value chain development; it also defines the role of upstream research and provides a framework that directs our research to address the needs of the poor. The systems perspective through the lens of IMOD is ICRISAT's most promising answer to igniting a spark of transformation that will reach many thousands in the semi-arid tropics.



William D Dar

Director General

Said Silim

Regional Director for
Eastern and Southern Africa

2011 Highlights

Making farming pay: Market-based solutions to poverty

Gift Lungu is a man with a long-term plan. Last year, he bought a pair of oxen. This year he will buy a small plot of land in town. With time Lungu says he will build a house on his land so that he can rent it out and use the money to pay for school fees for his eight children. He is making progress.

As a smallholder farmer in Zambia's Eastern Province, Lungu's biggest source of cash to turn his dreams into reality will come from the sale of groundnuts. And for the last two seasons, the markets have been paying Lungu well for the new high-yielding variety of groundnuts he is now growing. MGV-4, also known as CG-7, was recently released in Zambia and the red-colored groundnut has higher yields than the other varieties Lungu previously grew. Today Lungu is no longer just a dreamer. Tangible rewards from the marketplace have turned his dreams into the first steps of a new reality.

The challenge for agricultural research and development organizations has been to determine ways to replicate Lungu's story on a large scale. How can we increase the likelihood of success for all those individual plans and dreams? The answer to this question may lie, not on farm as was previously assumed, but at the markets where farm products are sold and profits drive household investment patterns.

The bottom line

For many of us the bottom line lies in the amount of money we earn. The more we earn, the more we can afford a better quality of life – better houses, better education for our children, health and life insurance, travel and holidays. Farmers are no different; their quality of life is determined by the money they earn at the rural marketplaces where they sell what they have grown that season.

Gift Lungu, his wife Jessie, and his namesake and son Gift Junior, pose in front of their groundnut granary at their home in Chipata, Zambia.

And, just like for many of us, the grass can appear greener on the other side. When faced with the choice of replacing a rural life for an urban one, many farm families choose to move. U.N. Habitat estimates that 14 million people in sub-Saharan Africa migrate from the rural to urban areas each year. After a careful assessment of the costs and the risks, more and more farmers exchange their farms for the monthly paychecks from jobs in cities, factories and mines. Families agree to be separated as husbands work regular city jobs and send cash home to wives and children in the villages. By 2050, the World Health Organization predicts that 70% of people will be living in urban areas.

One of the drivers of this trend is the fact that for many farming is simply not sufficient as the only means of earning a living. For those with other options, farming can become a secondary source of income, a buffer to protect them from the shocks and upheavals that life brings. Off-farm income is crucial in not only augmenting income, but also allowing greater on-farm investment and therefore greater on-farm returns. For this group, earning more from their farming can make a difference in securing each foothold as they climb out of poverty. For the other families for whom farming and a rural life is the only option, making as much money from their farm is important to secure the basic standards of life that will allow them to make ends meet each month, to pay for school fees and uniforms for their children, to handle medical fees and hospital costs should they need it.

Turning to markets

In the search to make smallholder farming more profitable, markets appear to offer the possibility of generating sustainable solutions to the issues surrounding food security and poverty. Many organizations, including ICRISAT, are testing the value of market-based approaches. One of the benefits of working with markets is the increased likelihood of both short- and long-term impacts.

Left: After two–three days of drying them in the African sun, a worker in Malawi shovels groundnuts into bags. Right: Reminding parents to make sure they get their children ready for the next school term, these new uniforms are on display at a market day in Gwanda, Zimbabwe.

In the short-term, farmers have more cash to spend. In the long-term, as long as the markets keep paying a fair price making re-investments in production possible, there is a good chance for these benefits to accrue long after any individual project has come and gone. Finding market-based solutions that allow rural populations to integrate into supply chains appears to be the best way to address chronic problems of poverty and food insecurity.

Effective market-based solutions can also build resilience into rural communities. Farming is a risky endeavor in drought-prone marginal areas, or in countries that are economically or politically unstable. Diverse and functional supply chains that allow profits to trickle down to farmers provide more options to farmers and their families. "The possibility to invest more in farming activities or exploring other rural livelihood options increases diversity in systems, which is important in building resilience," says André van Rooyen, ICRISAT Senior Scientist. "Tomorrow if disaster strikes, they will perhaps be better prepared to handle it than before."

Marketing challenges

While working at devising market-based solutions is a promising area, it comes with its own challenges and constraints, which are not always that straightforward to address. "In Africa there are a lot of farmers who have a great difficulty in selling what they produce," says Alastair Orr, Economist at ICRISAT-Nairobi. According to him, market-related problems can usually be classified into two broad categories: access to markets and the terms of market engagement.

Farmers' proximity to the marketplace can make a big difference. "Three out of four farmers in Kenya are at least four hours away from a market," Orr says. As a farmer's distance to the market increases, the cost of transporting his/her produce to that market becomes higher, cutting into the

The miles between farm and market means walking far carrying heavy loads.

profit to be made. Should farmers attempt to avoid the transport costs by selling to a passing trader, they run the risk of getting a lower price than what the market would have paid them directly. Besides physical access to markets, farmers also face other restrictions to successfully selling their products. For example, they may find that they do not produce enough quantities to warrant the transport to a better paying market. Or they may not be aware of what the market requires, the kinds of products, the qualities and when the market needs these products.

This lack of information can result in skewed terms of market engagement, resulting in unfair prices. "One of the big questions is can markets be made more friendly to farmers? The fair trade market is the best example we have to answer that," Orr says. Regular up-to-date information on prices, market demands, the right technologies, the ability to negotiate terms and prices are all factors that can influence a farmer's mode of engaging with the market.

