Improving Food Security and Nutrition in Malawi and Tanzania through Research on Edible Legumes

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Proceedings of Stakeholder Workshops on Groundnut Production in Malawi and Tanzania

1-2 March 2007,
Lilongwe, Malawi

&

13 April, 2007
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Sponsored by
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International Crops Research Institute for the Semi-Arid Tropics
Patancheru – 502 324, Andhra Pradesh, India
ICRISAT, P.O. Box 1096, Lilongwe, Malawi

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Editors

Monyo E	Principal Scientist – Breeding, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Osiru M	Associate Professional Officer – Pathology, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Kadyampakeni D	Scientific Officer – Breeding, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Mponda O	Principal Research Officer - Breeding, Department of Research and Training, Naliendele Research Institute, Mtwara, Tanzania
Chinyamunyamu B	Director for Development – Economist. National Smallholder Farmers Association Malawi

Disclaimer:

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FOREWORD

Groundnuts play an important role in the diets of the rural poor of the Semi-Arid Tropics (SAT) of sub-Saharan Africa (SSA) due to their high oil and protein content as well as other nutritionally important traits. The crop provides the vital protein and oil source for the largely carbohydrate-based diets characteristic of rural populations of the African continent. The crop provides much needed cash income, and has the potential to improve the livelihoods of women in particular. Oils are required for the uptake and utilization of Vitamin A, the deficiency of which results not only in blindness, but is also crucial for maternal and child survival.

Groundnut productivity in SSA remains low however, due to various biotic and abiotic constraints, including drought, socioeconomic challenges, diseases and pests and, importantly, low use of improved technologies. It is now commonly agreed that the use of well-adapted improved cultivars with disease resistances and preferred traits, offer the most practical solution to sustainably improving productivity in SSA. It is in this vein that the McKnight Foundation, under its Collaborative Crop Research Program, funded a four-year project entitled "Developing short and medium-duration groundnut varieties with improved yield performance, acceptable market traits and resistance to foliar diseases". The Project activities are targeted to benefit rural groundnut farmers in the East and Southern Africa region. To ensure delivery of its promised outputs, the Project has adopted a multi-disciplinary and cross-sectoral approach. A multi-institutional/ disciplinary team with relevant experience, representing three organizations and coordinated by the International Crops Research Institute for the Semi-Arid Tropics was identified to implement the activities.

The project goal is reduction of poverty by improving income level, food and nutrition security through investments in short and medium duration high yielding groundnut varieties with acceptable market traits and resistance to foliar diseases. Malawi and Tanzania have more than 300,000 farm families who will benefit directly from adopting short and medium duration groundnut varieties that the project will deliver through use of participatory methodologies. The strategy adopted will involve diagnostic studies, breeding and capacity building, to address three critical constraints to production – low yields, diseases (rosette, early leaf spot and rust) and drought.

This publication contains a series of papers presented during two stakeholder workshops on groundnut production held in Lilongwe Malawi, and Mtwara Tanzania 1-2 March, and 13 April, 2007. The workshops provided opportunity

for stakeholders to identify issues related to groundnut production and inform Project activities. The meetings, thus, hoped to identify issues and strategies that could be used to improve project workplans and design and ensure more sustainable outcomes as envisaged in the proposal.

It is my hope that this publication will prove useful well beyond this Project, particularly to those interested in improving livelihoods of rural groundnut farmers in Malawi and Tanzania and wherever groundnut has assumed importance.

Dr. Monyo ES Principal Scientist (Groundnut Breeding), ICRISAT- Malawi

Contributors

Monyo E	Principal Scientist – Breeding, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Siambi M	Senior Scientist – Agronomy, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Osiru M	Associate Professional Officer – Pathology, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Kadyampakeni D	Scientific Officer – Breeding, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Shomari S	Zonal Research Director – Southern Zone, Department of Research and Training, Naliendele Research Institute, Mtwara, Tanzania
Mponda O	Principal Research Officer - Breeding, Department of Research and Training, Naliendele Research Institute, Mtwara, Tanzania
Kafiriti E	Principal Research Officer – Agronomy, Department of Research and Training, Naliendele Research Institute, Mtwara, Tanzania
Kamalia S	Chief Executive Officer – Atlas Trade/Export Company, Dar es Salaam, Tanzania
Chinyamunyamu B	Director for Development – Economist, National Smallholder Farmers Association Malawi
Nakhumwa C	Monitoring and Evaluation Officer – Economist, National Smallholder Farmers Association Malawi
Warren D	Director for Farmer Services and Training, National Smallholder Farmers Association Malawi
Banda M Deputy	Director for Technical Services – Department of Agricultural Services, Malawi
Kapewa T	Groundnut Breeder – Chitedze Research Station, Department of Agricultural Services, Malawi
Kaudzu G	Research Officer – Seed Services, Department of Agricultural Services, Malawi

Comments from the Principal Investigator

Monyo[1] Emmanuel S

On behalf of ICRISAT, I would like to warmly welcome you to this meeting. My role today is very simple, firstly to welcome you, and secondly to inform you about the objectives of this two-day stakeholder meeting. Without wasting any of your time, allow me to proceed directly to the Workshop objectives. We hope to achieve three main objectives during this meeting:

1 To review groundnut research and development (R&D) challenges for smallholder farmers in Malawi and Tanzania
2 To review plans for the successful implementation of this Project including agreement on tools, methods and approaches
3 To discuss and agree on required steps to operationalize (budget and work plan) the Project.

I would like to re-emphasize to all of you that the Project target area includes two countries - Malawi and Tanzania. Thus, it will be important that we build strong and robust partnerships to enable successful implementation of the Project. In Malawi, three key collaborating institutions are participating in the Project-the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the Department for Agricultural Research Services (DARS) and the National Smallholder Farmers' Association of Malawi (NASFAM). In Tanzania, the Directorate of Research and Training (DRT) through Naliendele Agricultural Research Institute (NARI) is implementing the project with various private sector stakeholders.

The meeting that we are attending today was scheduled to be held over six months ago, at the inception of the Project. However, due to various administrative and technical difficulties, funds for the project were disbursed later than expected and it was not only difficult, but also impractical to hold this meeting any earlier than today. Nonetheless, we agreed that some field activities, particularly those that have bearing on timely delivery of outputs, were initiated with funding from the implementing partners to ensure that the Project meets its agreed targets and on time. Allow me to remind you that this is a four-year Project from September 2006 to October 2010.

For funding, we are indebted to the McKnight Foundation Collaborative Crop Research Program for making available finances for this important work on groundnut in the region, and for the workshop.

[1] Principal Scientist, Breeding ICRISAT-Malawi, Chitedze Research Station, P.O. Box 1096, Lilongwe, Malawi. E-mail: e.monyo@cgiar.org

Finally, I would like to inform participants that ICRISAT is now placing increasing emphasis on the SAT regions of Africa. To stress this, the Governing Board of ICRISAT will be holding its Annual Meeting in Lilongwe, Malawi this year. We remain committed to identifying and strengthening strategic partnerships to ensure that the farmers in the SAT of the World are able to improve their well-being.

Comments from the ICRISAT Country Representative, Malawi

Siambi[1] Moses

The Regional Groundnut Improvement Program for Southern Africa, was initiated by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and stakeholders in 1982 in response to the challenge of improving the productivity of groundnut in the East and Southern (ESA) Africa region. Over the 25 years since then, a number of important achievements have been realized, highlighted by strong strategic partnerships between national and international programs and institutions. All this could not have been possible without funding from various donors in the past and present. ICRISAT is located at the Chitedze Agricultural Research Station, 16 kms west of Lilongwe at 14^{o}S and 33^{o}45'E at an altitude of 1050m on the Lilongwe Plains, the major groundnut producing area of Malawi. This is also a hotspot location for various prominent pests and diseases of groundnuts and offers an excellent environment for screening groundnut germplasm against these important constraints.

We are very grateful to the McKnight Foundation's Collaborative Crop Research Programme (CCRP) for providing support to an important intervention embodied by the Groundnuts Breeding Project for East and Southern Africa. The Collaborative Crop Research Program (CCRP) is a competitive grants program funded by The McKnight Foundation for the purpose of increasing food security for resource-poor people in developing countries. ICRISAT is happy to work together with the McKnight Foundation on improving groundnut production in the region. I note that the Project Team is relatively small and I expect that this can be translated into improved efficiency, better coordination and higher effectiveness of the team and subsequently, the Project. ICRISAT and NASFAM have built a partnership in Malawi that has enabled various successes that are impacting the lives of poor farmers. We want to build and better this.

[1] ICRISAT County Representative, Malawi. Chitedze Research Station, P.O. Box 1096, Lilongwe, Malawi. E-mail: m.siambi@cgiar.org

I would like to welcome all delegates attending the meeting and urge them to feel welcome. I assure you that ICRISAT will make every effort to ensure that all participants are comfortable during the meeting. However, I also urge that all delegates fully participate in this important meeting by making contributions in one way or another to the success of the workshop.

Comments from the Deputy Director Technical Services – Department of Agricultural Research Services, Malawi

Banda[2] Mackson P H

It is indeed a great pleasure for me to be with you this morning to share my views on the general framework for legume research in Malawi, and particularly issues related to this project.

First of all, Ladies and gentlemen, on behalf of the Ministry of Agriculture and Food Security, I would like to extend a warm welcome to those of you from outside the country, to Malawi. To everyone I extend a warm welcome to Lilongwe and to this venue. We feel most honored that the McKnight Foundation chose to fund activities to be undertaken in Malawi and specifically, the initiative for 'Improving Food Security and Nutrition through Edible Legume Research in Southern and Eastern Africa'.

I am told the goal of the funded groundnut project is 'reduction of poverty by improving income level, food and nutrition security through investments in short and medium-duration high yielding groundnut varieties with acceptable market traits and resistance to foliar diseases'. I am also made to understand that this project will target over 300,000 farm families across Malawi and Tanzania who rely on groundnuts as a food and nutrition security crop. This will be done by undertaking diagnostic studies, developing improved varieties through breeding and strengthening existing capacity to address three critical production constraints – low yields, diseases (rosette, early leaf spot, rust and aflatoxin contamination) and drought.

We all know that groundnut is a very important crop to our farmers in Malawi, the SADC region, and beyond. It is not only a principal source of protein and oil, but is also a significant source of cash income for our farmers, especially women. It is becoming increasingly clear to us, that groundnut has the potential

[2] Deputy Director, Department of Agricultural Research Services, Ministry of Agriculture and Food Security, P.O. Box 30779, Lilongwe 3, Malawi. E-mail: bandamackson@yahoo.com

to excel on the export market for confectionery purposes, and thus earn the country much sought after foreign exchange. Therefore, I am confident that this crop will receive even more attention in the coming years – thanks to the McKnight Foundation for the support given to Malawi and Tanzania through this Project.

This Project brings together stakeholder institutions: ICRISAT, Government ministry of agriculture research departments from Malawi and Tanzania, farmer organizations represented by NASFAM, and the Private sector, to achieve three key outputs.

1. High yielding farmer and market-acceptable short and medium-duration groundnut varieties with resistance to foliar diseases
2. Increased adoption rates of improved farmer and market-acceptable varieties and production technologies
3. Increased groundnut productivity through a sound practical and implementable technology dissemination program

Research is a dynamic process, and hence the necessity to address the changing needs of our end-users. We have accomplished much this far, but there are many new challenges, which I hope a gathering of this nature will be able to tackle. We must remain relevant to our clientele by clearly defining our research agenda, taking into consideration the situation prevailing in the rural areas in our region. To be practical, farmers must have access to improved varieties if we are to alleviate poverty and contribute to food security. Still, we should not, as scientists, remain comfortable in our knowledge that we have bred these varieties and developed production packages - our ultimate goal should always be to make significant contributions towards improving the standard of living for those involved in agriculture. I am aware that there is a lot of good groundnut germplasm already developed by ICRISAT and NARS that needs to be accessed and assessed by the NARS for our farmers. With this understanding, I urge the scientists present here, to seriously look for opportunities that will enable us to complete the task. There are new challenges in meeting marketing standards, consumer needs and alternative uses, if we are to be competitive on the world market. Do our varieties meet these diverse end-user preferences? If not, what can we do differently to add value to what has been achieved this far?

It is my hope that through this Workshop, participants will deliberate on all that is necessary to solve the prevailing groundnut production problems in the context of this new Project we are launching today. I am confident that you

distinguished scientists gathered here today will use these two days effectively through your presentations and discussions to develop strategies aimed at enhancing the delivery of usable technologies. We must be able to learn from our past mistakes and be more aggressive in the pursuit of our research agenda to attain high and sustainable groundnut production levels in Malawi and the region at large.

I am conscious of the fact that your time is limited due to the busy schedule ahead. So at this juncture, please allow me to conclude by wishing you ladies and gentlemen, creative, stimulating, and productive discussions during the next two days.

Please feel at home here in Malawi – "The Warm Heart of Africa". Should time permit, I urge those of you from outside this country to extend your stay and see the beautiful Malawi countryside.

Finally, it is my singular honour, to declare this Workshop officially open.

Comments from the Zonal Director for Research and Training (Southern Zone), Tanzania

Shomari[3] SH

Let me start by saying I feel honored and privileged to be given this opportunity to say a few words as opening remarks in this inception workshop of the McKnight Groundnut Project. On behalf of the Department of Research and Training, Ministry of Agriculture, Food Security and Co-operatives, allow me to welcome you all to Mtwara, in particular to Naliendele Agricultural Research Institute, and specifically to this workshop. For our colleagues from Malawi, we are so delighted to have you with us today. I believe you will enjoy your stay here, however brief.

Dear participants, I believe most of you are aware that groundnut is one of the most important crops in Tanzania as a source of food and cash especially in areas where the traditional cash crops do not thrive. Groundnut also makes an important contribution to soil fertility, which is one of the major limiting factors to crop productivity in the country. Acknowledging the importance of the crop, the Tanzania Government, in collaboration with the United Kingdom, initiated a research programme before Independence, specifically to address production problems of the crop alongside sesame and sunflower. Since then, there have been a number of achievements. I hope some of these will be highlighted further during the workshop.

[3] Zonal Director for Research and Training, Southern Zone; Department for Research and Training, Tanzania

Although progress has been made in groundnut research in Tanzania, production under farmers' conditions is still low. I am told farmers' yield is estimated at about 500 kg ha^{-1} compared to the potential yield of over 2000 kg ha^{-1} under optimal conditions. Annual production in the country is estimated to range between 52000 tons to 54000 tons between the years 2000 to 2007. This is a very big challenge to all of us involved in groundnut production and I urge each one of us in this workshop to think seriously how this yield gap can be reduced.

Workshop participants, ladies and gentlemen, I am informed sustainable groundnut production in the country has been prevented by adverse effects of several biotic and abiotic stresses. The most important of these are foliar diseases (Groundnut rosette disease, Early leaf spot, Late leaf spot and rust), and erratic rainfall resulting in severe drought, particularly towards the end of the growing seasons (terminal drought). For rosette disease 10–30 % yield losses annually are common but 100% loss has been reported in epidemic years. I am delighted however to learn that these are some of the areas that this project will address.

During the 1970s, this country was a net exporter of groundnut. I am not sure whether this is the case today. I have often heard farmers, for example in Masasi, complaining that they cannot market their groundnuts. I hope in this project there is provision for exploring opportunities and limitations for groundnut marketing in the country. Unless farmers are provided incentives for investing in the crop they will only grow just enough for domestic consumption.

On behalf of the Department for Research and Training, I would like to extend my profound gratitude to McKnight Foundation for funding this project. I urge all of you involved in this Project to use this opportunity and ensure that Project outputs are attained. May I also extend my thanks to ICRISAT for inviting us to collaborate in this Project and for all the support they have given us in groundnut research over the years. Obviously the achievements in groundnut research that we are proud of would never have been realized without their support.

Looking through the list of participants, I see a number of extension officers from the project areas. It is my hope that you will upscale project findings to other areas within your mandate not covered by the project. It will be a shame should everything achieved by the project go down the drain when McKnight support comes to an end in 2009/010.

With these few remarks, ladies and gentlemen, I now have the pleasure to declare the workshop officially opened.

Researchable challenges and opportunities in groundnuts for smallholder farmers in Eastern and Southern Africa - A regional perspective

Monyo[1] ES, Osiru[2] MO, Mponda O[3] and Chinyamunyamu[4] B

Abstract

Groundnut (Arachis hypogeae L). is an important crop grown on over 4.5 million hectares, predominantly by smallholder farmers in the East and Southern Africa region with yields varying from 400-700 kg ha^{-1}. Productivity is constrained by lack of seed of improved varieties, poor agronomic practices, pests and diseases. This paper highlights significant strides in overcoming some of the key challenges to groundnut production in East and Southern Africa. For each of the major constraints: research progress, gaps and recommendations are discussed. Current research and development strategies for the ESA region are also highlighted, and implications for ICRISAT and her partners are discussed.

Introduction

Groundnut (*Arachis hypogaea L*). is an important food and cash crop planted on approximately 4.5 million hectares in the East and Southern Africa (ESA) region. Angola, the Democratic Republic of Congo, Malawi, Mozambique, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe are the major groundnut producing countries.

Smallholder farmers grow the crop under low input conditions in most areas except in parts of South Africa, Zimbabwe and Sudan where commercially oriented farmers adopt improved cultural practices. Yields vary from 400 - 700 kg ha^{-1}.

Lack of seed of improved varieties, poor agronomic practices, diseases and pests are considered to be the major factors limiting yield in the region. The potential for increasing groundnut yields through crop improvement, particularly for biotic and abiotic stress resistance breeding, and thus total production in the region is very high.

[1] Principal Scientist - Breeding and

[2] Associate Professional Officer - Pathology, ICRISAT, Chitedze Research Station, P.O. Box 1096, Lilongwe, Malawi. E-mail: e.monyo@cgiar.org, and m.osiru@cgiar.org

[3] Principal Research Officer – Breeding, Naliendele Research Station, Box 509, Mtwara, Tanzania. E-mail: omarimponda@hotmail.com,

[4] Director for Development – Economist, National Smallholder Farmers' Association of Malawi (NASFAM). E-mail: bchinyamunyamu@nasfam.org

Groundnut is the single largest source of cash income for small-scale farm families in SSA. The nuts are rich in protein, oil, amino acids (e.g. cystine), and B-group vitamins. Groundnut oil is excellent for cooking and for health. In addition, groundnut cake and haulms are excellent livestock feed. The plant itself can biologically "fix" atmospheric nitrogen, benefiting not only the groundnut crop but also crops that are grown the following season.

Research priority for groundnuts can be grouped into two broad categories - oil and confectionary use based on consumer's preferences (taste, grain color, size, shelf life of marketed products and industrial specifications for particular size and shape).

Groundnut is regarded as a 'Priority 1' crop in the oilseed crops category by the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), because of its potential impact on the human population in the region where area under-production has increased dramatically from 2.3 - 3.3 million in the last five years (2000 – 2004), much of this in the Sudan (ASARECA, 2006). Current demand for vegetable oil in the ESA region stands at 631,000 tons annually, which is expected to soar to 938,000 tons by 2015. Although vegetable oil from soybean, sunflower and palm is cheaper in the international market and therefore the greatest competitor for the development of the groundnut oil industry, appropriate rural technologies for extracting oil from groundnuts exist, and if well promoted, the rural groundnut oil enterprise, can significantly contribute to the anticipated vegetable oil demand, which is currently met through imports.

