



Unlocking Opportunities in African Pulses Production through Public-Private Partnerships

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Introduction

The World Health Organization (WHO) reported in 1998 that the number of classically undernourished people in Africa had more than doubled between 1948 and 1998 (WHO, 1998). The International Food Policy Research Institute (IFPRI) followed 3 years later with a projection of 18% rise in the number of malnourished children in Africa by 2020 (IFPRI, 2001). Globally,

the number of chronically hungry people in 2013 is 842 million (66% of whom are in South Asia and Sub Saharan Africa), down from 1 billion three decades ago (FAO, 2013), but more than 2 billion are still affected by hidden hunger – that is deficiencies in essential micronutrients such as iron, vitamin A and zinc (IFPRI 2013). IFPRI now projects that both hunger and malnutrition can be eliminated sustainably by 2025 (IFPRI, 2013).

Legume production and consumption is a cost-effective contribution for improving income, food and nutritional security of the low-income producers and consumers in the Sub Saharan Africa, and contributes significantly to keep these alarming hunger and under-nutrition figures down. Harvests consumed at home supply the protein - which is 2-3 times higher than the content in cereals (Kimaro et al. 2009; Messina 1999) - and micronutrient needs of these less fortunate folk and surplus is sold to generate family income. Legumes as an alternative source of protein instead of animal sources reduces pressures on natural resources and benefits the environment (Pimentel and Pimentel, 2003; Stehfest et al., 2009). Chickpea, for example is an important source of diet, consumed in different preparations like snacks, curry, blend to bread/Enjera powder, greenpea, and salads among other forms. Chickpea production helps intensify cropping systems by utilizing under-exploited production niches, serving mostly as rotation-, inter- and double-crop with cereals, especially wheat, barley and tef.

The ability of legumes to fix nitrogen, and improve soil health enhances overall farm productivity and smallholder incomes. The fast growth and maturity of legumes not only improves

soil-protective land cover, but also helps break pest, disease and weed cycles in cereal cropping systems. Furthermore, diversifying farm activities with legumes among other legumes reduces risks of catastrophic farm-wide harvest losses prone to occur in cereal systems, thereby increasing farm resilience to climate change.

Role of ICRISAT: Legume breeding and seed systems

ICRISAT through its overall strategy of Inclusive Market Oriented Development (IMOD) conducts demand driven cultivar development to produce superior legume varieties, and work with partners to make available quality seeds that meet the household and market needs of African farmers, while satisfying consumer tastes and preferences. Legume farmers need varieties with good yield, disease and pest resistance, and tolerance to environmental stress (especially heat and drought), among other traits. Consumers of legume and legume products demand good quality, appearance, taste, and nutritional value.

Need for food safety, good nutrition and healthy sources of proteins and micronutrients through diversified diets continue to increase in priority, especially in urban areas of sub-Saharan Africa (SSA) as worldwide health awareness increases and household incomes grow. Increased yields from quality seeds of superior legume varieties would increase productivity and production and availability of legumes to provide alternative and diversified sources of non-animal proteins to the consumers. Besides, increased legume production would ensure that there is surplus that can be marketed to increase household incomes and improve household purchasing power and livelihoods to enhance dietary diversity through consumption of market purchased food items. ICRISAT complements these efforts with consumer awareness and education programs on consumption and utilization of legumes to ensure optimal human nutrition by both farmers and consumers.

Use of host plant resistance is one of the most effective contributions to integrated pest and disease management. Besides, plants in their natural habitat are endowed with adaptive mechanisms to survive harsh abiotic environments. These adaptive features can be mined and introgressed into adapted varieties to improve resilience of these varieties to abiotic stress factors. Many governments and development partners recognize this

fact and devote lots of resources to international and national research institutions to develop resilient varieties. Most traditional varieties were developed through conventional breeding approaches. Through the Generation Challenge Program (GCP)-supported Tropical Legumes I (<http://www.slideshare.net/IITA-CO/characterization-of-genetic-diversity-of-conserved-germplasm#>) and the Bill and Melinda Gates Foundation (B&MGF)-funded Tropical Legumes II (<http://www.icrisat.org/tropicallegumesII/>), ICRISAT and partners have developed modern breeding tools for integrated breeding approaches that accelerate the breeding process. Besides, there are some difficult quantitative traits such as insect pest resistance, drought and heat tolerance which may require transfer of traits from wild species or engineering the traits genetically, for which conventional breeding has rather been unsuccessful.