Marketing solutions

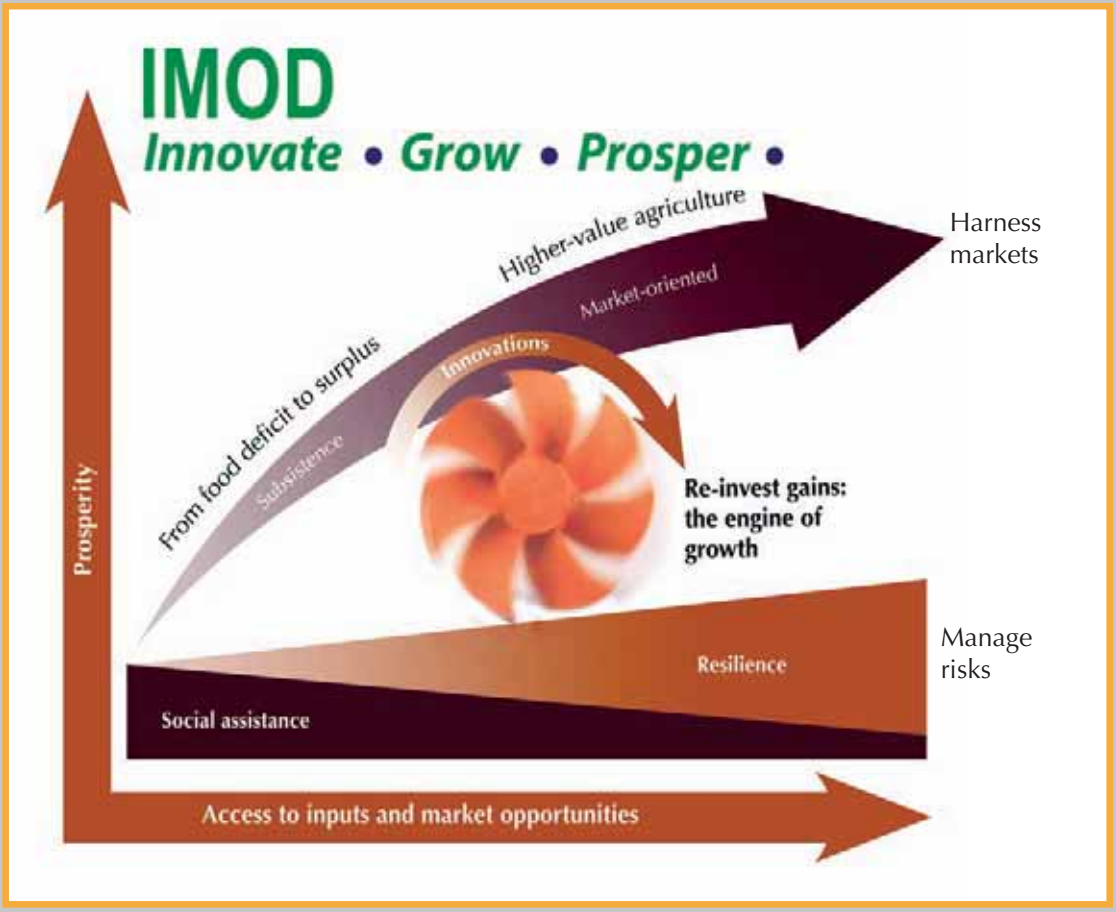
Some solutions to the issues of access and engagement lie outside the domain of the research sector or even the agricultural sector. For example, building the right infrastructure such as roads makes a huge difference in rural livelihoods. But the agricultural sector rarely influences such decisions.

However, there are a variety of options that research and development are exploring to create market-based opportunities in rural areas. Sometimes the solution lies in being able to help farmers change what they do to better align with market demand. For example, improving the availability of seed of market-preferred varieties, such as in the case of Lungu, can make the difference. Breeding varieties that have the right characteristics such as size, taste, cooking time etc. can enable farmers to tap into domestic and export markets easier. In Ethiopia, for example, farmers have switched to growing large-seeded white kabuli varieties preferred by the export market instead of desi varieties (page 12).

Research that teases apart the steps that take a crop from a farmers' field to its final destination miles away in other countries can open opportunities to increase profits for farmers. Finding ways for them to add value on-farm, utilize safer post-harvest technologies or joining together to market a product as a group as Malawian farmers do when selling their groundnuts can solve market access and engagement problems and increase the final take home profit (see page 17).

Sometimes the solution lies in physically building a market where regular sales can take place and prices reflect rewards for quality as in the case of emerging small-stock markets in Zimbabwe (see page 23). As these solutions evolve and we continue to learn more from the process of developing market-based solutions, it may just be possible to turn more of the dreams and plans of smallholder farmers into realities.