Institutional constraints affecting the development of groundnuts in the region include inadequate funding for public agricultural research, lack of a network to facilitate critical mass in research, spill-inns and access to inflow of innovations including germplasm. With enabling policy environment, there is a great scope for increased inter-regional trade of the crop.

Priority constraints to groundnut production in Eastern and Southern Africa

Major constraints to groundnut production in the region include biotic (diseases/pests; aflatoxin contamination), abiotic (drought), social, economic and institutional. Diseases are generally considered the major constraints to increased production in all countries where groundnut is grown, with perhaps the exception of Botswana, where low and erratic rainfall is the main factor limiting production.

The Groundnut Rosette Disease (GRD). Groundnut Rosette Disease transmitted by aphids is endemic to the African continent and epidemics occur often in SSA that significantly reduce groundnut production and in some instances, cripple rural economy. Rosette epidemics can induce losses approaching 100% in many fields. First reported in 1907 (Zimmerman, 1907), recurrent epidemics have been reported in many countries of Africa. Most recently during the 1999/2000 cropping season, rosette occurred in epidemic proportions in Malawi. The average rosette disease incidence on national scale was 21.1% leading to a yield loss of about 17,657 tons of shelled groundnuts. The monetary loss due to the 1999/2000 epidemic in Malawi was estimated at $9.0 million (Subrahmanyam, personal communication, July, 2000). Even assuming a minimum annual average loss of 5%, the ESA region could be losing between 100,000 to 175,000 tons (assuming average yields 400 – 700 kg ha^{-1}) equivalent to $50 – 89 million each year.

Leaf diseases. Early leaf spot (ELS) caused by *Cercospora arachidicola* Hori, Late leaf spot (LLS) caused by *Phaeoisariopsis personata*, and rust caused by *Puccinia arachidis* Speg, are fungal diseases that cause considerable damage to groundnut production in SSA. On a global scale estimated yield losses (ICRISAT Medium Plan 1994-99) are as follows: ELS $326 million, LLS $599 million, rust $467 million. It was estimated in Malawi that crop losses due to ELS alone was close to $5 million per annum (Babu *et al*., 1995). These losses have serious consequences for household income and nutrition. Assuming the same trend, ESA could be losing groundnut crop worth more than $100 million each year. Late leaf spot (*Phaeoisariosis Personata*) and rust (*Puccinia arachidis*) assume importance in some lower lying areas such as the coastal lowlands of Tanzania, and web blotch (*Phoma arachidicola* Marasas, Pauer, & Boerema) in large-scale farming areas of Zimbabwe.

Although leaf diseases can be effectively controlled by timely applications of fungicidal sprays, these applications increase production costs, and smallholder farmers in ESA seldom adopt this type of control. Additionally, poor access to these fungicides (due to cost and lack of availability) coupled with their indiscriminate use, often result in harmful effects on human health, contamination of the soil and underground water and damage to beneficial microorganisms and insect fauna.

The use of resistant crop cultivars provides the most appropriate means of disease control especially for smallholder farming situations, where lack of resources does not encourage expenditure on external inputs. Improved resistant varieties can easily be incorporated into smallholder farmers' operations at little extra cost.

Insect pests. No data is available for losses caused by insect pests. The leaf miner is now becoming a pest of concern, and Mozambique has reported complete crop loss in the Southern Districts of the country. Cases have also been reported in Malawi, South Africa and Zambia particularly in the low altitude areas with short growing season. Termites and Hilda patruelis (a sucking bug which induces a severe wilt) are sometimes of local importance (Groundnut hopper; *Hilda patruelis* is of importance in Tanzania especially in the coastal areas where cashew is grown. Cashew is an alternative host for the pest), but at regional level cannot be described as such. Thrips and jassid damage are in evidence throughout the region but, in comparison with other factors, they are probably not of major significance.

Aflatoxin contamination and market quality. Groundnut seeds/pods can be infected with strains of the fungi *Aspergillus flavus and Aspergillus parasiticus* that produce aflatoxin with serious consequences to human and livestock health. Among reported deleterious effects on health are cancer of the liver and suppression of the immune system. This often exacerbates the effects of HIV and AIDS and masks the already known excellent health benefits from good nuts. Aflatoxin contamination of groundnut is a widespread problem in most groundnut-producing countries where the crop is grown under rain fed conditions and which encounter end-of-season droughts. Aflatoxin contamination affects productivity through seedling diseases, such as aflaroot but, more significantly, also renders produce unfit for human and livestock consumption, as toxins are injurious to health. Aflatoxin contamination is an invisible problem, in many cases there are no visible symptoms so farmers are unaware of the problem and the associated potential health risks. Importantly, marketability of contaminated produce, particularly in international trade is diminished, and often blocked due to stringent standards relating to permissible limits of aflatoxin contamination and the lack of screening capacity.

The aflatoxin-producing fungi, *A. flavus* and *A. parasiticus,* can invade groundnut seed in the field before harvest, during post-harvest drying and curing, and in storage and transportation. The SAT environments are conducive to pre-harvest contamination when the crop experiences drought stress prior to harvest, whereas in the wet and humid areas, post-harvest contamination is more prevalent. Adopting certain cultural, produce handling and storage practices can significantly minimize aflatoxin contamination. However, although such practices are available, they have not been widely adopted by the smallholder farmers in developing countries, primarily due to lack of awareness. Breeding for resistance to seed colonization by the aflatoxin producing fungi and aflatoxin production is potentially a cost effective method of solving this

constraint provided sources of resistance and an effective way of incorporating resistance in adapted germplasm can be worked out. This strategy needs to be complemented with use of improved production practices known to reduce aflatoxin contamination during groundnut husbandry.

Drought. In response to a request by the Southern African Development Community (SADC) heads of Government to address effects of drought on food security, ICRISAT established two regional crop improvement programs (the Sorghum and Millet Improvement Program, SMIP based in Bulawayo, Zimbabwe and the Groundnut Improvement Program based in Lilongwe, Malawi) in 1982. These multi-disciplinary programs aimed to develop genotypes better adapted to the production environments of the region. These programs have since been expanded to cater to the needs of the entire Eastern and Southern Africa (ESA) region.

More than three quarters of ESA's groundnut production is confined to areas characterized by semi-arid zones (unpredictable rains with a length of growing period of 3 – 4 months). Materials bred for this vast region therefore must fit into this ecological zone (particularly short duration germplasm and drought tolerance) or must have drought resistance bred in. Groundnut production is limited by water deficits at any stage of the crop cycle. The ability of genotypes to produce acceptable yields under water limiting conditions is a sure way to stabilize yields under rain fed conditions under which the crop is predominantly produced. With the exception of Malawi, South Africa, and Zimbabwe, the current status of improved adapted germplasm in the region as a whole, is far from encouraging. Even in these three countries (where for the most part, the season ends pre-maturely), work on improved short-season cultivars has received little attention.

Achievements

Notwithstanding the above, there have been numerous achievements, particularly arising from the collaborative work pioneered by the ICRISAT Groundnut Improvement Program in Malawi and in the entire ESA region.

Germplasm exchange and use. Efforts in germplasm assembly and conservation, together with breeding activities in Malawi have resulted in a large, diverse collection of germplasm and improved material. These materials have been freely distributed to National Agricultural Research Systems (NARS) breeding programs. A total of 8,130 improved lines have been distributed, including nearly 7000 lines to 12 ESA countries. National breeders have used these materials to develop and release improved varieties.

Twenty eight (28) new sources of resistance were identified from wild *Arachis spp* using the infector row technique between 1996/97 – 1999/2000 at the ICRISAT Chitedze Research Center in Malawi (Subrahmanyam et al., 2001). Of these, 25 wild Arachis accessions including *A. diogoi* (1), *A. hoehnei* (2), *A. kretschmeri* (2), *A. cardenasi*i (2), *A. villosa* (1), *A. pintoi* (5), *A. kuhlmannii* (2), *A. appressipila* (3), *A. stenosperma* (5), *A. decora* (1), and *A. triseminata* (1) were resistant to groundnut rosette disease. Some accessions of *A. appressipila, A. diogoi, A. stenosperma, A. decora, A. triseminata, A. kretschmeri, A. kuhlmannii,* and *A. pintoi* were resistant to all three components of rosette, Groundnut rosette assistor luteovirus (GRAV), Groundnut rosette umbravirus (GRV) and its satellite RNA (sat. RNA). Two accessions of *A. stenosperma* and one accession of *A. kuhlmannii* showed the presence of all three components of the rosette disease. In all these accessions, infected plants were chlorotic and severely stunted. The value of exploitation of these resistances in wild *Arachis* species in rosette resistance breeding programs is enormous and is currently being pursued.

On the transgenic front, ICRISAT has successfully deployed the GRAV-CP gene into the cultivar JL 24 and produced over 60 transgenic events. It is expected that this gene will confer resistance to GRAV, one of the main components of the GRD. These events will be field screened in contained field trial facilities in South Africa during the 2007/08 season. Following the selection of the most promising transgenic events, these can then be introgressed in locally adapted groundnut varieties with conferred resistance to Rosette.

Variety release. To date, 26 improved groundnut varieties have been released in eleven ESA countries. These include high-yielding rosette-resistant varieties in Malawi, Mozambique, South Africa, Uganda and Zambia (Table 1).

Adoption studies. Adoption studies carried out in Malawi and Zambia show the impact created by ICRISAT. Farmers in both countries are progressively adopting new improved varieties co-developed with partners. In Malawi, 35% of the farmers have adopted the variety CG 7. In Zambia, 68% of the farmers in the Eastern Province are growing improved varieties from ICRISAT.

Table 1: ICRISAT advanced breeding lines and germplasm accessions released by NARS partners

Country	Breeding line/Germplasm Accession	Released name	Year of release
DR Congo	ICGS 27	ICGS 27	1990
	JL 24	JL 24	1990
Ethiopia	ICG 7794	Roba	1988
	ICG 273	Sedi	1993
Malawi	ICGV-SM 83708	CG 7	1990
	JL 24	Kakoma	2000
	ICGV-SM 90704	Nsinjiro	2000
	ICG 12991	Baka	2001
	ICGV-SM 99568	Chitala	2005
Mauritius	ICG 7898	ICG 7898	1990
	ICGV-SM 85048	Stella	1992
	ICGV-SM 86715	Veronica	1992
	ICGV 93207	Sylvia	1997
	ICGV 87853	Venus	1997
Mozambique	ICG 12991	Nematil	2000
	ICGV-SM 90704	Mamane	2000
South Africa	JL 24	JL 24	2002
	ICGV-SM 93437	Nyanda	2005
	ICGV-SM 99537	Mwenje	2005
Swaziland	ICG 221	TMV 2	1995
Tanzania	Robut 33-1 selection	Johari	1985
	ICGMS 33	Pendo	1998
	Spancross	Nyota	1983
	ICGMS 46	Sawia	1998
Uganda	ICGV-SM 83708	Serere Red	1999
	ICG 12991	Igola 1	1999
	ICGV-SM 90704	Igola 2	1999
Zambia	ICGMS 42	MGV 4	1990
	ICGV-SM 83005	Chipego	1995
	JL 24	Luena	1999
	ICGV-SM 90704	Chisango	2000
	ICG 12991	Msandile	2000
Zimbabwe	ICGV-SM 86068	Jesa	1999
	ICGV-SM 93437	Nyanda	2002

Capacity building. NARS capacity to evaluate and test germplasm under local conditions has been greatly enhanced in many of the countries in the region. Well over 300 technical staff from research and extension in Kenya, Malawi, Swaziland, Zambia and Zimbabwe have been trained in groundnut production. Additional training of trainers (ToT) courses on groundnut production technologies have been held in Malawi and Mozambique, helping NARS and NGO staff to upgrade their skills.

Gender issues. In most countries of the region, the majority of smallholder groundnut and other legumes farmers are women. ICRISAT research in ESA has attempted to integrate gender issues into the R&D process, and ensure the participation of women at all stages.

Dissemination. Trials and demonstrations by ICRISAT and partners have served multiple purposes, including verifying new technologies, creating awareness, multiplying initial seed, and demonstrating the benefits from new varieties and improved crop management, e.g. integrated disease management, early planting, weeding, participatory plant breeding etc. Attractive, illustrated handbooks on groundnut production have been produced for Malawi, Zambia and Zimbabwe with some translated into the local languages.

Challenges, opportunities and approaches to address the constraints

ICRISAT has had 25 years of physical presence in ESA with established regional offices in Zimbabwe and Malawi since 1982. ICRISAT also maintains offices in Kenya, Malawi, Mozambique and Zimbabwe. The presence of ICRISAT in ESA provides for closer interaction with NARS for technology development and dissemination. Excellent working relationships have been established with the two Sub-Regional Organizations (SROs), SADC/FANR in Southern Africa and ASARECA in East and Central Africa. Malawi provides natural screening environment for the key biotic and abiotic constraints. This is also where the ICRISAT Groundnut breeder is based with full time involvement in genetic enhancement activities. A pathologist, two scientific officers, one field technician and one field assistant support him. Excellent working relationships have been established with national programs for regular input into the program. There is a molecular biologist at Nairobi Kenya with major responsibility for transgenic work focusing on the rosette (the Groundnut Rosette Assistor Virus (GRAV) component) and aflatoxin constraints. NARS Kenya and South Africa are also contributing to the transgenic research work because of their advances in transgenic testing facilities in the region. Challenges, opportunities and strategies to address each of the major groundnut production constraints follows:

Groundnut Rosette Disease

Resistance to rosette was first discovered in groundnut land races originating from Burkina Faso and Cote d'Ivoire as early as 1954 (Berchoux, 1960). Since then more sources of resistance have been identified in germplasm but it is not yet clear if these lines have resistance to GRAV. The resistance identified is governed by two independent recessive genes and has formed the basis for rosette resistance breeding programs throughout Africa (Berchoux, 1960). Several resistant varieties in ESA are currently released including var. RG1, ICG 12991, ICGV-SM 90704, ICGV-SM 99568, and ICGV 93437 while others are currently in advanced testing. However, most are late maturing and are not suitable to most production systems in ESA, where the rainy season is short. This necessitated the search for sources of resistance in early maturity background and resistance to GRAV for utilization in breeding programs. Segregating material in Malawi varies from F2 to F6 generations which have revealed traits that could be used to develop improved GRD resistant breeding populations and to combine GRD and vector resistance traits. Field screening trials in Malawi have clearly separated genotypes resistant to two virus components (GRV and its satellite RNA) in the disease complex, while others appear to be resistant to the aphid vector (e.g. ICG 12991). This finding provides opportunity for development of genetic markers availing a simpler screening methodology to identify aphid and virus resistance in lines thereby accelerating breeding progress. It is important to develop genetic markers for the two independent recessive genes that govern resistance towards groundnut rosette virus as well as markers for the single recessive vector resistant gene.

GRAV is the main component involved in aphid transmission. We are not certain how GRAV alone is affecting the plant system and its productivity, although recent reports suggest that GRAV alone significantly reduces groundnut yield (Naidu et al., 2007). Thus, GRAV resistance will provide additional defence, and will be particularly helpful in situations when very high aphid infestation results in late infection in some branches in resistant genotypes. Identification of combined resistance to GRAV, GRV and its sat. RNA is regarded vital to broaden the genetic base of rosette resistance in groundnut.

Research priorities for GRD should therefore center on characterization of the sources of resistance and knowledge of alternative hosts. Though several sources of resistance have been identified in both wild and cultivated groundnuts, these sources have not been characterized and therefore not much is known about the diversity of the observed resistance. Once this is known,

then their incorporation into adapted high yielding varieties will be the next step while additional efforts are directed to the identification of more sources of resistance and the alternative hosts.

Leaf diseases

Early leaf spot (ELS): Breeding for resistance is one of the most effective means of reducing crop yield losses and it is a strategy particularly well suited to help smallholder farmers who generally lack the financial resources to use chemical control methods. Screening and breeding of agronomically acceptable varieties with resistance to early leaf spot has been extensively performed in Malawi. Breeding populations ranging from F2 to F7 generations are available; some of which carry multiple resistances (ELS and GRD combined). Currently a number of improved early-maturing ELS-resistant varieties, such as ICGV-SM 95713, 95714, 95740 and 95741 are available. These have consistently out performed JL 24 in yield trials at Chitedze Research Station. In Malawi, the kernel yield of these ELS-resistant varieties increased by 23 to 43 % compared to JL 24 across 15 locations. Similarly in Mozambique yields of the ELS-resistant varieties increased by about 50% compared to the local variety Natal Common. However, ELS resistance is usually associated with poor grain qualities. The program is therefore focusing on the development of new ELS-resistant varieties combining both agronomic and quality superiority over the known acceptable controls. Based on the results obtained on components of resistance to early leaf spot (incubation period, infection frequency, lesion diameter, and defoliation) by the ESA program, suitable parents have been chosen to generate different filial generations for inheritance study and transfer of resistance.

No absolute resistance to ELS is known in cultivated groundnut, rather, just enhanced levels of resistance. However, immunity was recently identified among wild *Arachis* accessions from South America using the infector row technique at Chitedze Agricultural Research Station in Malawi (Subrahmanyam *et al.*, 2001). Success has been achieved in hybridizing some of these with cultivated groundnut and using embryo rescue techniques to achieve fertile hybrids. This approach has provided opportunity for utilization of the wild *Arachis* gene pool for the improvement of ELS resistance in cultivated groundnuts. Opportunities also exist for Marker Assisted Selection (MAS) to speed up the rate at which resistance can be incorporated into cultivated groundnut and this is being explored.

Aflatoxin and market quality

Genetic resistance though very important should be looked at as a component in the integrated management of the Aflatoxin problem. There are three types of resistance to aflatoxin producing fungi - resistance to pod infection (pod wall); resistance to seed invasion and colonization (seed coat); and resistance to aflatoxin production (cotyledons). There are already known sources of resistances to all the types reported above. Facilities are available at Chitedze Agricultural Research Station for screening against seed invasion and colonization. The value of a resistant source depends upon the level and stability of its resistance. One of the difficulties has been the large genotype by environmental (GXE) interaction associated with resistant germplasm. Resistance to pod infection has been reported to be highly variable and of a low level. In-vitro seed colonization by A. flavus (IVSCAF) is not absolute and only a few lines (J 11, PI 337394 F, and PI 337409) have shown stable resistance. And finally, resistance levels to aflatoxin production in the known sources are not very high. This is the main reason why currently, genetic resistance efforts must be complemented with integrated management of the aflatoxin problem as a whole, while efforts to identify durable and stable resistance continue.

The confectionary groundnut market seems to be governed by consumer's preference for taste, grain color, size, shelf life of marketed products and industrial specifications for particular size and shape. This demands that efforts be directed towards breeding and selection for oil content and quality, particularly low oil content, to reduce problems of rancidity and high oleic/linoleic ratios which favor long shelf life. There is also a large market for large seeded varieties. The Malawi groundnut market till the mid 1990's was dominated by one popular variety 'Chalimbana' (large seeded, long duration variety with excellent roasting qualities). The challenge is to develop large seeded cultivars for short duration environments. However, since confectionary nuts are eaten directly, the greatest challenge to the growth of this market worldwide is aflatoxin contamination. Research efforts to reduce aflatoxin contamination in groundnuts should therefore be accorded priority. Opportunities in transgenics also exist. ICRISAT has developed transgenic groundnut plants containing the rice chitinase gene, conferring a broad spectrum resistance to fungal infections. The derived plants are currently under greenhouse trials and will also be tested in the field for resistance to *Aspergillus* infection, and resistant plants will be used as a complementary approach to combat aflatoxins in groundnut. Resistance can be incorporated into adapted varieties through a backcrossing program or by transforming farmer preferred varieties in Africa, using the genotype independent method.