Listening to Farmers: Improving on Existing Indigenous Knowledge and Diversity

Breeders are prone to utilizing germplasm long held in-situ in genebanks and mining all sorts of desired traits from these genetic materials. As the impacts of climate change become more evident, the hardiness and ecological adaptation of local landraces is increasingly becoming important. Small-scale production of legumes, with farmers as the major custodians of the indigenous genetic materials and production technologies is recognized by ICRISAT in its working strategy of IMOD. Improving these already existing technologies and genetic materials by introgressing needed traits and improving yields is an important approach to integrate farmers into the variety development process and enhance adoption of new varieties. Besides, farmer's voices are included in participatory variety selection of the improved cultivars.

Many times, legumes have been argued to be women's crops because women's interest in growing secondary crops such as legumes and vegetables is usually greater than in producing the world's staple crops – rice, wheat and maize (FAO 2007a, b). As such women should play a prominent role and co-own the legume research for development plans, actively participate as partners in technology generation projects and inform the stakeholders of capacity development needs. Besides, they should receive full information in the critical stages of legume value chains as pertains to available new production and crop management technologies, new market opportunities, postharvest handling and easy-to-implement value addition strategies. In many parts of Africa legumes are purely subsistence and semi-subsistence crops and women are more visible in the production roles, thereby necessitating a close interaction with them and listening to their voices (Bationo et al. 2011). ICRISAT through its IMOD strategy recognizes the

need for an inclusive approach to technology development and dissemination.

To be effective, farmer participation in research programs must involve a feedback loop, which includes participatory varietal selection for evaluating superior lines, identification of best bets, and multiplication and dissemination of the farmer-preferred variety. The choice of varieties is guided by response to environments and varietal preferences by end-users (farmers, consumers, traders, processors, etc) in different locations. For example, chickpea consumers in Ethiopia have for a long time preferred the Desi types for making "shiro" while those in Sudan, Kenya, Tanzania and Malawi would go for Kabuli cooking types. This is why ICRISAT consults with farmers in the region through participatory variety selection to decide on which chickpea variety is best yielding, early maturing, terminal drought tolerant, easy to cook, demanded in the local and export market, better priced, most responsive to rhizobium inoculation and easier to manage with minimum weeding, fertilizer and water application under their conditions.

Particular variety traits such as colour, shapes, sizes, ingredients, and even recipes inform the tastes and preferences of a society. Interaction between researchers and farmers/consumers enable the researchers to dig into the underlying genetic origins of these traits and use them to develop new cultivars that enhance and complement the particular socio-cultural tastes and preferences. The decision by farmers in a pre-release participatory variety evaluation and selection is a critical consideration for both ICRISAT and NARS partner legume breeders. It helps the researchers to decide on which lines to recommend for official release that will be adopted and produced by farmers without need for further promotion. Such "innovative" varieties are unanimously agreed on both by the breeder and the farmer or other stakeholders.

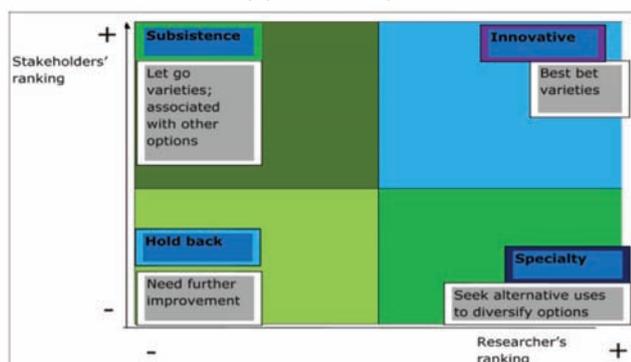
Breeders can use existing lines as sources of the traits or the specific traits can be introgressed. Where there is a mutual agreement that a variety is not preferred, it could be held back from further trials until further improvement is done (see illustration in Fig 1 below). Sometimes, unexpected results are recorded where farmers' voices are listened to. While the researcher may be hesitant to recommend a variety due to a weakness such as susceptibility to a disease, farmers may demand it due to traits of preferences such as high yield, good taste, good color and good grain size; breeders have to release such varieties and work on improving the specific weaker traits.