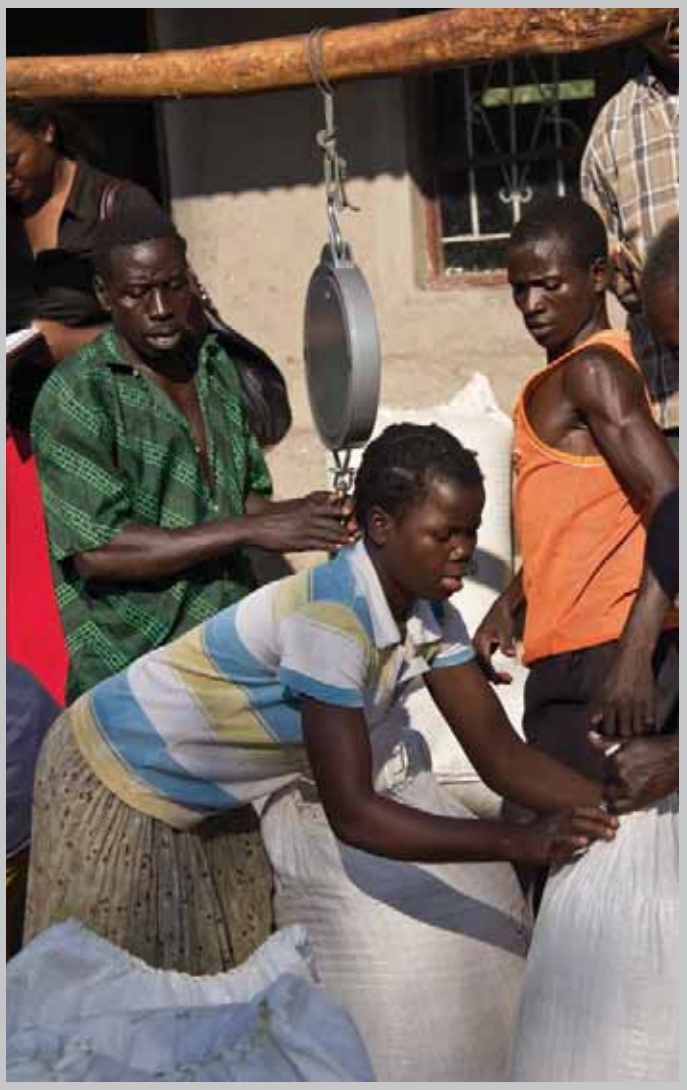
ICRISAT's IMOD



In 2011 ICRISAT developed Inclusive Market-Oriented Development (IMOD) as the unifying conceptual framework of the strategic plan to 2020.

IMOD envisions a pathway out of poverty by better linking farmers to markets to increase incomes. Research-for-development generates technology and innovations that increase the productivity and value of dryland farming. A portion of the profits are re-invested in additional innovations in following years, further increasing gains in a self-reinforcing cycle (engine of growth). Gains are also reinvested in building resilience (e.g., by increasing stocks of human, social, natural, physical, and financial capital), supplanting the need for high levels of social assistance such as emergency relief aid.

– Adapted from ICRISAT's Strategic Plan to 2020



What does ICRISAT as an agricultural research institute gain from the IMOD framework? Some of the ICRISAT scientists based in Eastern and Southern Africa weigh in:

"The emphasis on market helps us to reorient our research better and ask better questions. Traditionally we are production economists looking at supply side problems. Now we are being asked to solve demand-side problems as well."

– Alastair Orr, Economist, ICRISAT-Nairobi

"I think of IMOD as a very useful tool to locate the specific situation of the target group and to visualize a way 'forward'. This would help to tailor the intervention to their needs."

– Kai Mausch, Economist, ICRISAT-Lilongwe

"IMOD promotes our chances of increasing the adoption of technologies. It isn't us talking about technologies any more but it is the markets that define what production technologies farmers need."

– Patricia Masikati, Modeller, ICRISAT-Bulawayo

"I think of IMOD as a yardstick for all of us to relate to. It is a reference point so that we can keep looking at the big picture and understand how our work fits to reducing poverty."

– Sam Njoroge, Pathologist, ICRISAT-Lilongwe

"IMOD requires a real change of mindset of scientists to identify bottlenecks in farming systems and find solutions beyond the usual commodity-oriented approach. In the risk-prone environments that we work in markets stimulate greater reinvestments in both crops and livestock."

– Sabine Homann-Kee Tui, Social Scientist, ICRISAT-Bulawayo

"Working with markets is a very effective model to bring about real change because it is driven by real incentives. The rewards are external to projects and we can engineer positive feedback loops to increase sustainability and build resilience in dryland systems."

– André van Rooyen, Crop-Livestock Scientist, ICRISAT-Bulawayo

"IMOD allows us to be much more research-oriented. It helps us to refocus on our research mandate and to go beyond the usual monitoring and evaluation methods of asking how many varieties were released and how many farmers it reached to the next big question, which is, how much does this make a difference."

– Dave Harris, Agroecosystems Scientist, ICRISAT-Nairobi

Previous page: Farmers in Karonga district produce seed of Malawi's special Kilombero rice. Fifty kg bags of rice are weighed and stored in warehouses until they are sold. Above left: Trucks that can bear heavy loads are important in linking farmers to markets far away. Above right: children in Zambia play on bags full of groundnuts.

Chickpea: Linking soil fertility and market demand in Ethiopia

Ethiopia is ancient and enduring but recently major landscape scale changes are transforming the face of the country. "Three years ago, when you drove past, the countryside did not look like this. All these darker brown squares are where chickpea has been harvested," explains Tsedeke Abate, Scientist at ICRISAT-Nairobi. "You can really see how much acreage is being devoted to chickpea today. Ten years ago this was all mostly teff. "Teff, a small-grain cereal, is the primary ingredient of injera – the bread that accompanies almost every Ethiopian meal. "What we are seeing is a shift from cereals to legumes on a large scale and it is the market that is responsible for this," Abate says.

Unlike other countries where farmers routinely clear rangeland or chop down forests to turn them into new farms, Ethiopian farmers do not have that option. Most arable land is already in use. So if farmers are to make a better living from their existing resources they must find options that pay better. Chickpea is one such recently discovered opportunity. A few years ago, all the legumes combined were grown on about 10–12% of a farmer's land in central Ethiopia. Today legumes represent about 50% of a farmer's land.

Market demand, variety adoption, and soil fertility

A farmer for 26 years, Temegnush Dhabi in East Shewa has recently been doing things differently. "I always grew chickpea, but the traditional varieties," Dhabi says. "But for the last four years I have been growing the modern white chickpea varieties. There's no question in my mind. I will keep growing these new varieties."

The new varieties of chickpea Dhabi is referring to are kabuli chickpeas rather than the smaller-seeded brown desi varieties. There is a huge worldwide demand for kabuli chickpea, characterized by its white color and large seed

From cereals to legumes – this shift in Ethiopia's farmers' priorities is reflected by the landscape as the golden pieces are replaced with more and more of the darker brown representing harvested chickpea.