Success in these areas will require strong partnerships between the Advanced Research Institutes (ARIs) and national research and extension services with a range of other partners including NGOs, farmers and farmers' organizations, the private sector, universities, policy makers and donor agencies.

Drought

The largest area under groundnut production in the ESA region lies in the SAT, characterized by short and erratic rainfall season. Short duration varieties would be more suitable for these areas but less than adequate research efforts have been committed to developing these materials. There are several reasons why short duration varieties are not popular among farmers in the ESA region:

1. Lack of varieties matching the available length of growing period
2. Sources of foliar disease resistance in the early maturity germplasm are very rare whereas in the region in general both ELS and GRD are endemic
3. Lack of appropriate screening facilities for drought research – particularly end of season drought which is the most serious in ESA
4. Problem of sprouting due to lack of seed dormancy in the few available short duration accessions. Fortunately this is a constraint that can be addressed through research.

The confounding constraint of lack of sources of resistance to foliar diseases in the early germplasm is now partly addressed with identification of some ELS and GRD resistance sources. Our strategy to address the cultivar needs of the region will therefore be to target varieties that will reach physiological maturity within 90 – 100 days for the large part of ESA. Very short season germplasm accessions from Bolivia have been identified which reach physiological maturity within 70 days in Bolivia. It will be important to introduce some of these accessions to our region to study their maturity patterns and identify from them, some that can be useful for our farmers needs. In our quest to address the drought constraint in groundnut, there is need to develop genotypes that have the ability to use limited available water efficiently, in order to enhance groundnut productivity in ESA. In physiological models, pod yield is associated with transpiration (T), transpiration efficiency (TE) and harvest index (HI). However, some of these traits are not easy to measure in large populations under field conditions. A search for easily measurable surrogate traits for TE led to specific leaf area (SLA) and then, on to SPAD

[4] A lightweight handheld meter from GENEQ Inc. for measuring chlorophyll content of leaves without causing damage to plants.

Chlorophyll Meter readings, which can be used for rapid assessment of SLA and specific leaf nitrogen (also a surrogate measure of TE in groundnut). Water-use efficiency (WUE) is correlated with specific leaf area (SLA), which is an easily measurable trait. To improve SLA and in turn WUE and HI, a good knowledge of the genetic system controlling the expression of these traits is essential for the choice of an efficient breeding procedure. There is therefore, need to study the mode of inheritance of these traits. For ESA, in the absence of facilities like rainout shelters and line irrigation systems, we rely on screening under natural dry land conditions. Our location, Ngabu in Malawi, provides an excellent natural environment because the season is short (90 days), hence a combination of planting time will ensure good end of season stress for the crop. Finally genetic resistance to dormancy is available which will necessitate combining drought resistance/tolerance or escape with dormancy so as to avoid the problems of seed sprouting in the soil in case of few accidental showers at the end of the season.

In the transgenic front, ICRISAT has developed a very efficient, genotype independent transformation protocol for groundnut. One of the genes inserted into JL24 is the drought responsive DREB1A transcription factor, which, under control of the drought-responsive rd29A promoter, delays stomatal closure during drought stress. These plants are currently in the T4 generation and are being characterized in dry-down experiments in the green house in India. If they prove to use water better and have the ability to survive periods of drought without a concomitant reduction in the accumulation of biomass, these plants may be more drought resistant than current varieties grown in the region and can be introduced into the ESA region for use in back-crossing program.

ICRISAT's comparative advantage to conduct the research

ICRISAT has the global mandate for groundnut improvement in the SAT. It holds the world's genetic resources for groundnuts and its wild progenitors at its gene bank at headquarters (ICRISAT- Patencheru, India), and a significant portion in its regional programs for ESA and WCA. The institute has a critical mass of scientists well distributed in ESA, WCA, and Asia which makes it the prime supplier of strategic research, improved genetic material, and technical services, as well as capacity building for NARS and partners in the SAT. In ESA strategic alliances have been developed between ICRISAT and a few lead NARS with capacity to implement specific research areas of benefit to the region. South Africa and Kenya have capacity for transgenic work and therefore lead the region in this research area by providing both human resources and testing facilities. Tanzania has excellent natural screening

hot spot sites for rust resistance which provide useful information on this constraint. Uganda and Malawi NARS contribute useful information on germplasm resistance to rosette. Excellent screening facilities for GRD and ELS have been developed at the ICRISAT Lilongwe site for the ESA region. ICRISAT is thus well accepted as a technology leader in groundnut research for development. As a result many development investors and NGOs in the region are willing to partner with ICRISAT because of their common interest of uplifting the standards of living of the rural poor. Starting with Malawi as a launching pad in the ESA region, ICRISAT and its partners have brought economic prosperity for the first time to many thousands of female-headed households. This has been echoed in those villages in Malawi who have entered the European market with effective social capital engendered through their groundnut-producing clubs organized by NASFAM and ICRISAT. Several similar examples are emerging in other countries e.g. partnerships with Reapers in Zimbabwe, Mozambique Leaf Tobacco (MLT) in Mozambique and Producer's Owned Development Cooperative (PODC) in Zambia just to mention a few.

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Discussion

Banda: How are groundnuts consumed in Tanzania?

Mponda: Groundnuts may be consumed fresh, that is boiled or eaten raw, or they may be dried in the shell and pounded into flour before mixing with food (Nsinjiro), or shelled and roasted; dried unshelled and roasted, dried unshelled cooked, dried shelled cooked, fresh cooked dried and stored. Also roasted and mixed with melting sugar to produce a snack known locally as “Kashata”. Many variations exist and many local recipes are being used by consumers of the crop.

Warren: What is aflatoxin?

Monyo: Aflatoxins are toxic secondary metabolites produced by the fungi *Aspergillus flavus* and *A. parasiticus.* Aflatoxins have carcinogenic effects on animals and toxicological effects in humans. The occurrence of aflatoxins are influenced by certain environmental factors such as water stress, moisture content of nuts and temperatures both before and after harvest.

Banda: What is the origin of aphids?

Monyo: Aphids are found all over the world on a wide number of plant hosts, including many legume crops. However, Groundnut Rosette Disease (GRD) is only found in Africa.

Yamikani: ICRISAT is doing a commendable job on research on groundnut diseases. Nkhotakota district is currently faced with a serious attack of rosette disease, especially in Mwansambo and Zidyana Extension Planning Areas (EPAs) on variety CG7. Is a deliberate effort to inject new seed in the area possible?, because the thinking is, that farmers may have over recycled their seed?

Siambi: It is important to note that variety CG7 is susceptible to the GRD. So even if you have new seed, you will still have a problem with GRD on this variety. However, farmers can also use some cultural practices to delay spread of the disease, such as planting early with first effective rains. I realize

that farmers like variety CG7 because it provides good yields, - more than 2.5 metric tones in good years. If there is really need to inject a new variety, it then has to be a variety favored by farmers and preferred by the market. However, you are right in saying that there is a need to ensure that farmers access good quality seed.

Kapewa: Does the theme of this workshop specifically focus on the McKnight foundation groundnut-breeding project?

Siambi: The theme for this meeting should not be narrowed to just the McKnight Foundation Breeding Project. Although the information that we are discussing here will feed into this project, the discussions here are broader and may not always specifically relate to this project. This project is specifically to develop short and medium duration varieties, but this is still to contribute to improving the lives of our farmers.

Mponda: Why has GRD not spread in other countries despite the trade in groundnuts?

Monyo: GRD is spread by aphids in the field and overwinters in live plants. There is no evidence that GRD is seed transmittable and thus trade does not transmit it.

Researchable challenges and opportunities in groundnuts for smallholder farmers in Malawi

Kapewa[1] Tobias

Abstract

In Malawi, over 25% of agricultural cash income is realized from groundnuts. However, due to unpredictable weather and recurrent droughts, poor soil fertility, limited use of cultural practices, lack of access to improved seed of acceptable quality, diseases and low producer prices, groundnut crop productivity remains low. Some of the key challenges to improving productivity of groundnuts in Malawi includes the need for strengthened NARS capacity building through training and infrastructure development; to further strengthen farmer-research-extension linkages; to increase involvement of the private sector, particularly in the processing and marketing of groundnuts and to improve mechanization to reduce drudgery. This paper highlights the major collaborative activities being undertaken by the Department of Agricultural Research Services (DARS) and related achievements.

Introduction

The importance of the groundnut crop among smallholder farmers in Malawi cannot be overemphasized. Over 25% of agricultural cash income in Malawi is realized from the groundnut. The seeds are important sources of protein and oils containing approximately 25% digestible protein and 50% edible oils. Groundnuts are traditionally consumed in a variety of ways including as roasted pods/ kernels, boiled fresh nuts, peanut butter alone or richly mixed with traditional dishes as a sauce and oil. In addition, groundnut haulms and cake are a valuable source of livestock feed and when grown in rotation with cereals such as maize. Groundnut also improves soil fertility.

Although improved cultivars and management practices for improved groundnut productivity are available and have been recommended to farmers, groundnut yields in Malawi remain low in comparison with averages for Africa (0.86MT Ha^{-1}) and the World (1.35 MT Ha^{-1}) (ASARECA, 2006). The reasons for this low productivity are varied but include unpredictable weather and recurrent droughts, poor soil fertility, limited use of cultural practices, lack of access to

[1] Groundnut Breeder; Chitedze Research Station, P.O. Box 158, Lilongwe, Malawi.
E-mail: groundnut@malawi.net

improved seed of acceptable quality, diseases and low producer prices. However, through concerted research efforts by various stakeholders, particularly the National Agricultural Research and Extension System (NARES) in Malawi and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) there has been an increase in the availability of improved seed and utilization of improved technologies resulting in improved productivity.

This paper highlights the major collaborative activities on groundnut research conducted by DARS, Malawi, in partnership with ICRISAT between 2002 and 2006. It will briefly mention areas where the partnership recorded major successes and suggest potential recommendations for the betterment of this partnership and the entire groundnut sector.

Germplasm exchange

The National Groundnut Improvement Program has limited human, physical and financial capacity to maintain an elaborate breeding program of its own. Based on this, ICRISAT as partner has continued to support the National Groundnut Improvement Program, particularly in the area of providing improved groundnut germplasm from its nurseries for adaptive testing at various agro-ecological zones of the country. In the past, varieties, such as CG 7, Nsinjiro, Kakoma and Baka have been identified and released for commercial production through this partnership. Another important example, recently in 2005, a line ICGV-SM 99568, was released in Malawi under the name Chitala. While these small-seeded varieties are good for the domestic and export markets and fit well into the farming systems due to short maturation periods, consumers in Malawi prefer large-seeded Chalimbana types due to flavor characteristics. However, Chalimbana is late maturing (120-150 days), low yielding and susceptible to predominant diseases in Malawi. Deliberate efforts should be made to include breeding objectives for flavor characteristics akin to the popular traditional Chalimbana. Much as ICRISAT's mandate is to serve the Eastern and Southern Africa (ESA) region, it will be worthwhile to also include this for Malawi and the region at large.

Participatory plant breeding

In the past, the National Groundnut Improvement Program has received advanced lines from ICRISAT nurseries for further testing at various agro-ecological zones for stability and adaptability. With the advent of participatory methodologies including participatory plant breeding, there will be need for ICRISAT and the National Groundnut Improvement Program as well as other partners and end-users to increase use of these methodologies

(throughout the breeding process) to increase ownership of the varieties by all stakeholders beyond the current level.

Capacity building

Training is an integral part of research and development. DARS is grateful to ICRISAT for organizing various in-country capacity strengthening programs, the most recent being a training on aflatoxin contamination. Two seminars were also delivered in Malawi by ICRISAT scientists on aflatoxin contamination and its management and on Biotechnology. These were useful seminars coming at an appropriate time when DARS is in the planning phase to institute a biotechnology laboratory within the country. DARS senior scientists of different disciplines participated in the two seminars.

The issue of aflatoxin contamination is crucial for the groundnut trade, particularly in the international market where standards are often restrictive for developing country groundnut exports, due to poor management practices and technologies and the lack of screening facilities. DARS technicians and other stakeholders were privileged to undergo specialized hands-on laboratory training in the diagnosis and determination of aflatoxin content using Enzyme linked immunosorbent assay (ELISA).

Outreach Programs

Although improved groundnut production technologies are available in Malawi, their adoption rates have largely remained low due to poor awareness and other factors. As a result, average national yields remain low (averaging 700 kg ha^{-1}) far below the potential yields as obtained at research stations. However, awareness campaigns conducted in partnership with farmers, researchers and extension workers has demonstrated that groundnut yields at farm level can be increased by over 70 percent by using improved methods of crop management. Since access to improved groundnut seed was improved, we have noted a dramatic increased in the area under groundnut production and national average production per unit area (Table 1). We believe that part of the reason for this success was due to the well established partnership between ICRISAT, NARS, civil society including NGOs and other stakeholders.

Table 1: Groundnuts production in Malawi (1996-2005)

Season	Area (ha)	Production (MT)	National Average (kg ha^{-1})
1996/1997	100,140	65,718	656
1997/1998	140,867	98,756	701
1998/1999	170,517	124,605	731
1999/2000	176,100	122,281	694
2000/2001	189,245	155,167	819
2001/2002	228,207	201,161	881
2002/2003	229,996	190,112	827
2003/2004	233,675	224,683	962
2004/2005	261,239	279,834	1,071
2005/2006	267,564	252,314	943
2006/2007	266,503	267,078	1,002

Source: Ministry of Agriculture, Malawi

Way forward

The following challenges are suggested as being critical for the betterment of the groundnut industry in Malawi:

1. There is need for strengthened NARS capacity through training and infrastructure development
2. Special attention should be paid towards further strengthening of farmer-research-extension linkages and use of participatory methodologies
3. Need to increase involvement of all stakeholders and particularly the private sector in research initiatives, specific emphasis should be made in value addition i.e. Processing for marketing of groundnuts
4. Groundnut production remains labor intensive; in order to improve productivity in a manner that does not affect quality negatively, there will be need to devise/develop improved labor saving implements including use of mechanization to reduce drudgery.

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Association for Strengthening Agricultural Research in East and Central Africa (ASARECA), 2006. Agricultural Research for Development in East and Central Africa. ASARECA's Strategic Plan for 2006-2015. ASARECA, Entebbe, Uganda. 50 pp.

Discussion

Mponda: How is the variety protection system working in Malawi? You had mentioned the farmers variety “Chalimbana”. Are farmers’ rights operational for the variety?

Kapewa: Farmers are involved in variety selection through on-farm experiments.

Monyo: Groundnut varieties are almost 100% self-pollinated. Farmers have over the years kept their preferred varieties.

Banda: Malawi is in the process of finalizing the Malawi Plant Variety Protection Bill. An issue that needs to be streamlined in this Bill is that of farmers’ varieties and their rights. The issues revolve around whether farmers can be considered breeders according to international standards (compliance with DUS requirements) for releasing the variety. Work on the Malawi’s Draft Bill continues, but it is likely that issues of farmers’ rights will be isolated and placed under the Farmers Access and Benefits Act under the Plant Genetic Resources Policy in the Environmental Act of Malawi.

Kamalia: What are the crop estimates for groundnut production in Malawi?

Siambi: No specific figures are available at the moment for this year, but during the 2005/06 season it ranged from 10,000 - 30,000 Tons however this is a general picture.

Overview of NASFAM experience in groundnut production and marketing

Warren[1] Duncan

Abstract

Through a sustainable network of smallholder -owned business organizations, The National Smallholder Farmers Association of Malawi delivers programmes to its members to strengthen their capacity, leading to improved productivity. Initially supported in 1994 by a USAID-funded Smallholder Agribusiness Development Project, NASFAM has grown to a member-based organization with over 100,000 member households. In 2002, NASFAM smallholders marketed over US$16 million worth of cash crops, the majority in the groundnut trade. The experience of NASFAM in the production and marketing of groundnuts provide important lessons for all stakeholders in improving the livelihoods of farmers in Malawi and beyond.

Introduction

Groundnut is, and has traditionally been, one of Malawi's major export crops and income earners. In the past this crop was exported primarily by the Agricultural Development and Marketing Corporation (ADMARC) of Malawi, a state controlled entity. ADMARC, until the end of the 1990's was a parastatal organization that provided both input and output markets (for all crops, including groundnuts and maize) for smallholder farmers. Initially, ADMARC held a marketing monopoly within Malawi, but with the advent of liberalization of the agricultural economy in Malawi in the mid-1990s as part of World Bank stimulated structural adjustment programmes, ADMARC was open to competition with private market traders and its budget support was significantly curtailed. In remote areas where groundnut production was still rudimentary, private traders still remain uncommon and ADMARC still plays a significant role. In these areas ADMARC continues to provide marketing services that otherwise may not be available.

Since the 1960's, the main groundnut variety exported was Chalimbana – a large grained, tan coloured, low to medium oil content variety which is grown in most of the low to medium to high altitude areas in the Central Region Plateau of Malawi. Groundnut also serves as an important rotation crop with

[1] Director of Farmer Services and Training, NASFAM, Box 30716, Lilongwe 3, Malawi. E-mail: dwarren@nasfam.org.

maize and tobacco and is grown largely under subsistence production but with some significant estate production. Research on groundnuts is conducted at Chitedze Agricultural Research Station, Lilongwe where both the National Groundnut Improvement Program and the International Crops Research Institute for the Semi Arid Tropics (ICRISAT) are based.

Various factors, especially the shortage of seed and the evolving role of ADMARC due to implementation of structural reforms by the International Monetary Fund (IMF), led to the decline in groundnut production to such low levels that by 2000, there were virtually no exports.

Farmers were predominantly using their own saved seed for subsequent planting from year to year, which resulted in reduced seed quality and largely mixed grain. In addition, farmers were selecting inferior kernels for seed after selling high quality grain for exports markets. The effect of the changes in ADMARC resulted in reduced involvement in groundnut trade and exacerbated the quality reduction of seed. As a result of private traders, farm gate prices of groundnut were relatively low. The private traders and small-scale itinerant traders with profit motive, were not concerned about seed quality. Further, the aflatoxin contamination issue began to increase in importance as importers became more stringent on regulations governing the trade in groundnuts. Average groundnut yields are currently about 700kg ha^{-1}. The paper focuses on the experience of NASFAM in empowering farmers to overcome constraints in the groundnut sector.