It is also important for farmers to know what consumers want from different legume varieties. Periodic multi-stakeholder workshops, conferences, field days, seedfairs and other agricultural shows

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help the various value chain players to find out what varieties of legumes people actually like best and why. In addition, such meeting platforms help to ensure that researchers on one end and farmers on the other end together with the rest of the value chain actors are contributing to the collective discovery of what works where and why.

Fig.1. Listening to farmers and other stakeholders in order to decide what to do with a pipeline variety



Development of legume production technologies to increase farmers' incomes

ICRISAT has worked with partners to develop grain and seed production technologies and documented these in manuals and leaflets that outline protocols on cultural practices for chickpea and pigeonpea. The manuals and leaflets (in English and local languages) describe varieties, suitable for specific agro-ecological zones, sowing time and crop management as well as harvesting and postharvest handling. An example of chickpea seed production manual adopted from the headquarters in Patancheru, India is available at (www.icrisat.org/tropicallegumesII/pdfs/ChickpeaManual_full.pdf).

Capacity development

ICRISAT offers practical skills training and research opportunities for researchers, technicians, farmers, subject matter specialists, community seed producers, women groups, NGOs, agricultural cooperative unions at various levels and durations. Short courses last between 3 days to 2 weeks while there are season-long courses that last 3 to 6 months. The areas covered usually include research methodology, data collection analysis and management, digitization of data capture, pre-breeding activities, agronomy and integrated crop management, screening varieties for diseases, integrated and modern breeding platforms. At the grassroots, farmer field schools are the most effective and the most dominant form of training conducted by our NARS partners. Since 2007, and through the Gates Foundation funded TL2 project, more than 21,000 farmers/legume seed producers (11,990 in Tanzania, 5,535 in Uganda, 2,300 in Ethiopia, 1,381 in Kenya, 677 in Malawi and 860 in Mozambique) have participated in a total of 171 farmer field days and 27 farmers' fairs held on-farm and on-station.

Innovation platforms: Public-private partnerships to get seeds to farmers and link farmers to markets

Smallholder legume farmers, who tend to dominate the legume production sector, have many times cited lack of access to quality seeds of adapted improved varieties as a constraint. Most of these smallholders rely on own saved seed or seed secured through informal networks such as local grain markets or farmer-to farmer exchanges. It has been documented that less than 10% of the crop seed planted in Africa is purchased from the formal market each year (Rohrbach et al. 2003). Although cheap and easily accessible, these informal seed sources may compromise quality, tolerance/resistance to pests and diseases, and productivity.

ICRISAT actively supports public-private partnerships which are of benefit to smallholder legume farmers by providing breeding and pre-breeding lines to fast-track variety development, providing training to those involved in the legume value chains and by linking farmers to input suppliers and traders in legume products, especially legume seed. Through location-specific innovation platforms, most of which have been recently supported by the TL2 project, collaborative networks of public-private sector stakeholders in the legume value chain have been formed that bring together relevant partners that contribute to the efficient flow of information between target stakeholders. In Ethiopia, for example, the partnerships involve: 1) Research Institutions such as Debre Zeit Agricultural Research Center (ARC), Gondar ARC, Debre Birhan ARC, Sirinka ARC, Axum, Mechara and Arekawich are involved in variety development, variety release, production of nucleus, breeder and pre-basic seed and dissemination; 2) Universities also provide support in agricultural training, especially at MSc and PhD levels; 3) National and regional seed enterprises such as Ethiopian Seed Enterprises (ESE), ensure availability of high quality seed to farmers and also contract farmers and farmer cooperatives to produce seed, thereby ensuring ready market; 4) Agricultural Transformation Agency (ATA) which provides policy support as well as extension services; 5) Seed and input related projects facilitate production and distribution of seed of improved varieties and accompanying rhizobia inocula, support with capacity building and up-scaling; 6) Federal Ministry of Agriculture, Regional Bureaus of Agriculture and local government authorities which support with enabling policies, availability of inputs, their seed departments supporting seed producers and also helping with farmer mobilization and technology dissemination; 7) NGOs, CBOs and other farmer organizations which help with mobilization of farmers, group formation and training, facilitate access to loans, inputs and markets, provide advisory services, and facilitate seed production and distribution; 8) Seed and other agroprocessing companies help with value addition, certified seed production, marketing and distribution; and 9) Contract farmers and farmers' groups which help with production of high quality seed, acting as seed buyers to smaller scale seed and grain producers.