All smiles: Temegnush Dhabi shows off an ox bought with money she earned from chickpea sales.

size. In fact, the market for chickpea is so well defined and specific that farmers can earn a premium of about USD 1000 dollars per ton more for growing the kabuli chickpea. It is the very real possibility of earning this cash that has made Ethiopian farmers adopt the new varieties.

Dhabi is so convinced that she is willing to devote more than half of her farm land to chickpea. Besides the actual profits, Dhabi finds chickpea is much easier to grow and harvest compared to teff. She has also noticed the soil fertility benefits to growing legumes. "My wheat and teff now grow well in a rotation and I don't have to use as much fertilizer," Dhabi says.

In January at the beginning of the season the price of chickpea was around 11 Ethiopian Birr (ETB)/kg or USD 0.61. But Dhabi says she knows she can earn more later on in the year. She plans to leave her chickpea in sacks stored at home. She will sell them at a later date when the market is not flooded with chickpea and the local traders will offer her a better price.

Dhabi is one of close to a quarter of a million farmers in sub-Saharan Africa and South Asia who are benefitting from the Tropical Legumes II project. Since 2007, the project, funded by the Bill & Melinda Gates Foundation and implemented by a number of members of the CGIAR Consortium and national partners, has been working towards improving the livelihoods of smallholder farmers through enhancing the production and productivity of legumes and providing the right training and information.

"The project works in a very holistic manner. Ethiopia is a great example of that," Abate says. "We connected all the value chain players together – farmers, traders, exporters, importers. And the market was there. It all came together and completed the circle."

From field to market: the rest of the chickpea chain

From fields around Ethiopia, chickpea is bulked and transported by farmers or traders to be

Rooted in science

Many market-based solutions have a solid foundation in science. In order for chickpea producers in Ethiopia to capture the profits of the export market, they have to grow a variety of kabuli chickpea that marries market requirements with the growing conditions in the country. Enter 'Arerti' – a kabuli variety with a name that means "not afraid of drought".

"Arerti is a variety that has improved resistance to disease as well as drought," says Ganga Rao, Scientist at ICRISAT-Nairobi. A series of tests, on-farm demonstrations, as well as training conducted by the Ethiopian Institute for Agricultural Research (EIAR) through the Tropical Legumes II project determined the potential of Arerti for the project sites and served as a vehicle to introduce farmers to the variety. "Arerti has increased farmer's yields from around 600–700 kg per hectare to around 800–1600 kg per hectare," Ganga Rao says.

sold at local markets or to small companies who handle the export. The export market demands kabuli chickpea whereas the local Ethiopian consumer prefers the desi variety, which is known for its taste. Gebeyehu Melesse is both a farmer in the city of Gondar and a shop owner in Casa Nchis, a small neighborhood in Ethiopia's capital Addis Ababa. The tiny shops with bags of grain crowding the already narrow streets bear the prices for each type of chickpea – ETB 17 for desi and ETB 20 for kabuli (USD 1 = ETB 18).

"I sell much less of the kabuli variety than the desi variety in my shop," Melesse says, underscoring the fact that the farmers produce chickpea primarily for the export market. "But more people are now buying the kabuli varieties than before," he adds.

As chickpea makes its way from rural to urban areas it begins to increase in price – compare for example Dhabi's ETB 11 to Melesse's price of ETB 17. This price reflects the costs of transport as well as any cleaning and grading that may have been carried out. The chickpea changes hands in a varying number of transactions as small traders sell to larger brokers who bulk up the chickpea into more desirable amounts for export companies who need to trade in high volumes.

Gebeyehu Melesse in his shop in Addis Ababa, Ethiopia.

Seeds that pay

The large-scale adoption of a new variety means that a lot of seed must be made available to farmers. In anticipation of this need, the Tropical Legumes II project trained selected farmers in the correct methods of seed production. Bedilu Mamo is a newly-trained seed producer in Memhir Hager village. Mamo is pleased with the performance of Arerti. "The variety is really good for drought conditions," he says. "There is a lot of demand for this seed." Mamo has produced 3.5 tons of Arerti seed to sell. "I expect a minimum of 30,000 Birr (USD 1700) from the sale of seed this year," he says smiling. Mamo plans to first pay for the school fees for his children. "The rest I will save and reinvest in better technologies and my farm," he says.

Women sort and clean the chickpea at the assembly line at ACOS.

The two export extremes

An example of one of the smaller export companies is the family-owned Choksi Agro-trading. They work with anywhere from 100 to 200 brokers who source the chickpea for them. Choksi Agro-trading exports about 15,000–20,000 tons of chickpea per year. "Our biggest destination for kabuli chickpea is Pakistan," Vinod Choksi, the owner of the company, says. "From Pakistan some of it is even re-exported by truck to Iran. We also sell directly to the UAE. India is another big market at the moment as there is a scarcity of chickpea there. India buys from us and then Bangladesh buys from India."

By contrast ACOS Ethiopia is one of the largest chickpea export companies in the country. Established in 2005 Acos mainly supplies chickpea to the EU. "There is a big canning industry in the UK, Spain, Germany and Italy. A newer market is the USA and Canada and we are also exploring options in the Middle East," says Kassahun Bekele, Manager and Co-owner of ACOS.

"Our approach is different from that of the other exporters because of the volumes we deal with," Bekele says. ACOS' premises look remarkably similar to a factory assembly line and large volumes of chickpea are moved efficiently on conveyor belts. From silos that can hold 1000 tons of grain the chickpea is rigorously treated for pests and even x-rayed to detect any live insects that may be lurking within the grain. Machines that sort by color and size segregate the grain into different qualities. The cleaned and graded chickpeas are then transported to the EU via Djibouti at the end of a process that takes 20–30 days.