Involvement in groundnut production

NASFAM started up the Mchinji operation in the year 2000, in Chiosya Extension Planning Area (EPA) after conducting a production, marketing and institutional survey. Key entry points were identified as being in seed systems, aflatoxin management, yield enhancement and marketing systems. The rationale was to provide a pilot initiative that could be adopted by other EPA's and districts to improve groundnut production in the country. NASFAM provided extension advice in areas related to groundnut production to member farmers through association field officers and provided a market for member-farmer grain produced. For specific high-value markets, NASFAM worked with partners, particularly ICRISAT, to firstly improve its own capacity to manage the aflatoxin problem, and later to work with farmers to improve production. One of the mechanisms adopted was the 'traceability' concept, which allowed for tracing of particular samples back to a specific farmer or farm. Such that when grain was identified with high aflatoxin contamination, NASFAM was able to work

with this farmer to pinpoint and correct practices that were leading to high contamination.

Current situation

NASFAM is today one of the major groundnut producing and marketing institutions in Malawi which has aflatoxin management systems in place. The organization has sizing equipment and significant regional export presence. NASFAM is also exporting groundnuts to Europe and has put in place relevant quality controls to meet stringent quality requirements of its target markets. Through the organization's initiative, a Fair Trade Certification has been acquired and now it has gained entry into processing and retail markets

Future plans

In the coming years, NASFAM has developed a five-pronged strategy to not only maintain its current gains, but to build on these achievements:

1. Improving groundnut yield and quality
2. Positioning groundnut as a key diversification crop in tobacco production systems
3. Integrating aflatoxin management into the quality management systems for groundnuts destined for both domestic and export markets
4. Scaling- out value adding activities on-farm as well as centralized processing
5. Scaling- out to additional international export markets.

Discussion

Kamalia: How did the most preferred and popular traditional groundnut variety in Malawi "Chalimbana" come to bear this name? Does this have any connection with Chalimbana Research Station in Zambia? Does it imply that the variety was bred in Zambia?

Kapewa: The germplasm for Chalimbana was obtained from Zambia, but all the breeding work was done in Malawi.

Siambi: Chalimbana was initially identified/selected at Chalimbana by Mount Makulu Research Station in Zambia and popularized in Malawi. Remember, groundnut is almost 100% self pollinated.

Kamalia: What led to the collapse of Chalimbana trade?

Kapewa: There was a time when Zambians exported the groundnut variety "Chalimbana" into European markets. This could have contributed to the poor quality of Chalimbana and its subsequent reputation, as most farmers there used uncertified Chalimbana seed. However what Duncan Warren has indicated as the reason for the collapse of the Chalimbana industry is quite right. Another reason that could have contributed to collapse of Chalimbana trade is the advent of market liberalization following structural adjustment programs that Malawi implemented in the 1990's. During that time traders went out and bought everything, as they were offering better prices than the Agricultural Development and Marketing Corporation (ADMARC), hence very little was left behind to be recycled as seed.

Mponda: In your presentation, you mentioned that farmers were given inferior seeds of Chalimbana after grading good, quality seed for exports. Was the seed system not in place at that time? You also mentioned that groundnuts were a major export crop at the time. Why was seed quality provision to farmers not a priority?

Warren: The capacity of smallholder farmers to purchase quality seed was an issue. They often preferred to purchase grain for use as seed. Also, the volumes of seed demanded was higher than the supply, hence the use of grain as seed. And with liberalization, private traders and small-scale itinerant traders with profit motive, overlooked seed quality.

Seed supply systems in Malawi

Kaudzu[1] Grace

Abstract

Lack of seeds of improved groundnut varieties remains a significant limitation to groundnut production in East and Southern Africa, including Malawi. Quality, quantity, good varieties, and timely supply of the seed Characterise seed supply. Two broad types of seed supply systems are recognised - formal and the informal. In Malawi, the high cost of such seed from the formal system makes use seed acquisition unaffordable by small-scale farmers who consequently resolve to use own saved seed that is of low quality. On the other hand informal seed supply system can be improved by improving seed security, enhancing seed quality, making available good varieties and reliable seed source structures. More importantly, improving farmer capacity and awareness of groundnut seed production can play a significant role in improving informal systems. The complementarities of the informal and formal seed supply systems offers multiple opportunities to develop well integrated seed sectors in which both systems play a significant role to the benefit of the farmer and the entire sector.

Introduction

A seed is a living plant part which when provided with ideal growing conditions can originate a fully functional plant. Seeds play a vital role in food security, and the availability of high quality seed of diverse crops is important for sustainable and high crop productivity. Critical for seed security is the availability of the right seed type, of high quality, at sufficient quantities when required. The seed should not only be available in the vicinity of farmers, but should be accessible to them and the farmers should have the means to purchase the seed either in cash, labour or commodity exchange. However, due to various reasons, most farmers in Malawi prefer to use saved seed and use the money for buying other inputs like fertilizers.

Characteristics of seed supply

Quality: Good quality seed results in improved crop vigor, ie,higher productivity in terms of yield and quality of grain. Seed quality therefore means viability which ensures good seed emergence and survival. High quality seed also

[1] Principal Agricultural Research Scientist; Chitedze Research Station, P.O. Box 158, Lilongwe, Malawi. E-mail: grace_lameck@yahoo.co.uk.

means that the seed is free from pests and diseases which when present often cause reduction in plant vigor and subsequent yield of the resultant crop. Pests and diseases also reduce viability of the seed due to the damage of some seed components.

In order to produce good quality seed, sustainably, prescribed production procedures and standards which include maintenance of isolation distances, use of certified seed, rogueing of off-types, registration of seed fields, field crop inspections and laboratory seed testing need to be adhered to. Seed crop that does not meet the prescribed standards will not be certified as seed and can be used as grain.

Quantity: Adequate quantities of seed must be available to plant adequate hectarages, to ensure adequate food for specific households. Groundnut seed quantity is an important issue, as it is commonly in short supply in the farming community as a result of unresponsive formal seed supply systems in combination with other factors, which cause farmers to consume seed as food or loose sources of seed.

Improved varieties: The use of improved varieties, which are well adapted to production areas, is important to ensure that yield potentials are maximised. This can also guard against various constraints such as droughts, pests and diseases. Use of improved varieties is an important pillar in management of pests and diseases.

Timely supply of seed: Ensures early planting, allowing the crop to grow during favorable environmental conditions, thus ensuring food security within the farming community. Late planting often results in higher disease pressure due to increased inoculum concentrations present.

Seed supply systems in Malawi

There are two broad types of seed supply systems that are recognised - formal and the informal seed supply systems.

Formal seed supply system

Seed provision under this system covers seed production and supply mechanisms that are governed by defined methodologies, combined stages of multiplication and international standardisation of methodologies (quality control). These are often divided into a clear functional division of labour and management where each component is linked and highly dependent on each other, such that if one part does not function the whole system collapses. Public and private seed

companies are involved and invest in research and development of the formal seed sector in order to maintain and improve national self-sufficiency in seed production and consequently food production. The level of involvement of the private sector is dependent on the crop. Farmers need to adopt use of seed produced in this system, if they are to be seed and/or food secure in Malawi, because the use of improved varieties increases yields. The seed is produced according to standards and is therefore of high quality, the products thereof are conveniently marketable. But the high cost of such seed in most cases makes it unaffordable by small-scale farmers who consequently resolve to use own saved seed that is often of low quality.

Informal (local) seed supply systems

The informal seed supply system essentially lacks structure and procedure. The small-scale farmer makes up a larger proportion of this system. They develop and maintain their own plant genetic resources based on local means of seed production, selection and exchange. Farmers do not see dependable and competitive supplies of commercial seed especially for cash and food crops like groundnuts, cowpeas and pigeon peas. There is no quality control in this system. Newly introduced varieties are subject to farmers experimentation and when adopted they become privy to the same processes - the seeds are recycled. Most of the farmers in Malawi use this system of seed supply for two main reasons; firstly it is cheap and secondly, because groundnut is a self pollinated crop, the difference between quality seed and farmer saved seed may not be immediately obvious to the farmer and the cheaper farmer-saved seed becomes the more practical choice for seed. Farmers plant seed of their choice suitable to their environment. This results in low yields since farmers use poor quality seed.

Challenges in the informal seed supply system

Selection: Rate of improvement is slow since farmers selection system depends only on natural ways of increasing genetic variation, which is very limited in a self pollinated crop like groundnut. Any introduction of new pests and diseases pose a threat to a whole crop if resistant germplasm is not introduced. Seed quality in many situations is sub-optimal due to diseases and storage problems.

Production: There is a tendency for genetic contamination of varieties due to the nature of the small-scale crop production systems. There is no quality control in the system and no defined methodologies.

Free food and seed relief: Interventions such as food and seed relief, undermine local initiatives since farmers develop a donor dependency syndrome and do not take the initiative of mobilizing resources to procure seed. Further, they operate to dampen seed prices that act as a disincentive to the more progressive farmers.

Diffusion: Diffusion of technology is very slow. Often diffusion of potentially adapted varieties can be the weakest link in the local seed supply system particularly by poor farmers within the community. This is exacerbated by lack of seed of the new varieties.

Improvements in the informal seed supply system

Informal seed supply system can be improved by improving seed security, enhancing seed quality by employing quality control standards in the seed production system, and availability of good varieties and reliable seed source structures. More importantly improving farmer capacity and awareness on groundnut seed production can play a significant role in improving informal systems. Farmers have particular knowledge of their seed and varieties. They are good selectors of varieties for their own use because they can weigh the different requirements, at the same time they can consider the needs of the household, how the varieties fit into the total production system and how it adapts to the environment.

The complementarities of the informal and formal seed supply systems can offer multiple opportunities to develop well integrated seed sectors in which both systems play a significant role. Farmer capacities and knowledge regarding local conditions, seed selection and traditional mechanisms of seed exchange are important elements in the functioning of the informal seed system. Instead of replacing this sector, formal sector can build on these elements to address more effectively seed demand of the small-scale farmers. Introducing improved seed technologies to local conditions can help in improving seed productivity by small-scale farmers.

Provision of training, can reinforce farmers' capability and knowledge to use improved varieties. In addition, the regulatory framework should be changed to suit and facilitate community-based seed supply system.

Discussion

Warren: Seed inspectorate services should consider recognition of quality declared seed to make seed affordable and available to smallholder farmers. To reduce the cost of seed inspection, consider the following:

- Reduce charges by visiting many farmers on one trip, to spread out travel costs
- Decentralize seed inspection services to Sub-Research Stations, Agricultural Development Divisions (ADDs) and District Agriculture Offices
- Delegate accreditation to credible institutions
- Promote quality declared seed.

Kaudzu: Quality declared seed cannot be declared when there is enough certified seed, unless otherwise.

Siambi: There is no commercialization of seed unless the seed is of high quality. It is therefore important to consider the position of groundnuts in this regard.

Kapito: It would be nice if the policy on seeds could be reviewed since most smallholder farmers do not have access to seed?

Kaudzu: It is very difficult to change the policy as far as the government is concerned.

Siambi: Can we have guided quality declared standards for groundnuts?

Kaudzu: A policy is already put in place so there is need for consultation.

Warren: Seed inspectors at RDP are not competent so they need proper training, government policy also needs to be revisited regarding certification of seed as quality declared seed.

Kapewa: The root cause of the problem needs to be identified, then some measures in the policy needs to be revisited, however not everything in the policy can be changed.

Mponda: How is the Malawian certification system prepared to decentralize certification? How is the quality of seed declared in Malawi?

Kaudzu: We are decentralizing the system e.g companies are able to do it.

Kapito: As government, what are the measures put in place to look at the price issue regarding seed production, and what is the government doing to inspect seed and ensure quality seed?

Kaudzu: Government has put aside some funds for inspection, albeit very little. Therefore for any inspection activity, a certain fee is charged.

Monyo: Some countries do provide compulsory seed certification for other crops.

Kaudzu: We have to move according to policy and regulations

Kapewa: It is indeed right and proper that the seed act is revisited, but policy can be reviewed after checking with relevant authorities.

Kapito: Could you please publish seed suppliers annually, so that buyers should know where to get the seed?

Kaudzu: Seed service department has a list of seed suppliers throughout Malawi. the information is available at the Department.

Researchable challenges and opportunities in groundnuts for smallholder farmers in Tanzania

Mponda[1] Omari

Abstract

Groundnut, Arachis hypogaea L., is an important source of income and dietary supplements for smallholder farmers in Tanzania. Major growing regions of production are in Dodoma, Singida, Tabora and Mtwara districts. Research on groundnut commenced over 60 years ago and is currently coordinated at Naliendele Agricultural Research Institute under the Oilseeds Research Program (ORP) in southern Tanzania. Over the last two decades research efforts have focused on making available improved varieties, developing technologies for integrated disease and pest management and agronomic practices. As a result, area under improved groundnut variety has increased and there is increased awareness and accessibility of improved seeds and technologies. However, there is still need to improve technology adoption, increase efforts in the development of resistant varieties against foliar diseases, develop improved low cost post-harvest technologies and strengthen the entire production to marketing chain.

Introduction

Groundnut, *Arachis hypogaea L.,* is an important source of income and a dietary supplement for smallholder farmers in Tanzania (Bolton, 1980; Mwenda *et al.,* 1984). Major growing regions are Dodoma, Singida, Tabora and Mtwara districts. The crop is often grown in pure and mixed stands with other crops such as maize in poor soils and predominantly low rainfall areas. Groundnut yields remain low and are estimated to average 600 kg ha^{-1}. Past reports indicate that the lack of price incentive was a key factor which contributed to low groundnut production in Tanzania (Doto and Mwenda, 1987). However, availability of quality seed has similarly not matched demand and has since become a constraint. Groundnut research in Tanzania is coordinated at Naliendele Agricultural Research Institute under the Oilseeds Research Program (ORP) in southern Tanzania.

[1] Principal Plant Breeder, Naliendele Agricultural Research Institute, 10 km Peg Newala Rd, P.O. Box 509, Mtwara, Tanzania. E-mail: omarimponda@hotmail.com.

Groundnut research in Tanzania.

Groundnut research in Tanzania commenced during the colonial period in 1940s at Nachingwea under "The Groundnut Scheme" by the Overseas Food Corporation (OFC). After independence, research on groundnuts was sporadic and lacked cohesion. However, on realizing the acute shortage of vegetable oils during the 1970's, Government of the Republic of Tanzania with support from United Kingdom (Overseas Development Assistance (ODA)) established the Oilseeds Research Program (ORP) on groundnuts, sesame, sunflower at Naliendele Agricultural Research Institute in 1978. At inception, the objectives of ORP were to:

1) Identify and develop groundnut varieties adapted to the main growing areas of Tanzania that are high yielding and resistant to the main diseases and insect-pest constraints of the crop
2) Identify diseases and insect pests of economic importance and develop economic and practical control measures
3) Identify the best agronomic practices for different varieties of groundnuts
4) Investigate the role of groundnuts in cropping systems and recommend improved practices in these systems

Achievements of groundnut research interventions

During the last two decades the following research achievements have been realized:

- Improved groundnut varieties with high yielding potential of 1500 kg ha^{-1} and above have been released and recommended to farmers. The varieties are Nyota, Johari, Sawia-98 and Pendo-98. Nyota and Pendo-98 are of Spanish type while Johari and Sawia-98 are of Virginia type. Based on farmer and market preferences Pendo-98 is the most preferred variety.
- The major diseases and insect pests of groundnuts have been identified and integrated management strategies developed. The major foliar diseases include leaf spots caused by *Cercospora arachidicola* and *Phaeosariopsis personatum,* groundnut rosette, rust (*Puccinia arachidis*). The major insect-pests are the groundnut leafhopper, *Hilda patruelis.* For leaf spots some recommended control measures include use of fungicidal applications using Chlorothalonil (Daconil 2787 or Bravo 500). However, this has since been found to be impractical for farmers due to high cost of fungicides among other reasons.

- Achievements in agronomic research include identification of optimal plant population, optimal time of planting, fertilizer type and rate of application that increases yields. Intercropping studies have also been conducted.

Impact of Groundnut Research

Although no specific study has been undertaken to determine the adoption of improved groundnut varieties and technologies, observations in specific research intervention villages indicate increased area and production of groundnuts. Through research-extension-and farmer contacts, the area under improved groundnut variety Pendo has also increased over the two decades. On-farm trials and initiatives such as rural seed fairs and contract groundnut seed multiplication schemes with farmer research groups have significantly contributed to increased awareness and accessibility of improved seeds and technologies.

Increased groundnut production has resulted in increased income. In Southern Tanzania farmers are now able to get cash at what farmers refer to as the most difficult period of the year, between May-August. Income obtained during this period enables farmers to purchase inputs for their cashew fields from which they get income later in the year (October to December) after selling cashew nuts or other crop.

Groundnut Research Challenges

Despite the above achievements made in groundnuts the following challenges exists:

a. Technical Constraints

1. *Low adoption of improved varieties and technologies:* Despite adoption of varieties and recommended practices in some areas, these remain limited and are not used by majority of smallholder farmers. This is a result of limited resources of smallholder farmers which affect livelihood strategies, lack of seed arising from limited multiplication initiatives which fail to cover major groundnut growing areas and therefore limited accessibility and use of improved seeds.
2. Although improved varieties have been released and recommended to farmers foliar diseases such as Early and Late leaf spots, GRD and Rust continue to reduce yields in farmer's fields. Yield losses due to leaf spots are of the magnitude of 36% while that for GRD are often 100% in single fields.

3. Incidences of the groundnut leaf hopper, *Hilda patruelis* in some years reduces yields in farmers' fields.
4. Post-harvest processing technologies for reducing drudgery (such as in groundnut shelling) and for increasing utilization options/value addition for the crop (i.e. low cost oil processing) have not been well exploited at farm level.
5. With increased production of groundnuts, drying of fresh groundnuts after harvest is a problem, especially during prolonged rains. Low cost drying methods for groundnuts need be introduced.

b. Marketing constraints

1. There is no organized structure for marketing of groundnuts in Tanzania. Groundnut marketing is on ad-hoc basis. Prices often fluctuate and are generally unpredictable. Unlike traditional cash crops (cashew nut, cotton, coffee etc.), groundnut production and marketing is not coordinated by commodity boards.
2. In the absence of organized market for groundnuts, farmers are not aware of the quantity and quality standards for groundnuts in the international market and therefore, have little incentive to produce groundnuts beyond what they consider are household requirements.
3. Potential buyers are not aware of the quantities and varieties of groundnuts produced in the major groundnut growing areas, it therefore becomes difficult for them to prepare marketing strategies for the crop.

c. Policy constraints

Production of oilseeds including groundnuts has not been adequately promoted in the country. Tanzania continues to import vegetable oils to fulfill large domestic demand despite the fact that oil crops such as groundnuts, sesame, sunflower, coconuts, oil palm and cotton can be produced in the country. However, with a few exceptions, there is little policy support to stimulate and sustain the domestic oil extraction industry

Potential of groundnut as an export crop

During the 1970s Tanzania was exporting groundnuts and was the leading source of export earnings among the oilseeds (Banda, 1992). However, from 1980s there was a decline in groundnut exports (Table 1). The General Agricultural Products for Exports (GAPEX) was responsible for the marketing of groundnuts including other crops during 1970-1980. The decline in the production and exports of groundnuts may therefore, be attributed to lack of organization to

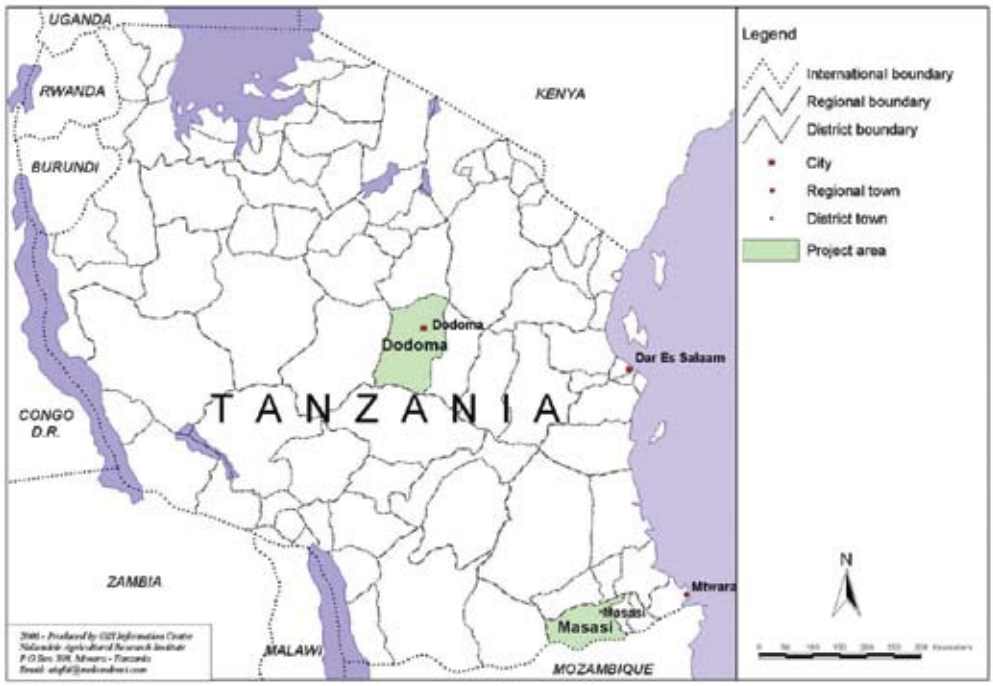
spearhead the production and marketing of groundnuts. However, this was further exacerbated by the new trade standards arising from new legislation after discovery of the *Aflatoxin* problem.

