The McKnight Foundation

Collaborative Crop Research Programme: Improving Food Security and Nutrition through Edible Legume Research in Malawi, Mozambique and Tanzania

LEGUME BEST BETS TO ACQUIRE PHOSPHOROUS AND NITROGEN AND IMPROVE FAMILY NUTRITION 06-740

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By

Prof. George Kanyama-Phiri, University of Malawi,
Dr. Sieglinde Snapp, Michigan State University
Ms. Lizzie Shumba, Soils, Food and Healthy Communities Project
Dr. Kate Wellard Dyer, University of Malawi
Mr.Patrick Thawe, Malawi Enterprise Zone Association, Malawi
Ms.Wezi Mhango, Univ. of Malawi and Michigan State University
Dr. Patson Nalivata, University of Malawi
Mr. Keston Njira University of Malawi

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1.WEBPAGE Summary

The “Legume Best Bets to Acquire Phosphorous and Nitrogen and Improve Family Nutrition” project is being implemented in Northern Malawi at Ekwendeni, and in Central Malawi at Mkanakhoti Extension Planning Area in Kasungu. Non-governmental partners, farmer research groups and extension teams have partnered with researchers to investigate 1) legume diversification for improved soil nutrition and family health; and 2) participatory development approaches. Nutrition education has markedly enhanced farmer use of new legumes such as pigeon pea (*Cajanus cajan*) intercropped with groundnuts or soybeans.

- **Training outputs:** one graduate student Austin Phiri has completed his MS degree, another student Keston Njira has started an MS and Wezi Mhango is close to finishing her PhD dissertation.
- **An on-farm soil test kit** provided immediate soil pH and texture results to facilitate discussions with farmers and soils were analyzed in the lab, documenting soil texture and organic matter characteristics among field sites
- **70% of participating farmers are expanding production of doubled up legume best bets in Ekwendeni, and** 90% of farmers experimenting with pigeonpea in Kasungu are interested in growing the multipurpose legume again.
- **Farmer to farmer exchange through visits between Ekwendeni and Kasungu** sites have enhanced local knowledge of integrated soil fertility management (compost, legume residue incorporation, combining with small amounts of fertilizer) and use of legume grains to diversify family diets through new recipes.
- **On-farm research trials** were carried out in 2008 and 2009, including 86 mother trials and 40 baby trials in Ekwendeni, 70 mother trials and 250 baby trials in Kasungu. These trials simultaneously tested biological performance and documented farmer assessment of legume technologies. Under investigation is the quantity of nitrogen fixation obtained with different legume diversity and intercrop patterns, overall cropping system performance and soil improvement from legume best bet technologies. The two growing seasons demonstrate strong interactions with weather, as dry conditions in 2008 reduced crop growth, limited

calorie production to ~70% of normal, and reduced production of nitrogen-rich residues. Crop yield in 2009 in contrast benefited from a high rainfall year and maize yields where ~150% of normal. Pigeonpea growth was outstanding, to the extent it competed with maize growth in the farmer cropping system (ratooned, second year pigeonpea intercrop with maize). Tradeoffs between soil building best bets (e.g. high population of long-duration pigeonpea) and nutritional best bets (high population of short duration groundnuts and maize) will be documented.

- **Innovative extension** underway includes nutrition education through recipe days, on-farm adaptation of legume varieties and residue management practices, and farmer-to-farmer visits.
- Training materials developed include **3 Extension Bulletins on Legume Technologies and 10 Farmer Flyers on Legume Recipes.** This provides information on how to utilize legumes, and how to manage doubled up pigeonpea-groundnut and multipurpose legume technologies. Additional training materials on compost preparation and legume recipes are planned for 2010.
- **Research and extension plans for 2010** are a third year of on-farm trials, as multiyear rotation systems require evaluation over time. Farmer assessment is on-going and an iterative process.
- A new best bet comparison will be introduced in 2010, evaluating the biological impact and farmer assessment of combining a preplant roundup herbicide treatment with legume-maize best bets. Promising new varieties of pigeonpea and groundnuts in different combinations will also be investigated, as farmers have expressed strong interest in expanding the number and types of varieties grown.
- **Policy input:** An exciting development is input into Malawi government policy on agricultural subsidies, which have been broadened to include legumes for the first time, although pigeonpea was not included (groundnut, common bean and soybean were the initial targets). Follow up with the Ministry will be conducted in 2010 working with the new McKnight Scale Up project, to support policies that address the bottlenecks in seed systems and soil fertility recommendations supporting legume diversified technologies.

2. RESEARCH REPORT

2.1 Authors – Research Team

Prof. George Kanyama-Phiri, University of Malawi, Bunda College, Lilongwe, Malawi – Principal Investigator

Dr. Sieglinde Snapp, Michigan State University, East Lancing, Michigan, USA - Collaborator

Lizzie Shumba, Soils and Healthy Communities Project, Ekwendeni Hospital, Ekwendeni, Malawi -Collaborator

Dr. Kate Wellard Dyer, University of Malawi, Bunda College, Lilongwe - Collaborator

Patrick Thawe, Malawi Enterprise Zone Association, Kasungu, Malawi - Collaborator

Wezi Mhango PhD student, Michigan State University, East Lansing, Michigan, USA and lecturer, Bunda College of Agriculture, Univ. of Malawi