"There is no real time constraint with the canning industry, " Bekele says. "They need a constant supply of chickpea around the year. Our problem is that we cannot really supply such a huge demand as yet." ACOS is working to increase their network of traders and they are also exploring the option of contract farming with farmers in order to ensure a consistent supply of chickpea. As the demand for chickpea continues unmet, Ethiopian farmers are well positioned to earn better incomes and improve soil fertility on their limited lands.

Collective action and reaction: Market-based groundnut development in Malawi

Now worth stealing

Malawian folklore says that if you steal another farmer's crop, your feet will freeze in his fields. You would have to wait there for all to know of your misdeed until your kinsmen came to free you by paying some form of compensation. It may have been as a result of stories such as these, or maybe it is because Malawians are by nature honest and friendly, but it used to be rare for crops to be stolen in this country – until this year when newspapers have started reporting stories of thieves reaping harvests that they did not sow.

"The groundnut season is just beginning. But already the prices are higher than they were at this time last year," Moses Siambi, ICRISAT Country Representative, says. In the month of June last year, groundnuts were selling for around 80 Kwacha (K), roughly USD 0.50, for a kg. This year they are selling for almost double that, close to USD 1 (K260) per kg. After more than a year of economic and political uncertainty and close to 50% devaluation of the Kwacha, this season, more than any other, groundnuts represent much-needed, hard-earned cash, making it a commodity worth stealing.

Working together for more

James Chilombo of Chawamba village is one of the 19 members of the Msangu Club, named after a huge Acacia tree that grows nearby. "Groundnuts brings me the most cash. It is the biggest earner of income for me," Chilombo says. This is why he has devoted one third of his farm to growing groundnut seed, reducing the area that he used to devote to tobacco.

ICRISAT's revolving seed fund works with farmer groups like the Msangu Club in the central region of Malawi to increase the availability of legume seed in Malawi. Farmers were trained in

all the different aspects of seed production. Each member of the club then received 20–30 kg of basic seed that they were then to multiply into certified seed. Once tested to ensure that it was of high enough quality the seed would be made available to the general public through a variety of channels, such as through the government's groundnut subsidy program or else through a newly created Malawi Seed Alliance (MASA) brand, promoted through a project funded by Irish Aid.

"We started out with ten members and now we have 19," says Chilombo. "Farmers at the beginning were not sure how it would benefit them. But after the first season more decided to join."

Chilombo knows he benefits from being part of the club. Soon after harvest, the group sets a minimum price for their groundnuts so that no one accepts a lower price or undercuts the other. He says that "membership to the group is a major benefit because we can sell at a price that is higher than other prevailing prices. We have plans to turn this club into a fully-fledged association. That way we can negotiate even better prices." Chilombo also says that being part of the group has meant the possibility of learning new techniques and better methods of groundnut farming.

The future belongs to the organized

If belonging to a group of 20 can make a difference to a farmer like Chilombo, how much more can membership to a group as large as 100,000 bring? The slogan of Malawi's largest farmer organization, the National Smallholder Farmers' Association of Malawi (NASFAM) says it all – the future belongs to the organized. For the extremely low fee of K200, less than a dollar, for a year's membership, NASFAM offers its members a lot of benefits, the biggest being the link that NASFAM forges between rural Malawi and groundnut markets in the UK.

This link is what drew Nemezio Joseph Kadamanja to become a NASFAM member. "It used to be a problem to sell groundnuts. And so I became a NASFAM member because it was a well established market and because they provided us with training. I would never stop being a NASFAM member," Kadamanja says.

Nemezio Joseph Kadamanja, a farmer and a member of NASFAM.

Kadamanja farms five acres in the Chiwoko Market Action Center (or MAC) in Mchinji District of which two acres are sown to groundnuts. NASFAM to Kadamanja represents a trustworthy, guaranteed market. NASFAM's scales are known to be accurate unlike the scales of other groundnut traders. "Groundnuts makes me the most money," Kadamanja says. "It is very important to me and I appreciate the training and information I receive from NASFAM."

As an organization NASFAM is highly structured. NASFAM has six chapters in Mchinji District, each with around 600 farmers, most of whom grow groundnuts. Each chapter has a Field Officer; Wezzi Chisi is the Associate Field Officer

Wezzi Chisi, NASFAM Field Officer, (right), inspects the Grade One Chalimbana groundnuts produced by farmers from the Mchinji area.

Oswin Madzonga, ICRISAT-Lilongwe Scientific Officer (left), discusses groundnut marketing with Quesho, a trader. Behind them the sign bears the price of groundnuts: Mtedza 240.

for Kadamanja's chapter, and she is based at NASFAM's Mchinji Office. Chisi works with the farmers in her chapter throughout the season, visiting their fields, answering their questions, providing advice and solutions on a one-on-one basis as needed as well as at village level. When farmers sell their groundnuts through NASFAM, Chisi also coordinates the logistics of taking the nuts to NASFAM's warehouse and the transfer of money from NASFAM to the farmer.

In NASFAM's warehouse, the groundnuts of each farmer are graded into three classifications based on size. The nuts are then fumigated against pests and tested to ensure conformity to market requirements. The best nuts will make their way to the UK through the fair trade market. NASFAM's other big buyer of groundnuts is Afri-Nut Ltd., a locally incorporated company that processes peanut butter and snacks, and also exports peanuts.

An open market and a "black market"

Before 2004, NASFAM was synonymous with the groundnut market. "However, since 2004, there are a lot of buyers and groundnut traders operating in Malawi. Farmers these days have other options to sell their groundnuts besides NASFAM," says Oswin Madzonga, Senior Scientific Officer at ICRISAT-Lilongwe.