Table 1: Marketed groundnut production (May-Apr) Tanzania, 1971/72- 1984/85

Year	Tons
1971/72	3,295
1972/73	3,454
1973/74	1,363
1974/75	509
1975/76	510
1976/77	417
1977/78	1,448
1978/79	2,615
1979/80	6,676
1980/81	1,728
1981/82	227
1982/83	131
1983/84	845
1984/85	575

Source: GAPEX Headquarters, Dar es Salaam

Any attempt to stimulate production and to improve marketing of groundnuts in Tanzania must focus on improving the entire 'production to marketing chain'. Although groundnuts are grown predominantly as a subsistence crop, potential for commercialization of the crop is great. Farmers often cannot afford to use inputs such as fertilizer and some practices such as harvesting are delayed due to competition for labor. Present policies, including the Agricultural Policy, Poverty Reduction Strategy (APPRS II) and the Agricultural Sector Development Strategy (ASDS) are conducive to commercialization of the groundnut sub-sector. The McKnight Foundation funded project piloted through two key groundnut production districts (Masasi and Dodoma) represent one of several initiatives to addressing the production to marketing chain (Map 1 pg 43)



Conclusions and recommendations

Based on the above, we conclude that;

1. There is need to improve technology dissemination and adoption. The Oilseeds Research Program based at Naliendele Agricultural Research institute has developed improved groundnut technologies but efforts, particularly in technology promotion, are required to increase the adoption of groundnut technologies
2. Breeding programs in the region should increase focus on the development of resistant varieties against foliar diseases which continue to reduce yields in groundnuts fields.
3. The problem of lack of quality affordable seed of improved varieties requires urgent attention. Approaches aligned with best practice that enable farmer multiplication of quality seed should be utilized.
4. To reduce drudgery, there is need to develop improved low cost pre and post-harvest technologies and make these accessible to smallholder farmers in groundnut growing areas to reduce labor demand especially during shelling and value addition. Specifically, technologies to facilitate oil extraction will impact smallholder farmers in the short term.

5. The 'production to marketing' chain should be strengthened. Building capacity along the entire chain will stimulate production and result in increased exports. Initially, there is need to improve public-private partnerships in research and increase inclusiveness, ie, participation of private groundnut players in research, for better marketing of the crop.
6. There is need for an enabling policy environment for groundnuts. Although the country is suitable for growing many oilseeds crops in the future this may be constrained by vegetable oils imported in large quantities. of which Groundnut oil could replace on a sustainable basis. Further this would also lead to savings in foreign exchange. Policies that promote production, domestic processing and value addition, need be in place for oilseeds.

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Discussion

Kapewa: The project aims at developing short to medium duration maturing genotypes for Malawi and Tanzania. In Tanzania, I note that your rainy season runs from December to April. How do you intend to marry this with the project aim? I have asked this because short duration genotypes will mature right in the middle of the season rendering a drying problem and an aflatoxin conducive environment.

Kafiriti: In the northern part of the country characterized by bi-modal type of rainfall, Spanish varieties (short season) are usually grown during the short

rainfall season. In southern part of the country where there is uni-modal type of rainfall, groundnuts are planted anywhere between late December to early February. Farmers who prefer to grow Spanish types are advised to plant late in the season (late January to early February), so that harvesting coincides with the end of rain season. Farmers wishing to plant early in the season are advised to grow Virginia types.

Banda: The low groundnut yields in Tanzania are comparable to those obtained in Malawi. Are these low yields due to diseases alone? Does Tanzania also target the EU market?

Mponda: Low yields are a result of lack of price incentives, drought, lack of seed supply of required varieties, weeds, insect pests and diseases. The level of any particular constraint differs from place to place and time to time. Nonetheless, diseases are considered the most important constraints.

At the moment most of the groundnut produced by smallholder farmers consists of mixed varieties. This might be because the markets that the farmers are used to, don't require high quality nuts. Most Tanzanian growers at the moment market their groundnut locally and don't target external (or EU) markets. However we hope this will begin soon.

Sustainable Intensification of Groundnut Production

Kafiriti[1] Elly

Abstract

Sustainable intensification of groundnut production is the successful management of resources for increased productivity of the crop while maintaining or enhancing the quality of the environment. Groundnut productivity is estimated at around 500 kg ha^{-1} low compared to the average 1500 kg ha^{-1} obtained under research conditions. Used predominantly for food, groundnut is an important source of protein and high grade fat. Subsistence farmers with very limited inputs produce most of the crop. Due to resource and knowledge limitations of the small farm holders, chemical fertilizers and pesticides are usually not applied. For sustainable intensification of groundnut there is need for farmers to be commercially oriented. Issues related to marketing and policies to enable commercialization of the crop are of utmost importance.

Introduction

Groundnut (*Arachis hypogaea L*) is one of the most important crops in Tanzania. The crop is grown in all regions of the country but at various levels, depending on the importance. It is adapted to a wide range of environments, but does better from sea level up to 1500 meters above mean sea level (m.a.s.l.) in sandy soils (light sandy to sandy loam), and evenly distributed annual rainfall of between 500–1000 mm. Used predominantly for food, groundnut is an important source of protein and high grade fat. Groundnut thus contributes significantly to household food security in the country. Oil intake is another but less important, end use of the crop and its products – edible oil in the country is produced mainly from cottonseed, coconut and sunflower.

Groundnut productivity is estimated at around 500 kg ha^{-1}. Low compared to the average 1500 kg ha^{-1} obtained under research conditions. Subsistence farmers with limited inputs produce most of the crop. Seed of improved varieties, which is arguably the most important input, is not easily accessible to most farmers. The crop is labour intensive, particularly during planting and shelling. In view of the fact that the same groundnut farmer is engaged in production of other crops to which he/she might attach higher importance, often results in competition for

[1] Principal Agronomist, Naliendele Agricultural Research Institute, 10 km Peg Newala Rd, P.O. Box 509, Mtwara, Tanzania. E-mail: ellykafiriti@yahoo.com, kafiriti@hotmail.com.

labor which usually goes towards the staple crops before groundnuts. Due to resource and knowledge limitations and cost, chemical fertilizers and pesticides are usually not applied by smallhold farmers.

Sustainable Groundnut Production and Intensification

Sustainable intensification of groundnut production can be said to be the successful management of resources for increased productivity of the crop while maintaining or enhancing the quality of the environment and conserving natural resources. We believe that groundnut production in Tanzania can be intensified in a sustainable manner. However, this has not been previously achieved due to the following:

- The crop is produced under subsistence conditions;
- Most groundnut farmers do not have necessary financial means to access required inputs to intensify production of the crop in a sustained manner
- There has been low adoption of improved technologies for increased productivity of the crop. For example less than 20 % of groundnut farmers use improved varieties while not more than 5 % follow recommended agronomic practices
- There is a lack of farmer' awareness about labor saving technologies for planting, harvesting, shelling etc
- Drying of groundnut is a problem. If production is to be instensified, sustainably, steps should be taken to minimize post harvest crop losses through adoption of improved technologies
- Groundnut marketing is still a problem in Tanzania, particularly for the export market. This is one of the complaints most often encountered from farmers.

In-order to achieve sustainable intensification of groundnut production the crop should be commercialized. This will be attained when and if the above factors have been addressed so that there is an incentive to invest in the crop. Issues related to marketing and policies towards commercialization of the crop are of utmost importance.

Discussion

Mponda: Is there any seed supply component by Seed Co Malawi? Other research stations have recommended 30 cm x 15 cm spacing. Why are we recommending a 75 cm x 10 cm spacing?

Siambi: Associations have to ensure that seeds are available at the right time. The seed production system is now highly distorted. Seed Co Malawi does not supply groundnut seed in Malawi.

Kapewa: The 75 cm inter-row spacing was adopted to facilitate rotation of groundnut with maize in maize-based systems. However, where mechanization is possible, 60 cm inter-row spacing is recommended.

Siambi: It is a question of ridge pattern. In areas where they use 30 cm x 15 cm spacing, broad beds are used and not ridges. To compromise on the maize/groundnuts crop rotation, 75 cm x 10 cm spacing is advised. But if it is purely commercialized, 60 cm x 10 cm is recommended.

Kamalia: How do you determine aflatoxin levels in groundnuts?

Kapito: We begin by picking samples (250g) from the warehouse, using standardized sampling techniques to take into account the skewed distribution of the pathogen in the produce. This is used to test for aflatoxin at the ICRISAT Chitedze laboratory using an ELISA also developed by ICRISAT. The method is cost effective and allows us to test for more samples and has been very effective in the past.

Warren: Commercial, large-scale farmers do attempt to manage the aflatoxin problem. This is a major concern.

Kamalia: What is the contamination period for aflatoxin?

Siambi: It is difficult to determine because its contamination period is heterogeneous. Rather, contamination is based on prevailing conditions both before and after harvest, such as relative humidity and temperatures.

Warren: If you put groundnuts in a moist environment the fungus develops very fast, including during transportation to Europe.

Phiri: The EU market treats aflatoxin as a serious issue. In the absence of other players such as Mulli Brothers, Transglobe etc at the workshop, are there mechanisms put in place to ensure that other exporters of groundnuts export aflatoxin-free groundnuts?

Warren: With the liberalized market, traders are free to export groundnuts. The Aflatoxin lab that NASFAM has is free to all exporters at a certain fee. However, the other partners cannot be forced to bring their samples for analysis. So really, their exports can affect Malawian groundnuts' reputation. It also depends on the market where the groundnuts are being sent, European markets are very strict about aflatoxin levels and that's where NASFAM sells its groundnuts. For other locally available markets, there is not much emphasis as far as aflatoxin levels are concerned. There is also need for conducting awareness meetings with other marketing agencies or traders in groundnuts with regard to the serious concerns surrounding aflatoxin in groundnuts.

Groundnut production in Dodoma Region

Mtei[5] Marcel

Abstract

Unpredictable rainfall is a common challenge effecting groundnut production in some parts of Tanzania. This is clearly the case in Dodoma District Council, within Dodoma Region of Tanzania. Here rainfall averages 500-800mm every year. The district is among the less developed districts with per capita income standing at US$100. Agriculture is characterized by low productivity resulting from low and erratic rainfall high vapour-transpiration and low moisture holding surface soils. Groundnut status in the district and key production challenges are presented in this paper.

Introduction

Dodoma District Council is located in Dodoma Region and has two Districts namely Bahi and Chamwino. The Council is located on the central plateau of Tanzania. The Council extends between Latitude 40 and 80 degrees South, and between longitude 350 and 370 degrees East. Climate in the Council locality is dry Savannah, characterized by a long dry season lasting between late April to early December, and a short single wet season lasting between late December to early April. Average rainfall is 500 – 800mm annually, and about 85% of this falls in the four months between December and March. Not only is the district rainfall relatively low but also it is rather unpredictable in frequency and amount, particularly in the month of January, in which most crops are generally sown. It is this unreliable rainfall which has imposed a pattern of risk evasion in traditional agriculture and also presents a serious constraint on present efforts to improve field crops. The district is among the least developed districts in terms of income per capita, which stands at Tsh.120,000/= (equivalent to USD 100). However by–laws have been introduced, which enforce farmers to cultivate among other crops, drought resistant crops, mainly Sorghum and millet (Tegemeo, okoa), cassava and sweet potatoes.

Production of crops is scattered around the entire district, with distribution dependent on the type of crop being grown. However, production of most crops tend to be concentrated in the Western and Northern parts of the district where climatic conditions and soil textures are favourable for crop growth. Crops such as sorghum and millet (drought resistant crops) are grown all over the district. Other crop grown include maize, paddy, beans, groundnuts, simsim, sunflower

[5] Dodoma District Council, Dodoma, Tanzania.

and castor. Tomatoes, onions, vegetables and fruits are also produced on a small scale.

Groundnut status

Since the 1960's groundnut ha been a major cash crop produced by farmers in the district. In some parts of the district the crop is produced through mixed farming with cereal crops such as sorghum, millet and maize. Some NGO in the District such as LVIA and DCT has tried to support farmers in the production of such crops in terms of seed distribution. In 2004/2005 farmers were supported with improved seeds of variety Nyota. The seeds were distributed amongst some groups of farmers. The amount distributed unfortunately, was very low, and made it impossible to cover a large number of farmers. This made most of them continue using the local varieties that are still used to date.

Challenges affecting groundnut production in Dodoma are as follows:

- Diseases and pests: Fungal and viral diseases are the major problems affecting groundnut production. More research is needed to overcome these problems. There are also insect pests that cause damage to the groundnut during the poding stage.
- Proper and recommended varieties have not been identified for production around the district. Farmers are still using the local varieties.
- Availability of other cash crops in the district such as sunflower and sesame which have good market compared to groundnut crop
- Absence of groundnut processing machines. This reduces the value of the crop and its price in general
- The availability of a proper market
- Inadequate research conducted for the crop in terms of drought resistance, diseases, pests, yield and adaptability.

Conclusion

Farmers in Dodoma District council intend to produce more of the groundnut crop. The major concern according to their practice, is how to minimize the above challenges. At the moment most of them produce the crop for local consumption.

Groundnut production in Mtwara region

Mpangala A[6]

Abstract

Mtwara region is characterized by sandy loam soils and receives about 900mm of rain every year. Most farmers cultivate groundnut fields that are less than 2 acres. Masasi and Nanyumbu Districts are key groundnut production districts of Mtwara region. Key constraints and district strategies are highlighted in this paper to provide an example of groundnut production in Mtwara. Groundnut marketing constraints in the two districts are pests and incidences of disease, lack of an efficient marketing system, poor and fluctuating groundnut prices, seeds of improved varieties not available, low use of labour reducing implements, lack of transport to markets, lack of knowledge on good agricultural practices, poor storage, and unpredictable climates and drought.

Introduction

Masasi and Nanyumbu Districts are in the Mtwara region. The districts on average receive about 900 mm every year. Most soils are 'sandy loamy', other areas have clay soil and the land is flat, and a few areas are 'stony hilly'. Groundnut is a source of food and income. Groundnut is the second cash crop after cashew. The crop is grown by small-scale farmers.

The cultivated area under groundnut per household on average, ranges from less than an acre to 2 acres. Most of the farmers intercrop groundnuts with other crops such as cassava, maize, and sorghum legumes. However, there are some farmers who plant in pure stand. A common practice in groundnut cultivation is by hand hoe, but some villages usedraft power and tractor, especially during land preparation. Hired labour is used during planting, weeding and harvesting especially for those farmers with big area under groundnuts.

Previously, improved varieties were not available, but now, farmers use improved varieties, thanks to Naliendele Agricultural Research Institute, which is implementing groundnut on-farm trials and seed multiplication activities in the two districts. The improved varieties disseminated in the districts were Nyota, Johari, Pendo and Sawia. Most of the farmers prefer to plant Pendo because of its high yield, early maturity, good pod filling, it is easy to harvest and easy to hand shell etc. In collaboration with NARI the districts has well established

[6] District On-farm Seed Production Coordinator, Mtwara, Tanzania.

seed multiplication centers for improved groundnut varieties and these are: Mpeta, Chiungutwa, Ngalinje, Chipuputa, and Nanyumbu. The production of groundnuts in Masasi for the past 5 years is as summarized below.

Production of groundnuts in Masasi and Nanyumbu Districts in past 5 years

	YEAR				
Area Under	2003	2004	2005	2006	2007
Production (Ha)	19,100	24,628	16,459	22,160	26,120

Groundnut production constraints in Masasi and Nanyumbu Districts

Groundnut marketing constraints in the two districts are pests and incidence of diseases, lack of an efficient marketing system, poor and fluctuating groundnut prices, seed of improved varieties not being available, low use of labour reducing implements, lack of transport to markets, lack of knowledge about good agricultural practices, poor storage, unpredictable climate and drought. Based on these challenges, the district has enacted various strategies to improve the production of groundnuts in Masasi and Nanyumbu Districts. These are listed below:

1. Each groundnut farmer should plant at least 1 acre of the variety Pendo (or other improved variety)
2. The district promotes the expansion of groundnut cultivation to attract more buyers
3. Farmers are encouraged to adopt improved technologies for groundnut production
4. Farmer groups are encouraged to increase areas under quality seed production to make seeds available to other farmers
5. Expand training programmes on groundnut production by extension workers to reach more farmers
6. Train farmer groups to produce quality seeds on a sustainable basis
7. Training of trainers (extension workers) on groundnut production;
8. Improve partnerships, particularly with the Naliendele Agricultural Research Institute in the implementation of On-farm trials and seed multiplication/ demonstration activities.

Experiences from the private sector in Tanzania

Kamalia[1] Shrikant

Abstract

The private sector plays an important role in groundnut production in Tanzania, although in its infancy, this is expected to grow in the coming years. The private sector continues to be limited by factors such as lack of consistency in the grade and type of peanuts, lack of adequate volumes, collection of produce from smallholder farmers; failure to agree and stick to agreed prices. In addition, issues such as aflatoxin contamination that pose barriers to trade often result in huge losses and need to be planned for. Roles of the private sector in value addition and marketing are discussed.

The Government of the United Republic of Tanzania recognizes that its role is to facilitate the private sector and other economic agents to actively and effectively invest in productive and commercial activities in order to accelerate economic growth and development. The private sector though in its infancy in the Republic, continues to grow. From the perspective of the Private Sector, the essential factors for trade in any commodity for the industrial sector, or for export, is guaranteed supply in quantity and quality. Also affordable and manageably-consistent agreed-upon rates through specific sales centers that have proper monitoring laboratories which would check and certify the product during the sales process.