These local, national and regional networks provide feedback on regional/national knowledge, data and information on legume trends, priorities and expectations. In addition, the networks (i) share evidence on best practices, innovative ideas and problem-solving expertise across the legume crops and regions; (ii) share facilities and services among those best equipped to carry out different tasks; (iii) coordinate and foster inter-disciplinary and cross-crop project collaboration; (iv) mentor and train of young scientists and provide them opportunities for professional development; and (v) create scientific consensus of opinion to informed policy-making.

Role of national agricultural research and extension systems (NARES) and Advanced Research Institutes (ARIs)

ICRISAT together with its CGIAR and ARI partners work closely with the NARES to provide (i) new tools and methods to identify trait-specific germplasm, (ii) technological support in using modern breeding tools, (iii) high-throughput phenotyping and genotyping platforms, (iv) strategies to improve existing seed systems models and policies, (v) developing post-harvest and value-addition technologies, and (v) capacity building of the NARES partners in R4D innovations. The NARES in most countries have been organized with regional and mandate produce crop portfolios. This is particularly important for the development of new legume varieties and for farmers, and to deal with location-specific pests and diseases.

The NARES play a critical role in organizing need-based farmer trainings, demonstration of integrated crop management technologies and open field days as promotional events. To ensure that increased demand for seeds due to farmers' awareness of new varieties is met, it is important that research agencies work with established private-sector seed companies. Alternatively, these institutions can work closely with the government to establish/strengthen national/regional seed enterprises or farmers' associations. These companies or seed enterprises can evaluate and promote the varieties chosen by farmers. In this way, the farmers' decisions about the best bets are communicated directly to seed producers and they can respond to the demand. The companies can also start doing the research necessary to make sure that the new varieties meet the regulatory requirements for seed production and certification.

The NARES also have the mandate to drive the varieties through official release processes that many times include multi-location testing, farmer participatory evaluation and selection, national performance trials (NPT) as well as tests of distinctiveness, uniformity and stability (DUS). Once the varieties are released, the NARES also have the mandate to maintain purity, produce breeder seed and supply foundation seed to the commercial sector. In short, the NARES ensure that the international public goods (IPGs) generated by ICRISAT and other research partners

are fine-tuned to meet the local needs and conditions, and subsequent adoption by smallholder farmers. They (i) evaluate the germplasm using modern tools to enhance efficiency of breeding, (ii) co-develop, evaluate and disseminate high yielding legume varieties, (iii) evaluate and disseminate integrated crop management technologies, (iv) identify and enhance improved seed delivery models, and (v) enhance capacities of farmers for legume technology innovations.

Role of seed regulatory systems, seed trade associations and Regional bodies

Policies guiding variety release, seed certification and conditions for import and export of legume seed are neither standardized nor uniform across SSA. Where existing, regulations on variety release and seed certification are based on field crops. Most of these policies encourage importation, packing and selling at the expense of local varieties. Whereas the process of variety development and release is long and tedious, commercialization is limited to be released registered varieties. Through the Tropical Legumes 2 (TL II) project, ICRISAT has worked closely with regulatory authorities by forming all-inclusive innovation platforms which enabled them to understand and co-own the breeding and fast-track variety release processes.

In Tanzania, for example, Tanzania Official Seed Certification Institute (TOSCI) oversees the process of variety release through NPTs and DUS. While the National Agricultural Research Institutes (NARIs) own the released varieties and are charged with the responsibility of purity maintenance and breeder seed production, the Agricultural Seed Agency (ASA) is the government body mandated to produce and avail foundation seed of these public varieties. Certified seed production is conducted by private seed companies and supervised by TOSCI. Where Quality Declared Seed (QDS) is produced, TOSCI still ensures that minimum quality standards are met and farmers are buffered from poor seed quality and unscrupulous seed dealers in the market. In Kenya, these roles are taken over mainly by Kenya Plant Health Inspectorate Services (KEPHIS) which houses plant quarantine, variety release and seed certification services all in one.