Quesho, a groundnut trader working alongside one of the major highways in Mchinji, represents one of these other options. Quesho buys different varieties of groundnut, maize and soya from farmers nearby. "We buy groundnuts and then hope others will buy from us," Quesho says, referring to buyers from a number of Malawi's neighboring countries. Burundians, Congolese, and Tanzanians who visit Malawi during the groundnut season often hire Chichewa-speaking Malawians to buy on their behalf. Once they have enough they smuggle the groundnuts across the border in the beds of empty transport trucks, making their return journeys back to their points of origin profitable.

"We know this is happening, but it is difficult to prove because official export statistics at border points can be inaccurate. For example, we have estimates of how much a country like Tanzania is supposed to produce based on statistics of the area under groundnuts. But some sources of data show that they are exporting more than they are producing. How is this possible?" Madzonga says.

Not just traded illegally

Some groundnuts cross Malawi's borders legally. "We have bought 500 tons of groundnuts in three weeks," says Ezekiel Diamond, Operations Manager at Chitsosa Malawi. The company buys shelled groundnuts from traders in five districts – Mchinji, Dowa, Kasungu, Nkotakhota, and Lilongwe. After performing basic quality checks, the company then transports groundnuts to Kenya, Tanzania and even Zimbabwe. "We have a huge demand for groundnuts in these countries," Diamond says. "It's good business."

When looking at it from one angle, this black market trade does not really affect Malawi's smallholder farmers adversely. (It only denies the government the necessary revenue from the exports since these are not declared.) For all practical purposes, the groundnut market is booming. Traders post and revise their prices for groundnuts on a daily basis. This open market gives farmers options outside of NASFAM should they need it. Even Kadamanja, who is a faithful NASFAM member, recently sold groundnuts to a local trader as he needed cash and NASFAM was yet to determine and announce a buying price for groundnuts.

However, from another angle, this open market for groundnuts has serious health implication caused by a microscopic soil-borne fungus called *Aspergillus flavus*. *A. flavus* produces a toxin called aflatoxin in a variety of crops such as maize, sorghum and groundnuts. It is found in soils throughout Africa and around the world. "The worst case of aflatoxin exposure in recent times was in 2003 when 120 people died in Kenya from eating maize with very high aflatoxin levels. However, that sort of acute situation is relatively rare," Sam Njoroge, Pathologist at ICRISAT-Lilongwe explains.

Most people instead are exposed to low levels of aflatoxin over the course of their lifetimes. Known as chronic exposure, the aflatoxin levels build in the body over time, eventually causing cirrhosis of the liver or liver cancer. Children are particularly affected by aflatoxin, which can lead to stunted growth and delayed development. "The diets of the rural poor are not that diverse or nutritive and so the effects of lower levels of aflatoxin can be more significant," Njoroge says.

The export market through NASFAM has rigid regulations on aflatoxin levels. "The fair trade

Children play in a field next to "Mandela Corks". This special way of storing groundnuts allows a column of air to filter through the center, slowly drying out the groundnuts, and preventing the spread of the Aspergillus flavus *fungus. As more farmers adopt better post-harvest measures, aflatoxin contamination can be reduced, making Malawi's groundnuts healthier and more profitable.*

market in the EU buys a very specific quality of nut. The aflatoxin content must be in the 0–2 parts per billion range," Chisi says. A lot of the NASFAM nuts pass this strict regulation. But what this means is that the lower quality, unsafe nuts are left for consumers within Malawi. The new black market trade of groundnuts from Malawi to neighboring countries also increases the probability that aflatoxin-carrying nuts will be circulated within the region.

Aflatoxin levels can be controlled by using appropriate post-harvest methods. Proper harvesting and storage of groundnuts can reduce aflatoxin levels. ICRISAT has been working with local partners to spread the word about aflatoxin and share best practices for control and mitigation. The Institute has also helped in the development of cheaper, rapid tests to remove some of the current barriers to routine aflatoxin screening within the country. Njoroge has been working on understanding the distribution and toxigenic/atoxigenic characteristic of *A. flavus* in Malawi's soils in order to identify potential aflatoxin hotspots. But Njoroge believes that the answer to the aflatoxin issue may lie in markets.

"We have been at this game for a while. And why are we not making any headway?" Njoroge asks. "We don't have good regulations. We don't have the standards. But more importantly we don't have the incentives within the country. There is no price premium on aflatoxin-free nuts. Once we get that, we will have an incentive for change."

Groundnut Shelling Made Easier

Shelling groundnuts by hand is not just time-intensive. The repeated motion results in skin being scraped and farmers and laborers regularly wet the groundnuts to make the task easier. This habit, though easier on the fingers, results in increasing the likelihood of aflatoxin contamination. As farmers begin to increase production of groundnut in response to markets that pay well, it becomes increasingly important to address other challenges related to the further processing or post-harvest issues as they arise.

A team from ICRISAT-Lilongwe and the Eastern Province Farmers' Cooperative Ltd. (EPFC) visited farmers in Kabunda village in Zambia to solicit their opinion on a groundnut shelling machine. The farmers provided some of their harvest to be shelled and then each took a turn at the machine to try it out.

In a ten-minute time trial between man and machine, the machine won. Farmers managed to shell around 1 kg of groundnuts in 10 minutes as compared to 8.5 kg by machine. The problem with the machine is the higher rate of breakage of the nuts. However, most farmers claimed that they were very willing to use the machine and the rate of loss in broken nuts was more than compensated for by the increase in speed of shelling. The discussions after the demonstrations revolved around finding ways for farmers to buy the shelling machine, the issue of maintenance and repair, as well as innovative ways to share it with each other.

This activity was conducted under the new Feed the Future project in Zambia. ICRISAT-Lilongwe was the source of MGV-4 (CG-7) basic seed, which was then converted into certified seed in villages such as Kabunda through a partnership with EPFC. EPFC provides farmers with training on seed production, increases the number of farmers producing seed through a seed loan system, and also buys back the groundnut certified seed produced by the smallholder farmers.