An earlier attempt by our company to collect and export peanuts from Tanzania in the late-90's ended in utter failure. There were several reasons for that failure.

1. No consistency in the grade and type of peanuts.
2. Lack of adequate volumes
3. We had no idea of aflatoxin contamination or any other legume diseases – resulting in a huge wastage factor and loss.
4. In the absence of sales centers, collections were a logistical nightmare
5. Several villages arbitrarily pushed up previously agreed upon prices, wrongly assuming that our interest in their product was us "taking advantage of some sudden hike in international pricing".

[1] Atlas Export ltd-Tanzania, P.O. Box 509, Mtwara, Tanzania. E-mail: shrikantkamalia@yahoo.co.uk.

Traders view the initiative undertaken by ICRISAT and the Department of Research Training as of paramount importance. Traders believe that the end result would be a most positive one for all stakeholders if this initiative is followed.

The effort to support production of groundnut in rural areas in which people currently have limited cash income, and poor diet, will be encouraged, since single cash crops – e.g. cashew nut is risky. At the same time, budding industries in the SME sector could be helped to access small scale oil expellers at the grassroots levels, it would improve value addition and incomes. With the impending electrification of Southern Tanzania, commercial orientation would be stimulated and also improve livelihoods in these rural areas.

Atlas Export Ltd is interested in purchasing groundnut grain from smallholder farmers and would do so at mutually agreed and negotiated prices that would encourage farmers. However, this would require that some of the bottlenecks, such as low quality grain that is often comprised of mixtures, and adequate quantities, can be sourced. In line with this, we would be interested in assisting farmers in adding value and ensuring quality of their produce with initiatives such as the establishment of de-shelling centers, with machinery at agreed centers, to help cut out the laborious, manual shelling which is currently employed for de-shelling peanuts in Tanzania.

Discussion

Mangazi: What motivates traders to look for groundnuts in Malawi instead of buying groundnuts in Tanzania, which is also a producer of groundnuts?

Kamalia: In business one looks for commodities that are affordable, to be sold where more profits can be generated. In this case it's a question of comparative advantage, so these people who flock to Malawi to buy groundnut have already taken that into consideration. In addition to that, in the marketing system in Malawi, there are no strict measures as to where to sell and who to buy from.

Mother and baby trials and Farmer field schools for technology targeting and scaling-up/out

Monyo[1] E, Osiru[1] M, Rusike[2] J, Mgonja[3] M, Mponda[4] O and Kadyampakeni[1] D

Abstract

Researchers acknowledge the importance of farmer participation in technology generation if the outcome of research is to have meaningful impact on livelihoods of small-scale farmers. The Mother-Baby approach is a concept that can be used to increase farmer participation in variety evaluation. The approach helps to generate data on performance of alternative technologies, provides a platform for researcher-farmer dialogue to refine the options being tested, and encourages farmer experimentation even in the absence of researchers. Through studies in Zimbabwe and other experiences, this paper demonstrates the usefulness of the Mother baby approach as a good communication and learning tool to generate swift results; that spontaneous adoption begins during experimentation and that specific targeting of resource-poor households during selection of host farmers results in a broader set of technologies. Five key lessons from the approach are highlighted.

Introduction

To increase farmer participation in variety evaluation, the Mother-Baby approach can be adopted. Mother trials (complete set of replicated trial for different technologies) can be planted at a central location under the direct supervision of a researcher. Optimal conditions are followed, including recommended practices e.g. fertilizer rates and cultural practices. Both researchers and farmers can evaluate the mother trials using the same methodology as that adopted on research stations. This involves taking farmers around the whole trial to get a feel for the project, then later dividing the farmers into small groups, and taking each group (of five or less), around the trial, giving each farmer the opportunity to give a score for each treatment, using a simple 1 to 5 score (1=very poor, 2=poor, 3=average, 4=good and 5=very good). Farmers are

[1] ICRISAT, P O Box 1096, Lilongwe, Malawi. E-mail: e.monyo@cgiar.org, m.osiru@cgiar.org, and icrisat-malawi@malawi.net,

[2] IITA, Box Lilongwe, Malawi,

[3] ICRISAT, P O Box 39063, Nairobi, Kenya, m.mgonja@cgiar.org

[4] Naliendele Research Institute, Box 509, Mtwara, Tanzania. omarimponda@hotmail.com.

also given an opportunity to judge each treatment in its entirety and select the best including comments on the whole exercise and providing suggestions for further improvement.

A village close to each of the mother trial sites is selected for baby (satellite) trials. Farmers in the village are asked to select 10 participants from among themselves to evaluate a subset of the treatments in the mother trial. The purpose of the baby trials is to enable individual farmers to evaluate a particular treatment (subset of the Mother trial) in their own gardens. Hence, baby trials are kept simple to enable farmer observation. For crop variety evaluations, each of the selected participants is given enough seed to grow agreed plots of four (for example) new varieties under evaluation (part of the mother trial) ensuring that each variety is grown at least by two farmers in the village. The four varieties are chosen at random using an alpha lattice design with blocks of four, and each of these blocks of four varieties given to one or more farmers. Furthermore, farmers are given a standard check, and advised to plant an additional plot of their own local variety. The checks are replicated twice, implying that most farmers will have eight plots of which four are new varieties. Farmers are advised to manage the plots equally. Essentially, all the varieties in the mother trial are evaluated, and the same randomization process used, except that, this is done by different farmers.

By facilitating hands on experience for farmers, the mother and baby trials provide a rapid approach to screen a large number of varieties with farmer participation.

Scaling-up improved technologies

Many researchers now acknowledge the importance of farmer participation in research if the outcome of research is to have any meaningful impact in the farmers' livelihoods (Ashby et al., 1987, Chambers et al., 1989,Sperling, L. 1992, Sperling L, Loevinsohn ME and Ntabomvura B 1993, Sperling l and Berkonitz P 1994; Monyo *et al.*, 2004). In the past, research has been unable to ensure dissemination of research results due to use of linear models for research-extension-farmer engagement. The mother-baby approach (Snapp, 2002), serves multiple functions: It helps generate data on performance of alternative technologies, provides a platform for researcher-farmer dialogue to refine the options being tested, and encourages farmer experimentation even in the absence of researchers. The approach can therefore be used as an important tool in improving adoption of technologies across smallholder farms while at the same time providing information that can be used to influence policy at higher levels.

Research in Zimbabwe has demonstrated that farmer innovation and participation in research is critical in developing viable solutions for soil and nutrient management with potential for expansion to crop water productivity. On crop water and fertility technologies – Rusike *et al.,* 2003 identified the following as outcomes from Mother-Baby Trials:

1. Mother-Baby trials linked to FFS is a good communication and learning tool and generates swift results

Farmer participation using these approaches results in the generation of a broader range of technologies that are scientifically sound, practical, and adoptable, with significant potential for improving farming methods, yields, and household food security. Farmers give feedback on technologies that they find most useful (with honest assessments), and even advise researchers on how to improve their methods.

2. Spontaneous adoption begins during experimentation.

Through the hands-on approach, farmers are provided an opportunity and are encouraged to experiment and gain confidence to apply new technologies, not only on trial plots but on their main fields. Group experimentation, evaluation and decision-making, result in faster learning and adoption compared to individual experimentation and assessment. Farmers are more likely to sustainably utilize the new technology and innovation.

3. Mother –baby trials can be used to target the most 'needy' farmers

If the participation in trials (choice of host farmers) is based purely on who volunteers, it will result in sampling bias and factor biasing of the technology options. The trials will mostly benefit farmers who can afford to buy hybrid seeds and fertilizers and have livestock, implements and carts to transport manure. In contrast, specifically targeting resource-poor households during selection of host farmers results in a broader set of technologies.

Conclusions and Lessons from FFS linked Mother-Baby Trials

Five key lessons emerged from this approach

1. High quality information can be collected from well-designed on-farm trials using this approach. The quality of data is often comparable to that from an on-station trial while maintaining farmer hands-on experience. The Mother-baby approach allows for the evaluation of more plots, more intensely, rather than larger plots less intensely. This enables sampling of more environments at a lower cost.

2. The allocation of technologies to different households is empirically observable and can be used to predict adoption potential and target these technologies accurately in new areas through farmer knowledge
3. The approach encourages farmers to experiment, and they rapidly gain the experience and confidence to use the technologies in their own fields even after the trials are completed
4. Farmers conduct adaptive research that can be used for moving from process research at the plot level, to analysis at the whole-farm, landscape and watershed levels, in order to define adoption boundaries and scale out technologies
5. The approach leads to joint researcher-extension learning, feedback, and changes in practice by both groups. This helps improve the efficiency of research and extension, improves accountability and results in greater impact

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Discussion

Kapewa: At what stage is it recommended to incorporate farmers' views and/or perceptions in the Farmer Field School (FFS)/ Mother Baby Trial/Participatory Breeding Approach?

Mponda: If the selection of varieties to enter Mother Baby Trials is done by a breeder alone ,there is a possibility of excluding varieties that are promising from the farmers' point of view. Involvement of farmers should start as early as possible in the breeding process even prior to making crosses.

Kapito: Is it possible for the Seed Services Section at Chitedze to provide a list of farmers with certified seed?

Kaudzu: This is possible. However, NASFAM needs to consult the Seed Services Section for such details.

Kafiriti: Will farmers be given the treatments? Is it necessary to have one variety per farmer?

Monyo: Three or four varieties can be given per farmer as long as it is a comparison of treatments. The key is not to confuse the farmer.

NASFAM organizational structure as a vehicle for technology dissemination to smallholder farmers

Chinyamunyamu[1] B

Abstract

The National Smallholder Farmers' Association of Malawi (NASFAM), the largest smallholder farmers' association in Malawi is involved in the promotion and marketing of various cash crops such as chillies, groundnuts, cotton, rice, soya, paprika, tobacco and beans. NASFAM engages itself in training and capacity building, business and institutional development, crop production and technical support, community development programs as well as in monitoring and evaluation of programs, information and communications. In partnership with stakeholders such as research institutions and seed companies, NASFAM conducts field days and on-farm demonstrations to disseminate agricultural technologies. Information and communication programs include radio programs, publications and field extension services. Field extension activities are led by the Farm Services Department at National Level. This paper provides insights into NASFAMs organizational structure and implications for technology dissemination.

Introduction

The National Smallholder Farmers' Association of Malawi (NASFAM) is the largest smallholder farmers' association in Malawi. The organization, through 38 associations operates in 15 of the 29 districts in Malawi. Membership is at an all time high of 108,000 individual registered members. NASFAM is involved in promotion and marketing of various cash crops such as chilli, groundnut, cotton, rice, soya, paprika, tobacco and beans. Selection of cash crop is based on regional importance and production.

The vision of NASFAM is 'to be the leading smallholder-owned business and development organization in Malawi that promotes farming as a business, producing economic and social benefits for its members, their communities and the country'. The mission of NASFAM therefore is 'to improve the lives of smallholder farmers'. Through a sustainable network of smallholder-owned business organizations, NASFAM develops the commercial capacity of its members and delivers program that enhance their productivity.

[1] Director, NASFAM Development,NASFAM. P.O. Box 30716, Lilongwe 3, Malawi.
E-mail: chinyamunyamu@nasfam.org.

NASFAM development methodologies

NASFAM has nine core development methodologies namely: working with motivated farmers; encouraging a spirit of volunteerism; promoting 'farming as a business'; promoting economies of scale; developing linkages with service providers; on-site technical assistance; common bond – area, crops, problems; strengthening marketing systems & reducing crop constraints; and building farmer capacity

Organisational structure: NASFAM works with its associations to empower smallholder members by addressing issues of relevance to smallholders and rural development. NASFAM member associations jointly own the NASFAM Development Corporation (NASDEC), a not-for profit company, which provides them with access to resources, training and technical assistance. NASDEC in turn owns two subsidiaries; NASFAM Commodity Marketing Exchange (NASCOMEX), which houses the revenue-generating private sector business and marketing services and NASFAM Centre for Development Support (NASCENT). NASCENT provides "soft" services such as information services, policy advocacy and outreach, HIV/AIDS, gender and other cross-cutting issues. Training services are implemented under the NASFAM Training and Development Institute (NTDI).

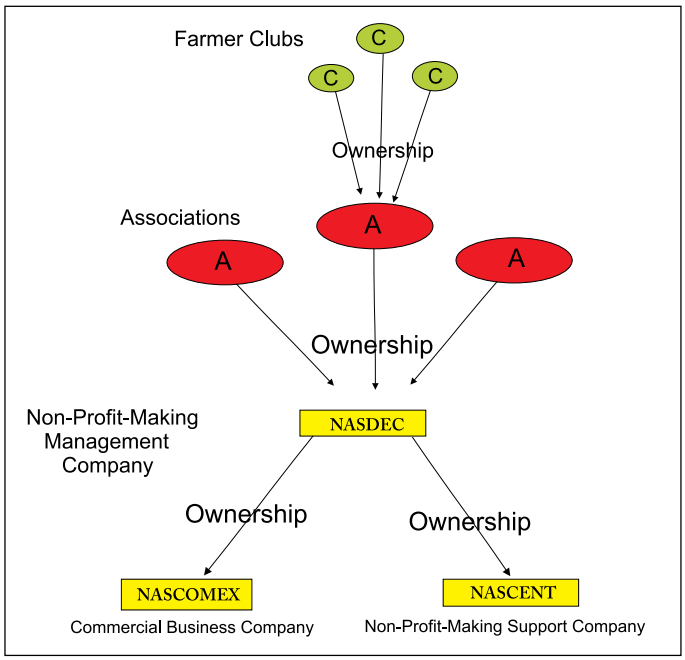

Figure 1. NASFAM ownership structure.

Governance

NASDEC is governed by twelve directors that comprise its Board. Of the twelve, eight are elected by the NASFAM associations while four are selected on basis of technical merit. NASCOMEX and NASCENT each run under advisory councils, with membership also drawn from a cross-section of stakeholders to provide guidance.

NASFAM Commercial Programs

NASFAM Commercial Programs have been strengthened by the increase in NASFAM membership,(Figure 2) its spread across the country and level of empowerment of the smallholder farmers (Figure 3). Membership has consistently grown from 2,200 individuals in 1995, 85,000 in 2001 to over 100,000 in 2004.

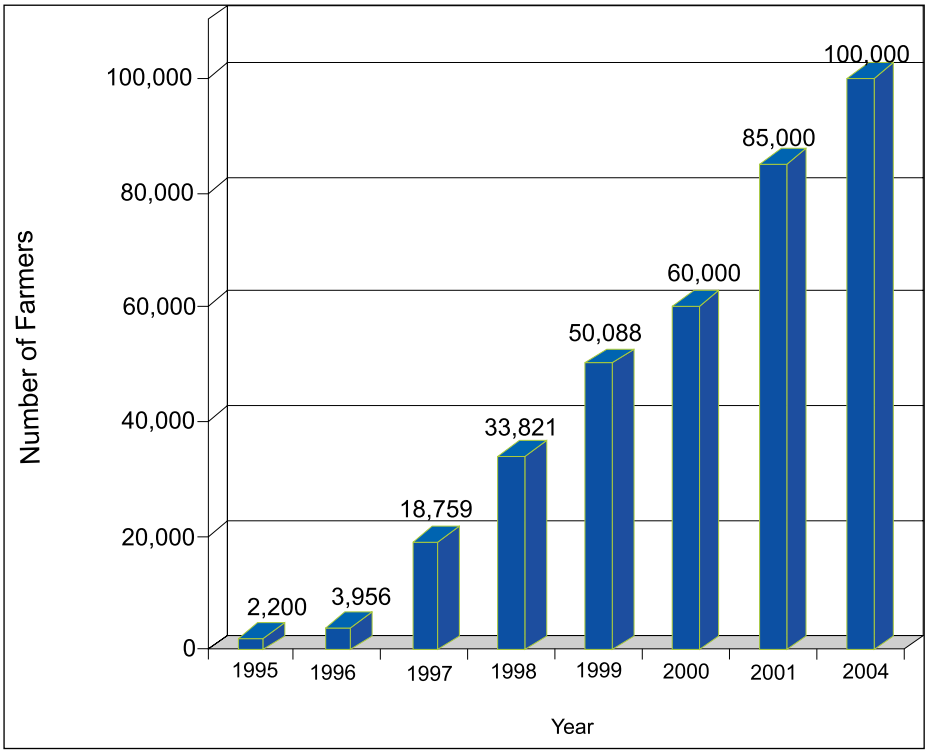

Figure 2. NASFAM Membership 1995-2004.

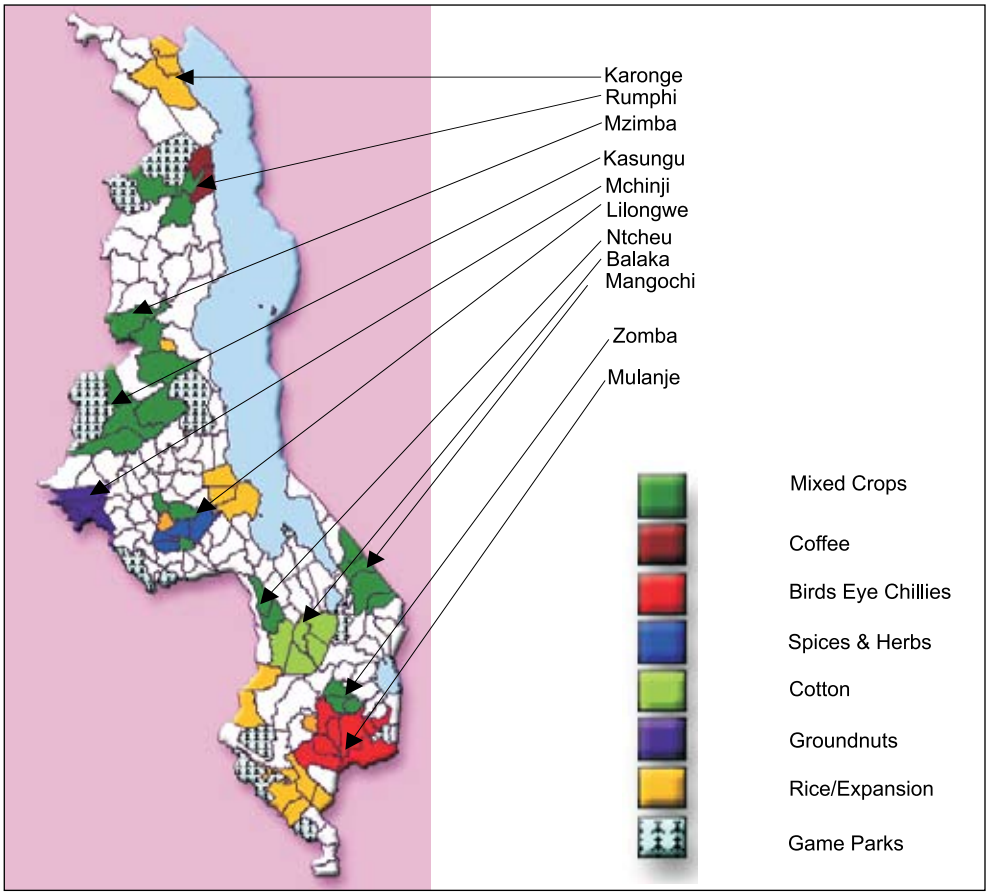

Figure 3. Districts where NASFAM works and crops in focus.