There are many in-country and regional efforts to bring together players in the seed trade for purposes of harmonizing policies in the seed market. Tanzania Seed Trade Association (TASTA) for example ensures a collective bargain for private sector partners with the government on various national seed policies. The African Seed Trade Association (AFSTA) endeavors to promote the development of private seed enterprises in the sub-region. Similar organizations with significant input in the seed systems include Alliance for a Green Revolution in Africa (AGRA) mostly through the Program for Africa's Seed Systems (AGRA-PASS), West Africa Seed Alliance (WASA) and East and Southern Africa Seed Alliance (ESASA).

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In West Africa, the West African Council for Agricultural Research and Development (CORAF/WECARD) has put legumes in top priority in their Strategic Plan (2007-16). Legumes collectively contribute 8.7% of agriculture GDP in the region. The Eastern and Central African counterpart, ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa) have acknowledged that “pulses have relatively high current and expected future demand in the region” in their strategic plan 2006-15. Malawi, a country in the SADC Region, has set 2011-15 prioritized strategy which targets “promoting diversified and enriched foods in complementary feeding programs for maternal nutrition and HIV/AIDS affected people through the use of soybean, common bean, pigeonpea and groundnut as key ingredients”. ICRISAT works closely with these regional and national regulatory and policy support bodies to develop and deliver legume technologies that are demanded by the farmers and end-users in the region.

Role of private sector companies

Generally, legumes do not attract a lot of private sector attention due to several reasons: self-pollinated nature of the crops enabling farmers to save their own seeds; low multiplication ratio; rapid loss of viability, high cost of transportation and erratic demand due to low seed replacement frequency. On the other hand private sector market leadership on any variety can only occur when they can offer farmers clear advantages such as convenience, access to superior varieties, and better seed quality over farm-saved seed.

There are a few seed companies with legume breeding and seed multiplication capacity for some legumes. As expected, most seed companies prefer to trade in hybrids rather than open pollinated varieties (OPVs) developed by international agricultural research institutes and NARES. If they have to, the private sector would prefer to acquire advanced OPVs which they would use in hybrid development. In this regard, ICRISAT has scored highly by developing hybrid pigeonpea, the first ever legume hybrid. Nevertheless, the private sector involvement in legume seed business is still low and ICRISAT continues to work closely with both national and multinational seed companies to increase their role in legume seed business. Besides, possible involvement of the private sector could include post-harvest processing and value-addition.

Role of development NGOs and other Development Partner Networks

Legumes are mostly grown by smallholder farmers in marginal areas, with minimum infrastructural establishments. Most of the NGOs operating in these remote areas work closely with marginal and smallholder farmers to help them access quality improved legume seeds, farm inputs, agricultural technologies and markets. ICRISAT works with these NGOs for participatory varietal selection, on-farm demonstration, promoting proven and best-bet integrated crop management technologies, facilitating village cooperatives for seed production and delivery, helping in seed business incubation,

enhancing awareness on pre- and post-harvest processing technologies and value-addition, and linking farmers to markets. NGOs such as CARE, Food for the Hungry, Catholic Relief Services (CRS), Adventist Development and Relief Agency (ADRA), World Vision, TechnoServe, ACDI-VOCA among others collaborate with international and national research institutions to facilitate farmer access to seeds of new and promising varieties, many times to recover from disaster and increase incomes and resilience. Some of these NGOs have supported farmer evaluation of new materials, the multiplication of farmer-selected varieties and their subsequent promotion and dissemination. Besides these NGOs, ICRISAT is building strong partnerships with other projects involved in seed delivery such as Integrated Seed Sector Development (ISSD) and N2Africa to reach tens of thousands of farmers in Ethiopia, Kenya and Tanzania, and are expanding into other African countries. On behalf of FAO, ICRISAT-Ethiopia hosted a multi-stakeholder workshop on Community Seed Production (CSP) in December 2013 to create a roadmap and develop strategies for enhancing uptake and effective implementation of CSP in developing countries, which will contribute to improved and sustainable crop production, food security and livelihoods especially in rural farming communities.

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