Crop-livestock intensification in Zimbabwe: Closing the loop to sustainability

Calculated decision making

Jabulani Moyo is a man of calculations. If he sells 1 steer for around USD 300 he can buy 20 bags or 1 ton of stock feed. With this and what he grows he can keep his 33 goats, 13 cattle and 6 donkeys alive through the dry season when there is little or no available rangeland for grazing. To feed his family of five, Moyo needs 100 kg of maize meal a month. This costs him USD 100 per month, which he can make by selling two goats. To pay his children's school fees last year he sold four goats. In the end, all these numbers boil down to one straightforward goal: in order to sustain his family through the year, Moyo needs to get his livestock through the dry season.

In an average year, dry season feed shortages begin in June/July and last until the beginning of the rainy season in November/December. The peak of feed shortages is from September

Despite water harvesting methods, a severe drought decimates maize crops in Zimbabwe.

Jabulani Moyo grows bana grass and treats his maize stover with urea to make a supplemental feed to get his livestock through the dry season.

to November when the communally grazed rangelands provide only a meagre amount of very low quality fodder and Moyo's animals, like everybody else's, begin to suffer. Their body conditions deteriorate making them vulnerable to diseases. The solution to this is to ensure a source of supplemental feed. Moyo is exploring two solutions. One is to grow his own feed in a garden that he has established, which has a borehole. The other is to buy commercial stock feed at USD 18–20 per 50 kg bag.

Feed and feedback loops

Not only is he a man of calculations, Moyo is also willing to experiment and evaluate different options. After working with ICRISAT and the Challenge Program for Water and Food to learn some of the management practices and benefits of growing feed crops such as bana grass and mucuna, Moyo began to save the crop residues he got after growing maize to treat it with urea to feed his animals. Estimating what he believed to be appropriate quantities, he fed each of his goats one handful of the pen feed he bought mixed with stover. He fed his entire cattle herd three 20 liter buckets of supplemental feed per day. His experiments have worked. "My goal was to conserve my stock, to keep them breathing. I have achieved that," he says.

"What Moyo is doing is the tail end of an interesting feedback loop. The market is paying him more for his animals. So Moyo has decided to invest more in his animals to ensure that they stay alive, that they are well fed and will therefore get him a better price at the auctions," says André van Rooyen, Senior Scientist at ICRISAT-Bulawayo. "We have had these crop-based technologies for a long time. But they weren't getting adopted before. There was no reason to. But now the markets that we helped develop are setting the stage for our interventions to make sense."

A systems approach

Van Rooyen and the crop-livestock team at ICRISAT have been testing the efficiency of a market-oriented approach to boost technology adoption rates in mixed systems and encourage strategic reinvestments that pay in both the short and long terms. While crop production is crucial to ensure household food security, the vast majority of farmers in marginal areas do not produce enough to satisfy household needs, let alone enough for sale. In other words, crop production does not generate enough cash for farmers to meet their basic needs and then reinvest in farming.

"We know that livestock is the largest on-farm income generator, and together with off-farm income such as labour and remittances, it drives the household's financial portfolio," says van Rooyen. To stimulate greater reinvestment in agriculture, ICRISAT and partners have developed small stock markets. The rewards from these functional markets have illustrated to farmers the value of feed and fodder, stimulated on-farm thinking about the value of feed resources, and is slowly changing farmers' investments in crop production, especially the use of legumes as fodder crops.

This work is done using an innovation platform approach that brings together various stakeholders in a value chain in order to determine where the bottlenecks can be found. "These may be production challenges, marketing challenges or even constraints that stop the efficient flow of relevant information. The innovation platforms then choose various solutions to test and implement," Patricia Masikati, Post-doctoral Fellow at ICRISAT-Bulawayo, says.

Top: Farmers in Zimbabwe discuss the merits of using sorghum stover to feed livestock. The crop is well adapted to Zimbabwe's semi-arid climate and is also used for human consumption. Middle: Farmers visit mucuna fields during an exchange visit. Bottom: The ultimate test – will cattle even eat the newly produced feed? The answer is yes.

One of the information constraints was between agro-dealers, farmers and the private sector. Limited communication between the groups meant that agro-dealers did not realize that farmers were willing to buy stock feed, farmers were not able to access stock feed for their animals when they needed them, and the stock feed producing companies had not realized that there was a newly emerging market for their product in Gwanda. By playing the role of a bridging organization, the Gwanda Innovation Platform built solid links between the groups.

Farmers like Moyo were able to clearly articulate their desire to buy stock feed as well as the quantities they would be willing to purchase. With this information, agro-dealers were able to discuss the potential of sourcing stock feed to remote areas with the private sector. Recognizing the importance of servicing this new market, the stock feed companies were willing to supply rural outlets, improving farmers' access to stock feed. Today in Gwanda's Nhwali and Takaliawa sale pen catchment area around 250 farmers are buying stock feed for their animals on a regular basis. "During the last dry season farmers bought 40 tons of stock feed. They are collectively spending USD 15,000 on stock feed," Masikati says. This year the demand is even greater.

Going once, going twice, sold!

The driving force behind the purchase of stock feed is the market, which in Nhwali, Zimbabwe, takes place every third Thursday of the month.

Satisfied buyers

It is not only farmers who are pleased with the newly established auction system. Ntobeko Sibanda, a buyer of small stock at Nhwali, is also pleased. Sibanda buys goats and sheep in Nhwali and then transports the animals to Bulawayo, where he sells them to Bulawayo Abattoirs, a company that processes goat meat for supermarkets in the city. "This system means that the goats are grouped in place and that makes it easier," Sibanda says. "It also reduces the amount of theft for me as I can take my animals straight from here to Bulawayo."