NASFAM Development Programs

NASFAM engages itself in training and capacity building, business and institutional development, crop production and technical support; and community development programs

Figure 6. NASFAM community development initiatives.

NASFAM is involved in monitoring and evaluation of programs, information and communications, and Policy and Programs. NASFAM serves as the channel for technology dissemination. NASFAM has linkages with stakeholders including research institutions such as International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Agricultural Research and Extension Trust (ARET). In partnership with stakeholders such as research institutions and seed companies, NASFAM conducts field days and on-farm demonstrations to disseminate agricultural technologies. Information and communication programs include radio programs, publications and field extension services. NASFAM also has its own radio program on national radio, which reaches all parts of the country twice a week for 30 minutes in each of the local languages. Experts are involved in the radio program when necessary. Publications include a quarterly newsletter for all member clubs (currently over 6000) and crop specific bulletins. NASFAM distributes brochures to its members from other institutions e.g. ARET.

Field extension activities are led by the Farm Services Department at National Level. The department is involved in program design, coordination and monitoring, training of trainers (for regional and association extension staff). Farm Services Officers – regional and district level engage in Program implementation at regional level; and training and monitoring of Association Field Officers (AFOs). AFOs are front line extension workers who train farmer members, and train and monitor farmer trainers. Farmer trainers engage in a program called 'Farmer to Farmer Training Program'. Farmer trainers are selected to train fellow farmers and this facilitates easier adoption of technology etc. These are equipped with basic technical information on production and other resources and they reach out to 50 to 200 farmers. Their farms are used as model farms and ease the burden of AFOs. This serves as motivation to farmers to improve their production.

Discussion

Mponda: What are the incentives for lead farmers who train their fellow farmers? How will NASFAM sustain its activities? How is budgeting of NASFAM done since their operations are done countrywide? How does NASFAM work in collaboration with government extension? Does NASFAM have a membership fee and what is the membership like?

Chinyamunyamu: Incentives for lead farmers are peer recognition among the farmers; resource incentives are put in place as well whereby the farmers travel to appreciate work of their colleagues. In addition, protective clothing and bicycles are provided to these lead farmers as a way of motivating them.

Sustainability is a key challenge to NASFAM, since NASFAM started as a project funded by United Agency for International Development (USAID) but later on developed into an association so as to have a local institution that can sustain itself even if funding may not be available. Later on NASFAM developed a commercial arm for better delivery of services.

NASFAM annual budget is approximately 3 million dollars and this is approved at the NASFAM national assembly. Government experts are consulted at local level depending on the project at hand eg HIV/AIDS project and food security. NASFAM field workers work with Agricultural Extension Development Officers (AEDOs), Agricultural Extension Development Coordinators (AEDCs), and District Agricultural Development Officers (DADOs).

Membership fee is paid annually and contributes little to the overall budget. Over the years the membership has gradually increased due to NASFAM outreach program.

Kafiriti: What impact does NASFAM have on the ground?

Chinyamunyamu: Impact assessment is done annually. There are sets of indicators, which are used; there is also a control sample from non-members. Some of the aspects taken into consideration are food security, assets, housing and marketing.

Kamalia: What type of company is NASFAM? Are their profits taxed?

Chinyamunyamu: It is limited and it pays taxes. Profits to be used for development will not be taxed. Taxation will be a future issue otherwise NASFAM provides an income base for smallholders.

Charlie: What mechanisms are put in place to ensure that farmers within your associations sell their produce through the associations and not to traders who may come with tempting offers?

Chinyamunyamu: We are trying to work on this otherwise we can't force the farmers. We hope that the farmers will recognize the benefit that they realize from NASFAM and take ownership of the organization. As of now no formal mechanism has been put it place to verify if farmers are selling their produce through other channels other than the Associations.

Project Monitoring and Evaluation Strategy

Nankhumwa[1] Candida

Abstract

Participatory monitoring and evaluation is an approach that enables all key stakeholders involved in a programme, project or activity such as NGOs, community based organisations, farmers etc to participate in monitoring and evaluating the action. The overall objective of the McKnight Foundation ICRISAT-NASFAM Groundnut Breeding Project is reduction of poverty and improvement of food and nutrition security among smallholder farm families through development of short and medium-duration groundnut varieties with improved yield performance, acceptable market traits and resistance to foliar diseases. Based on information collected before and immediately after project interventions, it is possible to analyse how successful a project has been based on impacts and intended goals. This paper provides insights into how project effectiveness will be measured.

Introduction

Monitoring and evaluation is critical to assess efficiency and effectiveness of any program. Participatory monitoring and evaluation is an approach that enables all key stakeholders involved in a particular programme, project or activity such as NGOs, community based organisations, farmers etc to participate in monitoring and evaluating the action. Participation includes decisions on what results should be measured and how and importantly, what actions should be taken based on information that has been analysed subsequent to collection. Data can be collected with use of a wide range of tools including semi-structured interviewing, use of open and/or close-ended questions, structured questionnaires, focused discussion groups etc. Based on the information collected before the activity (baseline) and immediately after inferences can be made about the project effectiveness.

Baseline surveys can be conducted to establish benchmarks on the situation before intervention on which to base project progress or impact. This allows a measure of change, attribution of impact and lesson-learning. The baseline information can also be used for ex-ante and ex-post impact assessments. The information is needed to attribute impact of interventions by assessing 'before and after' and the 'with and without' intervention. The following section provides information about the project targets.

[1] NASFAM, P.O. Box 30716, Lilongwe 3, Malawi. E-mail: cnakhumwa@nasfam.org.

Project goal, objectives and outputs

Overall objective

The overall objective of the McKnight Foundation ICRISAT-NASFAM Groundnut Breeding Project is reduction of poverty and improvement of food and nutrition security among smallholder farm families through development of short- and medium-duration groundnut varieties with improved yield performance, acceptable market traits and resistance to foliar diseases.

Project major outputs

The major outputs from the project are:

1. Development of high yielding farmer and market-acceptable short- and medium-duration groundnut varieties with resistance to foliar diseases
2. Enhancement of adoption rates of improved farmer- and market-acceptable varieties and production technologies,
3. Increased groundnut productivity.

Expected outcomes and potential impact

The project is expected to make the following impacts:

1. Improved technical knowledge of partners
2. Increased adoption of new improved high yielding varieties leading to increased productivity and hence food and nutrition security
3. Improved awareness and adoption of aflatoxin reducing technologies by smallholder farmers
4. Knowledge gains for farmers (good farming techniques, seed production, etc)

Indicators

The project performance will be measured through the following indicators:

1. Number of trainings undertaken
2. Number of improved varieties released
3. Increase in on-farm productivity
4. Increase in the proportion of households including groundnut in their main meals
5. Significant reduction in the proportion of aflatoxin contaminated groundnut samples from target districts
6. Households that have marketable surplus

7. Increased area under production i.e. evidence that smallholder farmers are putting more land to groundnut production

Baseline study

Baseline studies and benchmark indicators can provide the basis for the M&E process. A baseline study will be conducted to determine and document the starting point of the project. Tools to be used include household questionnaires, checklists for focused group discussions and interviews with key informants. Time series information on some aspects to be collected using pre-designed record sheets will also be used. Factors to be assessed include: socio-economic issues, markets, institutional support, food and nutrition security, crop production and post-harvest technologies

Plans for analysing impacts

Monitoring and evaluation (M&E) program was built into project design, and progress in all activities will be regularly monitored in comparison with pre-determined milestones. Quarterly and annual progress reports will be written to give highlights of activities in the project.

The following impact indicators will be pursued:

a) Increased productivity on farm (area under production as well as levels of production, i.e. yield. At least 30% increase in area under groundnut production is projected).
b) Improved nutrition and health: At least 30% increase in consumption of groundnuts.
c) Income growth: Increased productivity of groundnuts leading to marketable surplus. At least 30% of households are projected to have marketable surplus.

Conclusions and Recommendations

The stakeholder workshop deliberated on various issues over the two days and involved relevant stakeholders from Malawi and Tanzania involved in the project. Based on discussions and issues raised, the meeting agreed on the following recommendations:

Recommendation 1

Seed systems are a major limitation to the improvement of groundnut productivity in Malawi and Tanzania. There is need to strengthen existing seed

systems and better tailor them to suit the needs and requirements of small farm holders. Such an evolution should provide farmers with increased incentives to produce and use quality seed and must include strengthening of aspects along the entire production to marketing chain. Additionally, there is a need for a mechanism to improve harmony between the informal (local) and formal seed systems that will ensure that the cost of quality seed is reduced. In this regard, participants also suggested that:

a. The public sector departments with mandate for overseeing seed technology and seed service provision, should design actions that would result in reduced seed inspection charges. One such mechanism could be, by merging inspection exercises in such a way that many farmers fields areassessed at once, and thus benefit from economies of scale. Alternatively, delegation of 'accreditation' functions, to credible institutions could be explored.
b. Seed inspection services should be decentralized to sub-research stations, Agricultural Development Divisions (ADDs) or District Agriculture Offices to better reach their clients.
c. Seed inspectors at District Agriculture Offices need proper training.
d. The government policy regarding certification of seed as quality declared seed should be revisited so that availability of quality seed can be improved.

Recommendation 2

Breeding efforts to improve host resistance to important foliar diseases (early leaf spot, groundnut rosette disease) and aflatoxin comtamination in cultivated groundnut should be increased. These technologies offer practical avenues to improving productivity of groundnut in both countries, where it may not always be possible to increase land under groundnut. Varieties resistant against foliar diseases continue to reduce yield loss in groundnuts fields.

Recommendation 3

Aflatoxin contamination is a critical issue for the marketing of groundnuts in both Malawi and Tanzania. Participants noted that there is need for improving awareness of all stakeholders from farmers to policy makers. This could be through sensitization meetings among other avenues. However, while such initiatives will be important towards improving the marketing of groundnuts, the more significant internal markets for groundnuts should not be ignored. The meeting noted that other initiatives are required to allow further exploration of the complex interactions between the aflatoxin problems and human health.

Recommendation 4

Groundnut yields at farmer level in Tanzania and Malawi are shockingly low. The average yield under farmers farming circumstances is around 400 kg/ha (Tanzania) and 700kg ha^{-1} (Malawi), compared to reported yields of up to 4000 kg ha^{-1} under good management. Urgent steps are required to make available disease resistant, market preferred varieties to smallholder farmers and to ensure sustainable access to seed of these varieties.

Recommendation 5

Future research on this project and others should ensure full participation of end-users (i.e. farmers) in the research process. There is a possibility of excluding varieties that are promising from the farmers' point of view, if the selections of varieties for evaluations i.e. in Mother Baby Trials, and in demonstrations, are chosen by researchers alone. Involvement of farmers should commence early in the breeding process prior to crossing of parents. This calls for better grasp and utilization of participatory research techniques.

Closing remarks by the private sector representative

Kamalia[1] S

Mr Kamalia S speaking on behalf of Tanzania's delegation thanked the McKnight Foundation for sponsoring the delegates to attend the Stakeholders' Workshop that provided a forum for exchange of ideas. He appealed to the Workshop organizers to take advantage of this as a beginning of a long-term relationship between Malawi and Tanzania. He thanked all the participants and the hotel staff for being very friendly during the period of the workshop and expressed his hope that the project will be implemented according to the set goals.

Closing Remarks by the Project Leader

Monyo[2] E

In his concluding remarks, the Project Leader Dr Emmanuel Monyo thanked Mr Kamalia for showing a spirit of solidarity in attending the workshop and representing the Private Sector in Tanzania. Additionally, he thanked the

[1] Atlas Export lid-Tanzania, P.O. Box 509, Mtwara, Tanzania. E-mail: shrikantkamalia@yahoo.co.uk

[2] ICRISAT-Malawi, Chitedze Research Station, P.O. Box 1096, Lilongwe, Malawi. E-mail: e.monyo@cgiar.org, e.monyo@malawi.net.

project team from NASFAM Head Office and District Offices from Nkhotakota and Mchinji and expressed hope that this was the beginning of a long lasting relationship between NASFAM, DARS and ICRISAT. He also thanked the National Research Scientists from Chitedze Research Station in Malawi and Naliendele Research Station in Tanzania for participating in the Workshop.

Stakeholders' Workshop Program-Malawi[7]

DAY 1: Thursday, 1 March 2007		
SESSION-TIME	**ACTIVITY**	**RESPONSIBLE**
08:00 – 09:00	Registration, logistics and review of documents	Kadyampakeni D and Charlie H,
SESSION 1	**Introductions, Workshop Context and Opening**	**Rapporteur: C. Nakhumwa**
09:00 – 09:15	Introductions	Monyo E
09:15 – 09:20	Welcome remarks-ICRISAT	Siambi M
09:20 – 09:25	Welcome remarks – NASFAM	Chinyamunyamu B – NASFAM
09:25 – 09:35	Overview of NASFAM experience in groundnut production and marketing	Warren D – NASFAM
09:35 – 09:45	Project overview and workshop objectives	Monyo E
09:45 – 10:00	Workshop official opening	Banda MHP– DARS
10:00 – 10:30	Health Break and Group Photograph	
SESSION 2	**SETTING THE SCENE: Researchable Challenges and opportunities in groundnuts for smallholder farmers**	**Rapporteur: D Kadyampakeni**
10:30 – 11:00	Malawi	Kapewa T
11:00 – 11:30	Tanzania	Mponda O
11:30 – 12:00	Eastern and Southern Africa - A regional perspective	Monyo E
12:00 – 12:30	Sustainable intensification of groundnut production	Siambi M and Kafiriti E
12:30 – 13:00	General discussion	Facilitator: Warren D
13:00 – 14:00	Lunch Break	
SESSION 3	**SETTING THE SCENE: Tools, Methods and Approaches for Project Implementation**	**Rapporteur: E. Sichone**
14:00 – 14:15	Mother and baby trials for technology targeting and scaling up/out	Monyo E
14:15 – 14:30	Farmer field schools for technology targeting, and scaling up/ out	Monyo E
14:30 – 14:45	Farmer responsive seed/input supply strategies – the Malawi experience	Kaudzu G
14:45 – 15:00	General discussions	Facilitator: Warren D
15:00 – 15:20	NASFAM organizational structure – as a vehicle for technology dissemination to smallholder farmers	Chinyamunyamu B / Warren D

SESSION-TIME	ACTIVITY	RESPONSIBLE
15:20 – 15:30	General discussions	Facilitator: Warren D
15:30 – 15:45	Health Break	
SESSION 4	**SETTING THE SCENE: cont. Tools, Methods and Approaches for Project Implementation**	**Rapporteur: H Charlie**
15:45 – 16:05	Stimulating development of producer research networks and linking smallholder farmers to markets	Siambi M
16:05 – 16:20	Project budget, work plan format and budgeting	Monyo E
16:20 – 16:45	General discussions and group assignments (end of day 1)	Facilitator: Warren D
DAY 2: Friday, 2 March 2007		
08:30 – 09:00	Project monitoring and evaluation strategy	Nakhumwa C
SESSION 5	**Working Groups**	
09:00 – 13:00	Working groups review and agree on project work plans Discussion and agreement on the constraints and available opportunities /sufficiency analyses to ensure congruence with project goal, objectives, outputs & ratify work plans for 2006/07	Facilitator: Warren D Working Group Chairpersons, Rapporteurs, Facilitator
13:00 – 14:00	Lunch Break	
SESSION 6	**Plenary groups presentations and discussions:**	**Rapporteur: Chinyamunyamu B**
14:00 – 14:30	Plenary (Group 1) Presentations: discussions and agreement on constraints, available opportunities, site selection and country work plans	Working Group Rapporteurs and Facilitator
14:30 – 15:00	Plenary (Group 2) Presentations: Discussions and agreement on constraints, available opportunities site selection and country work plans	"
15:00 – 15:30	General discussion on group presentations	Facilitator
15:30 – 15:45	Health Break	
SESSION 7	**Agreements**	**Rapporteur: Nakhumwa C**
15:45 – 15:55	Brief discussion and agreement on the criteria and process for/and selection of project sites in the two countries	Facilitator
15:55 – 16:05	Brief discussion and agreement on work plans: activity timing, assignment of responsibilities, and implementation schedule	Facilitator
16:05 – 16:15	Brief discussion and agreement on project management, internal project monitoring, reporting, dissemination	Facilitator
16:15 – 16:30	Workshop synthesis, issues and way forward	Facilitator
16:30 – 16:45	Workshop closing remarks	TBA

[7] 1-2 March, 2007, Lilongwe, Malawi.

Stakeholders' Workshop Program-Tanzania[8]

SESSION- TIME	ACTIVITIES	RESPONSIBLE
08:30 09:30	Registration, Logistics	Mkandawile, Nzunda, Shayo
Session I	**Introduction of Opening Remarks**	**Repporteur: G Mkamilo R Bashiru**
09:30 – 09:35	Welcome Remarks	Kafirit E
09:35 – 09:50	Introduction	Kafiriti E
09:50 – 10:10	Workshop Official Opening remarks	Dr Shomari SH Zonal Director for Research and Training (Southern Zone)
10:10 – 10:40	Smokers' Break	All
Session II	**Chairperson: Dr Kasuga**	**Rapporteurs: Mkamilo G S & Bashiru R**
10:40 – 11:10	Project Overview	Monyo E
11:10 – 11:40	Groundnut Research in Tanzania:Achievements and tasks ahead.	Kafiriti EM
11:40 – 12:00	Challenges in groundnut production from the Extension perspectives	DALDO DodomaDALDO Masasi
12:00 – 12:30	Discussion	
12:30 – 14:00	Lunch Break	
Session III	**Chairperson:**	**Rapporteurs: Mkamilo G & Bashiru R**
14:00 – 14:30	Setting the baseline in Malawi or Impact Monitoring	Candida
14:30 – 15:00	Groundnut production and marketing in Malawi	Warren D
15:00 – 15:15	Discussion	
15:15 – 15:30	Smokers' Break	All
15:30 – 16:00	Workshop synthesis and main issues	MkamiloBashiru MR
16:00 – 16:15	Closing Remarks	Sendeu D Principal MATI

[8] 13 April 2007, NARI Conference Hall, Mtwara.