During their preliminary meetings to discuss the constraints surrounding the livestock sector, the Gwanda Innovation Platform felt that their main marketing constraint was centered around the fact that the markets for small stock were largely informal. Negotiations between buyers and sellers occurred on farms or under trees during cattle auctions. The informality of the sales meant that farmers often had limited information on what was a fair price for their animal. Desperate for cash, farmers would sell their goats for little money and walked away feeling cheated and reluctant to repeat the experience.

To turn this situation around the Gwanda Innovation Platform tested out a more formal marketing structure that would require the construction of sale pens for small stock as well as establishing and running the monthly auctions. After a few minor hiccups the auctions have now become an established institution in Gwanda and the most popular marketing channel for small stock. "Today more than 85% of sales of goats take place at auctions. This is a huge difference from five years ago when most of the sales were at the farm gate," says Thabani Dube, Scientific Officer at ICRISAT-Bulawayo.

Thabiso Ncube, a farmer in the Nhwali area, is very pleased with the auction system. "I attend every auction. I come here to make money. It is better than before when I was selling goats for 25 dollars," she says. Ncube sold five goats at a recent market day for USD 45 each. With the money she has made she plans to buy some food for her family and also some stock feed for the 70 goats and 23 sheep she has at home.

In the end, it is the calculated careful decisions of farmers like Moyo that will determine the direction of this system. "In five years the price for goats has increased to around USD 50 per animal. Yes, we still grow crops but we don't really get anything from it. The future for us is livestock," Moyo says.

Khumatso Nare, a livestock producer in Gwanda, knows the value of keeping her goats alive during the dry season. She grows dual purpose sorghum, velvet beans and bana grass for her animals. Nare's husband works as a taxi driver, augmenting their family earnings, increasing their ability to cope with uncertainty and change, and giving them options that other farmers may not have. For example, the Nares have managed to buy and bulk up commercial stock feed in preparation for the dry season, and they also plan to build their goat herd instead of selling off their animals immediately. So far they have 33 goats and 11 kids.

Working together for progress

"It's back breaking work, but we have to do it if we want progress," Judith Mlilo says holding a shovel in her hands as she takes a break from digging. Mlilo has been working for more than two weeks with her neighbors to help build a livestock sale facility for Matobo District under the supervision of Robert Moyo, the Livestock Development Committee Chairperson for Matobo. The sale facility is sponsored by an IFAD project.

"Our plan is to facilitate the sale of livestock in this area. Livestock is very important to us and this sale pen will attract people from at least four nearby wards. The prices we will get will be better with this facility," Moyo says. The schedule he has drawn up is tight. The poles are almost all cemented in place. But they have yet to be wired together. Then, shelters must be built and a weighing scale installed.

But to help him finish this work on time, Moyo has a willing team of 230 farmers who contribute to community projects. "We have a lot of community projects at the moment. We are also constructing a new building for our school. But we have no problem with handling this sort of work. Our people are very motivated and willing to work," he says.

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Driver	C. Sibanda
Office Assistant (Cleaner)	T. Ndlovu
Office Assistant (Cleaner)	S. Ndlovu
Tractor Driver	J. Mpofu*
Field Supervisor	Q. Nkomo
Regional Editor	S. Sridharan

Research Division

Principal Scientist	J.P. Dimes*
Scientist	K. Mazvimavi
Scientist	S. Homann Kee-Tui
Scientist	J. Nyamangara
Associate Professional Officer	S. Pandey*
Associate Professional Officer	M. Jumbo
Scientific Officer	P. Ndlovu
Scientific Officer	E. Mutsvangwa*
Scientific Officer	S. Kudita
Scientific Officer	M. Moyo
Scientific Officer	A. Chirima
Scientific Officer	E. Masvaya
Scientific Officer	R. Tirivavi
Scientific Officer	C. Murendo
Scientific Officer	M. Kunzekweguta
Laboratory Assistant	J. Ndlovu
Field Recorder	G. Mpofu
Field Recorder	B. Ncube
Laboratory Technician	M. Madzvamuse

ICRISAT-Lilongwe

Administration

Country Representative	M. Siambi
Finance Officer	B. Kachale
Accounts Assistant	T. Kademba
Accounts Clerk	A. Loga
Administrative Officer	H. Warren
Associate (Administration)	L. Chiwaya
Driver/General Assistant	P. Nkhoma
Driver/General Assistant	G. Nanthoka
Driver/General Assistant	S. Ng'ombe
Senior Guard	R. Mandala
Guard	H. Namkwenya
Guard	B. Chakongwa
Guard	M. Bello
Cleaner	J. Banda
Gardener	D. Kadengu

Research Division

Principal Scientist-Breeding	E. Monyo
Associate Professional Officer	S. Njoroge
Associate Professional Officer	K. Mausch
Project Manager	F. Sichali
Senior Scientific Officer	O. Madzonga
Scientific Officer	H. Charlie
Scientific Officer	H. Msere
Scientific Officer	W. Munthali
Scientific Officer	C. Mukhala*
Senior Associate (Research)	H. Chipeta
Senior Associate (Research)	E. Mkuwamba
Senior Associate (Research)	E. Chilumpha
Senior Associate (Research)	L. Gondwe
Senior Associate (Research)	T. Chirwa
Associate (Research)	C. Kamanga
Associate (Research)	E. Kumitete
Associate (Research)	I. Kimbwala
Associate (Research)	H. Mlenga
Associate (Research)	P. Gonani*
Associate (Research)	P. Kamwendo*
Associate (Research)	S. Malunga
Associate (Research)	M. Kandoje

ICRISAT-Mozambique

Administration

Country Representative	M. Siambi

Research Division

Technical Assistant /Driver	A. Castro

Note:
*Staff member left during the year
**Staff member joined during the year

About ICRISAT

ICRISAT
Science with a human face

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, and 644 million of these are the poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger and a degraded environment through better agriculture.

ICRISAT is headquartered in Hyderabad, Andhra Pradesh, India, with two regional hubs and five country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium.

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