PARTICIPANTS OF THE McKNIGHT GROUNDNUT PROJECT INCEPTION WORKSHOP HELD ON 1 - 2 MARCH, 2007 AT THE KOREA GARDEN HOTEL – LILONGWE, MALAWI

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Malawi

Harvey Charlie,
Scientific Officer (Plant Breeding),
ICRISAT Malawi,
P.O. Box 1096, Lilongwe, Malawi.
Tel: +265 1 707067/57
Mob: +265 (0) 9 346 186,
E-mail: h2charlie@yahoo.com

Ms Ethel Chilumpha,
Senior Research Technician,
ICRISAT Malawi,
P.O. Box 1096, Lilongwe, Malawi.
Tel: +265 1 707067/57
Mob: +265 (0) 9 317 273,
E-mail: saiwe2002@yahoo.co.uk

Davie Kadyampakeni,
Scientific Officer (Participatory Plant Breeding), ICRISAT Malawi,
P.O. Box 1096, Lilongwe, Malawi.
Tel: +265 1 707067/57
Mob: +265 (0) 9 226 149,
E-mail: dakadyampakeni@yahoo.com

Dr. Emmanuel S. Monyo,
Principal Scientist (Plant Breeding),
ICRISAT Malawi,
P.O. Box 1096, Lilongwe, Malawi.
Tel: +265 1 707067/57
E-mail: e.monyo@cgiar.org

Dr Moses Siambi,
Country Representative,
ICRISAT Malawi,
P.O. Box 1096, Lilongwe, Malawi.
Tel: +265 1 707067/57
Mob: +265 (0) 8201697,
E-mail: m.siambi@cgiar.org

National Smallholder Farmers' Association of Malawi (NASFAM), Malawi

Ms Betty Chinyamunyamu,
Director of NASFAM Development Programs,
NASFAM Head Office,
P.O. Box 30716, Lilongwe 3, Malawi.
Tel: +265 (0) 1 772 866,
E-mail: bchinyamunyamu@nasfam.org

Humphreys Kapito,
Manager,
NASFAM Mchinji District Office,
P/Bag 44 Magawa, Malawi.
Tel: +265 (0) 9 586 115,
E-mail: kapitohkapito@yahoo.com

Wilfred Mangasao,
Association Field Officer
NASFAM Nkhotakota District Office,
P.O. Box 96 Nkhotakota, Malawi.
Tel: +265 (0) 9 431 714

Lazarus Mangazi,
Manager,
NASFAM Nkhotakota District Office,
P.O. Box 96 Nkhotakota, Malawi.
Tel: +265 (0) 9 956 989

Ms Eunice Mhango,
Association Field Officer,
NASFAM Mchinji District Office,
P/Bag 44 Magawa, Malawi.
Tel: +265 (0) 9 361 652

Ms Candida Nankhumwa,
Monitoring, Evaluation and Communications Manager,
NASFAM Head Office,
P.O. Box 30716, Lilongwe 3, Malawi.
Tel: +265 (0) 9 405 861,
E-mail: cnakhumwa@nasfam.org

Samu D.T. Phiri,
Senior Research Technician,
NASFAM,
P.O. Box 30716, Lilongwe 3, Malawi.
Tel: +265 1 707067/57
Tel: +265 (0) 9 153 225,
E-mail: samudickson@yahoo.com

Duncan Warren,
Director of Farmer Services,
NASFAM Head Office,
P.O. Box 30716, Lilongwe 3, Malawi.
Tel: +265 (0) 7 772 866/
+265 (0) 9 969 229,
E-mail: dwarren@nasfam.org

Department of Agricultural Research Services, Malawi

Dr Mackson H.P Banda,
Deputy Director, Department of Agricultural Research Services,
Ministry of Agriculture and Food Security, P.O. Box 30779, Lilongwe 3, Malawi.
Tel: +265 (0) 1 707 363/
+265 (0) 9 945 329,
E-mail: bandamackson@yahoo.com

Tobias Kapewa,
Chief Groundnut Breeder
Chitedze Research Station,
P.O. Box 158, Lilongwe, Malawi.
Tel: +265 (0) 8 855 864,
E-mail: groundnut@malawi.net

Ms Grace Kaudzu,
Agricultural Research Scientist,
Chitedze Research Station,
P.O. Box 158, Lilongwe, Malawi.
Tel : +265 (0) 9 350 512,
E-mail: grace_lameck@yahoo.co.uk

Department of Agricultural Extension and Technical Services, Malawi

Ms Pauline Chioko,
Crops Officer,
Mchinji District Agriculture Office,
P.O. Box 7, Mchinji, Malawi.
Tel: +265 (0) 9 342 426

Elia G. Yamikani,
District Agriculture Development Officer
Nkhotakota District Agriculture Office,
P.O. Box 41 Nkhotakota, Malawi.
Tel: +265 (0) 1 292 317/
+265 (0) 8 344 945

Directorate of Research and Training, Tanzania

Dr Elly Kafiriti,
Principal Agronomist,
Directorate of Research and Training,
Naliendele Agricultural Research Institute,
10 km Peg Newala Rd, P.O. Box 509, Mtwara, Tanzania.
Tel: + 255-784 809 938,
E-mail: ellykafiriti@yahoo.com, kafiriti@hotmail.com

Dr Omari Mponda,
Principal Plant Breeder
Directorate of Research and Training,
Naliendele Agricultural Research Institute,
10 km Peg Newala Rd, P.O. Box 509, Mtwara, Tanzania.
Tel: + 255-784 471 813,
E-mail: omarimponda@hotmail.com

Private Sector, Tanzania

Shrikant Kamalia,
Private Trader,
Atlas Export lid-Tanzania,
P.O. Box 509, Mtwara, Tanzania.
Tel: + 255-784 471 813,
E-mail: shrikantkamalia@yahoo.co.uk

PARTICIPANTS OF THE McKNIGHT GROUNDNUT PROJECT INCEPTION WORKSHOP HELD ON 13 APRIL, 2007 AT NALIENDELE AGRICULTURAL RESEARCH INSTITUTE IN MTWARA - TANZANIA

Dr Shomari Shamte H
Zonal Director for Research and Training
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara - TANZANIA
Tel: ++255(073) 293 4035
E-mail: shshomari@yahoo.co.uk

Thelesia Mkufya
Extension Officer
PO Box 832, Dodoma – TANZANIA

Marcel Mtei
Extension Officer
PO Box 832, Dodoma – TANZANIA
Tel: ++255(713) 426946
E-mail: tulligo@yahoo.co.uk

Andrew Mpangala
Extension Officer
PO Box 23, Masasi – TANZANIA

Frank Kwingwa
Extension Officer
PO Box 23, Masasi – TANZANIA

Lazaro Sebarua
Village Extension Officer
Mnanje Village
PO Box 23, Masasi – TANZANIA

Ms. Mwajuma Ally
Groundnut Farmer
Mnanje Village
PO Box 23, Masasi – TANZANIA

Danford Evans
Groundnut Farmer
Mnanje Village
PO Box 23, Masasi – TANZANIA

Ms. Zawabu Selemani
Groundnut Farmer
Mnanje Village
PO Box 23, Masasi – TANZANIA

Rajabu Mpatia
Groundnut Farmer
Mnanje Village
PO Box 23, Masasi – TANZANIA

Hebron Mwizwa
Village Extension Officer
Mpeta Village
PO Box 23, Masasi – TANZANIA

Matayo Millanzi
Groundnut Farmer
Mpeta Village
PO Box 23, Masasi – TANZANIA

Ms. Shabira Musa
Groundnut Farmer
Mpeta Village
PO Box 23, Masasi – TANZANIA

Kassim Issa
Groundnut Farmer
Mpeta Village
PO Box 23, Masasi – TANZANIA

Dr. Emmanuel S. Monyo,
Principal Scientist (Plant Breeding),
ICRISAT Malawi,
P.O. Box 1096, Lilongwe, Malawi.
Tel: +265 1 707067/57
E-mail: e.monyo@cgiar.org

Duncan Warren,
Director of Farmer Services,
NASFAM Head Office,
P.O. Box 30716, Lilongwe 3, Malawi.
Tel: +265 (1) 772 866/ +265 (0) 9 969 229,
E-mail: dwarren@nasfam.org

Ms Candida Nankhumwa,
Monitoring, Evaluation and Communications Manager,
NASFAM Head Office,
P.O. Box 30716, Lilongwe 3, Malawi.
Tel: +265 (0) 9 405 861,
E-mail: cnakhumwa@nasfam.org

Dr. Geofrey Mkamilo
Principal Research Officer
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara - TANZANIA
Tel: +255(073) 293 4035
E-mail: gsmkamilo@hotmail.com

Dr. Mark Sijaona
Principal Research Officer
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara – TANZANIA
Tel: +255(073) 293 4035
E-mail: sijaona@hotmail.com

Abel Mtambuki
Principal Research Officer
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara – TANZANIA
Tel: +255(073) 293 4035
E-mail: mtambuki@hotmail.com

Ms. Joane Kasuga
Principal Field Officer
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara – TANZANIA

Charles Mkandawile
Principal Field Officer
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara – TANZANIA

Ms. Jackline Shayo
Principal Field Officer
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara – TANZANIA

Joseph Nzunda
Field Officer
Naliendele Agricultural Research Institute
10 km Peg Newala Rd
PO Box 509, Mtwara – TANZANIA

Dunstan Sendeu
Principal Training Officer
Ministry of Agriculture Training Institute
PO Box 121, Mtwara – TANZANIA

Kaleb Chomola
Diocese of Central Tanzania
PO Box 15, Dodoma – TANZANIA
dctdevelopco@gmail.com
Tel +255 0755096440

Example for Workplan Development (Baseline Workplan)

Title: Socio economic baseline surveys of farming systems and livelihoods, markets and institutions in Malawi and Tanzania

Objectives

1. Establish farmers' knowledge, levels of adoption and constraints to uptake of improved groundnut production and post-harvest technologies
2. Establish farmers' participation in input and output markets and access to credit, extension, market information and social networks
3. Establish productivity and production of groundnuts in Malawi
4. Establish livelihood assets (financial, physical, social, natural and human)
5. Set priorities for points of first intervention e.g. participatory adaptive trials, demonstrations; health and nutrition, markets and training

Expected Outputs

1. Farmers' knowledge established
2. Levels of adoption of groundnut technology characterised
3. Constraints to technology uptake identified
4. Farmers' involvement in input and output markets established
5. Accessibility to credit, extension, market information and social networks known.
6. Intervention priorities set.

Outputs and description

No.	Output	Activity	Location	Period
1	Farmers' knowledge established	Data collection and questionnaire development and administration, Focus Group Discussion, Interview with key informants, Secondary data collection/ Literature review, Observation, Data compilation and analysis, Reporting (writing and presentation)	Malawi:Nkhotakota and MchinjiTanzania: Dodoma and Masasi	March to September 2007
2	Levels of adoption of groundnut technology known	Data collection and questionnaire development and administration, Focus Group Discussion, Interview with key informants, Secondary data collection/ Literature review, Observation, Data compilation and analysis, Reporting (writing and presentation)	Malawi:Nkhotakota and MchinjiTanzania: Dodoma and Masasi	March to September 2007
3	Constraints to technology uptake identified	Data collection and questionnaire development and administration, Focus Group Discussion, Interview with key informants, Secondary data collection/ Literature review, Observation, Data compilation and analysis, Reporting (writing and presentation)	Malawi:Nkhotakota and MchinjiTanzania: Dodoma and Masasi	March to September 2007
4	Farmers' involvement in input and output markets established	Data collection and questionnaire development and administration, Focus Group Discussion, Interview with key informants, Secondary data collection / Literature review, Observation, Data compilation and analysis, Reporting (writing and presentation)	Malawi:Nkhotakota and MchinjiTanzania: Dodoma and Masasi	March to September 2007
5	Accessibility to credit, extension, market information and social networks known.	Data collection and questionnaire development and administration, Focus Group Discussion, Interview with key informants, Secondary data collection/ Literature review, Observation, Data compilation and analysis, Reporting (writing and presentation)	Malawi:Nkhotakota and MchinjiTanzania: Dodoma and Masasi	March to September 2007
6	Intervention priorities set.	Data collection and questionnaire development and administration, Focus Group Discussion, Interview with key informants, Secondary data collection/ Literature review, Observation, Data compilation and analysis, Reporting (writing and presentation)	Malawi:Nkhotakota and MchinjiTanzania: Dodoma and Masasi	March to September 2007

Location(s): The baseline survey will be conducted in Nkhotakota and Mchinji districts in Malawi and Dodoma and Masasi districts in Tanzania.

Period of work plan implementation: March to September, 2007

Project Team

	Name	Descriptive/Area of expertise	Institution	Time	Stakeholder group
Workplan leader	Nakhumwa[1] C	Economist	NASFAM	100%	Farmer organization
Team members	Mponda O	Breeder	DRT	50%	NARES,
	Kafiriti E	Agronomist	DRT	50%	NARES,
	Warren D	Agronomist	NASFAM	50%	Farmer organization
	Monyo E	Breeder	ICRISAT	50%	CGIAR
	Siambi M	Agronomist	ICRISAT	50%	CGIAR
	Chinyamunyamu B	Development Expert	NASFAM	50%	Farmer organization
	Osiru M	Pathologist	ICRISAT	50%	CGIAR
	Kadyampakeni D	Breeder	ICRISAT	100%	CGIAR

Stakeholders include: CGIAR, FARMER ORGANIZATIONS, NARES, EXTENSION ORGANISATIONS, TRADER(S)

Justification for work plan:

Baseline surveys will be conducted to establish benchmarks on the situation before intervention on which to base project progress or impact. This will be used to measure change, attribute impact and learn lessons. The baseline information will also be used for ex-ante and ex-post impact assessments. The information is needed to attribute impact of interventions by assessing 'before and after' and the 'with and without' intervention.

Methodology/Procedure:

Baseline surveys will collect primary and secondary data. Primary data will be collected by participatory assessment techniques and questionnaire interviews with a sample of farm households. Participatory techniques will include key informant interviews; focus group discussions using transects, resource mapping, problem analysis, institutional analysis, gender analysis, health and nutrition, income-expenditure patterns, and Participatory Action and Learning techniques such as participatory value chain analysis. The sample will constitute groundnut growers who are NASFAM members (70%) and non-

[1] Monitoring, Communications and Evaluation Manager, NASFAM, Box 30716, Lilongwe 3, Malawi.

members in Malawi (30%) and/or Farmer Research Group members (70%) and non-members (30%) in Tanzania. The sample will include a representative proportion of groundnut growers in each district where the study is conducted contingent on the availability of funds. A multi-stage cluster sampling procedure involving a combination of purposeful and random sampling procedures will be used to draw the sample. The first stage will involve purposeful selection of two districts where groundnuts are grown and the second stage will involve random selection of a representative sample of respondents for both quantitative and qualitative interviews

Activities and assignment of responsibilities

Activity	Time frame	Name of Institution responsible	Name of Staff responsible
Design questionnaire	March 2007	DRT, NASFAM	Mponda ONakhumwa C
Conduct Informal surveys and Participatory assessment using checklist, Focus Group Discussions	March, 2007	DRT, NASFAM	Mponda ONakhumwa C
Pre-test questionnaire	March, 2007	DRT, NASFAM	Mponda ONakhumwa C
Train enumerators	March, 2007	DRT, NASFAM	Mponda ONakhumwa C
Preparation of sampling frame and sample farmers for interviews	March, 2007	DRT, NASFAM	Mponda ONakhumwa C
Interview farmers	March, 2007	DRT, NASFAM	Mponda ONakhumwa C
Data entry	April, 2007	DRT, NASFAM	Mponda ONakhumwa C
Analysis and write-up of reports	April to May, 2007	DRT, NASFAM	Mponda ONakhumwa C
Report submission to stakeholders	August 2007 or September 2007	DRT, NASFAM	Mponda ONakhumwa C
Publications	September 2007	DRT, NASFAM, ICRISAT	Mponda O Nakhumwa C Monyo E

Milestones being addressed:

Baseline benchmarks on groundnut production and post-harvest technologies, socio economic, health and nutrition aspects, and markets completed (Aug 2007)

Due dates for progress reports:

Progress reports will be submitted in April 2007, June 2007 and September 2007

Expected review date:

Work on the baseline will be reviewed and a detailed report will be presented in September 2007

ABBREVIATIONS AND ACRONYMS

ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
AEDC	Agriculture Extension Development Coordinator
AEDO	Agriculture Extension Development Officer
AFO	Association Field Officer
AIDS	Acquired Immuno-Deficiency Syndrome
ARI	Advanced Research Institute
ASARECA	Association for Strengthening Agricultural Research in East and Central Africa
ASDP	Agricultural Sector Development Program
ASDS	Agricultural Sector Development Strategy
CCRP	Collaborative Crop Research Program (McKnight)
DADO	District Agricultural Development Officer
DARS	Department of Agricultural Research Services
DRT	Directorate of Research and Training
DUS	Distinct, Uniform and Stable
ELISA	Enzyme linked immunosorbent assay
EPA	Extension Planning Area
ESA	East and Southern Africa
EU	European Union
FFS	Farmer Field School
GAPEX	General Agricultural Products for Exports
GRAV	Groundnut Rosette Assistor Virus
GRD	Groundnut Rosette Disease
GRV	Groundnut Rosette Virus
GXE	Genotype by Environment Interaction
HI	Harvest Index
HIV	Human Immuno-Deficiency Virus
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics

M.A.S.L.	Meters Above Mean Sea Level
M&E	Monitoring and Evaluation
MT	Metric Tonnes
NARES	National Agricultural Research and Extension System
NARI	Naliendele Agricultural Research Institute, Tanzania
NARS	National Agricultural Research System
NASFAM	National Smallholder Farmers' Association of Malawi
NGO	Non-Governmental Organization
ODA	Overseas Development Assistance
OFC	Overseas Food Corporation
ORP	Oilseeds Research Program
PODC	Producer's Owned Development Cooperative
PPB	Participatory Plant Breeding
PRS	Poverty Reduction Strategy
R&D	Research and Development
SADC-FANR	Southern Africa Development Community Food, Agriculture and Natural Resource Directorate
SRO	Sub-Regional Organization
SAT	Semi-Arid Tropics
SLA	Specific Leaf Area
SME	Small and Medium Enterprise
SMIP	Sorghum and Millet Improvement Program,
SSA	Sub-Saharan Africa
TOT	Training of Trainers
USAID	United States Agency for International Development
WCA	West and Central Africa
WUE	Water-Use Efficiency

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 does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 644 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

Contact Information

ICRISAT-Patancheru (Headquarters)
Patancheru 502 324
Andhra Pradesh, India
Tel +91 40 30713071
Fax +91 40 30713074
icrisat@cgiar.org

ICRISAT-Liaison Office
CG Centers Block
NASC Complex
Dev Prakash Shastri Marg
New Delhi 110 012, India
Tel +91 11 32472306 to 08
Fax +91 11 25841294

ICRISAT-Nairobi (Regional hub ESA)
PO Box 39063, Nairobi, Kenya
Tel +254 20 7224550
Fax +254 20 7224001
icrisat-nairobi@cgiar.org

ICRISAT-Niamey (Regional hub WCA)
BP 12404, Niamey, Niger (Via Paris)
Tel +227 20722529, 20722725
Fax +227 20734329
icrisatsc@cgiar.org

ICRISAT-Bamako
BP 320
Bamako, Mali
Tel +223 20 22 33 75
Fax +223 20 22 86 83
icrisat-w-mali@cgiar.org

ICRISAT-Bulawayo
Matopos Research Station
PO Box 776,
Bulawayo, Zimbabwe
Tel +263 83 8311 to 15
Fax +263 83 8253/8307
icrisatzw@cgiar.org

ICRISAT-Lilongwe
Chitedze Agricultural Research Station
PO Box 1096
Lilongwe, Malawi
Tel +265 1 707297/071/067/057
Fax +265 1 707298
icrisat-malawi@cgiar.org

ICRISAT-Maputo
c/o IIAM, Av. das FPLM No 2698
Caixa Postal 1906
Maputo, Mozambique
Tel +258 21 461657
Fax +258 21 461581
icrisatmoz@panintra.com

www.icrisat.org

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