Keston Njira Staff Associate and MS Student, University of Malawi, Bunda College

Dr. Patson Nalivata, University of Malawi, Collaborating Scientist and MS Student Supervisor

2.2 INTRODUCTION

Smallholder farmers in East and Southern Africa face considerable development challenges. In Malawi, at least 1 million households have chronic food deficits, 50 percent of children under 5 are severely malnourished (wasted or stunted), and 60 percent of the population subsists on less that $1 per day. A series of droughts over the past decade have exacerbated the food shortage problem. Average farm sizes are around 1 hectare, necessitating continuous cropping primarily of maize, the main cereal crop. As a result, soil fertility, especially on sandy soils, is low. Low incomes mean that few farmers can afford to use purchased inputs (in the absence of subsidies), and there is limited knowledge of organic matter technologies such as composting.

Legumes have been widely used in many African countries in part to improve soil health and in part to improve family nutrition. Legumes contribute towards soil nitrogen through their ability to fix atmospheric nitrogen. Similarly some legumes have the inherent capacity to increase phosphorous through their symbiotic association with mycorrhiza. Legumes also contribute to protein when included in the diet of family households. Various traditional legume recipes have been developed over centuries and new ones are still being developed with the view to enrich the diets, particularly child weaning foods. In Malawi several legumes are grown for the foregoing reasons. Some such legumes include ground nuts (*Arachis hypogaea*), velvet beans (*Mucuna puriens*), soybeans (*Glycine max),* Pigeon peas (*Cajanus cajan*), Bambara nuts (*Vigna subterranea*), and Cowpeas (*Vigna unguiculata*), among others. Grains from these legumes have been used in various recipe combinations for the purposes of enriching the diets of family households.

A project entitled “Legume Best Bets to Acquire Phosphorous and nitrogen and Improve Family Nutrition” is being implemented in Malawi using participatory approaches. The project is funded by the McKnight Foundation under the Grant Number 06-740. It covers the Northern and Central Regions of Malawi. In the North, it is being implemented in Ekwendeni area of Mzimba District in collaboration with the Soils, Food and Healthy

Communities (SFHC) Project of Ekwendeni Mission Hospital. The participating farm households are patrilocal with half of them being female headed. In Central Malawi, the project is being implemented in Mkanakhoti Extension Planning Area (EPA) of Kasungu Agricultural Development Division (KADD) in Kasungu District. The Malawi Enterprise Zone Association (MALEZA) is the main collaborating partner. In both study sites, farmers have organized themselves into Farmer Research and Outreach groups which have leadership structures that guide in decision making and in the implementation of development activities.

2.3 NARRATIVE SUMMARY

The project started in November 2006. This report covers the third year (2008/09) of the Best Bets project.

OVERALL OBJECTIVE: **To improve household food & nutrition security by increased legume production and utilization and improved soil quality.**

2.4 Objective 1: Determine sets of characteristics of 'best bet' legumes and legume combinations which address nutritional and soil requirements.

Activities Year 3:

Participatory on farm trials/demonstrations, Ekwendeni catchment of Mzimba District, Northern Malawi

In the 2007/2008 season, and continuing for the second year of on-farm trials in 2008/2009, a PhD student/Bunda Lecturer Wezi Mhango conducted research on 21 farmers' fields working with the SFHC project in Ekwendeni catchment, Northern Malawi. Groundnut, CG7 variety; pigeonpea, ICEAP00040 variety; and maize, MH18 variety; were planted in sole and intercrop systems to quantify biological nitrogen fixation of the legume best bet combinations (Fig 1). At planting, soil samples were collected from all fields of the participating farmers to characterize the soil chemical and physical properties. The student and the participating farmers also mounted rain-gauges in the study area and rainfall data was collected. During the season, the measurements made included: chlorophyll readings, nodulation, plant samples collected to assess residue quality and quantify biological nitrogen fixation, and general crop performance. Crops were harvested and residues analyzed for nitrogen content. Residues were incorporated soon after harvesting in all plots to facilitate decomposition and also protect them from livestock grazing.

Best bet technologies and priorities for knowledge generation were monitored through two surveys conducted early in the participatory on-farm research process and after two years of participation.

Soil characteristics and Rainfall

Soils are sandy to sandy clay loams, pH=6.1. Total soil N and P average 0.07% and 10.5 ±1 ppm respectively, which documents the low soil fertility that farmers must manage. The area received heavy rainfall early in the 2007/08 season that led to loss of one field due to flooding and presumably considerable nutrient leaching. This was followed by a drought (early termination of rains) approximately 2.5 months after planting. In contrast, the rainfall was well distributed and above the long-term average in 2008/09, providing sufficient moisture for growth of all crops. High variability of rainfall has been predicted by climate modeling, and this illustrates the challenges that farmers must adapt to and risky environments that require testing and research over multiple years.

Nodulation, BNF, leaf characteristics and crop yields

There was good establishment of legumes in both years, but most notably growth was outstanding in year 2 (2008/09). Preliminary results indicate effective nodulation of all legume genotypes in sole and intercrop systems. The average nodule number per plant at ~8 weeks after planting was 9, 92 and 119 for pigeonpea, intercropped groundnut, and sole groundnut respectively. Plant analysis to quantify BNF is in progress. Legumes had higher chlorophyll levels than maize indicating better leaf quality (higher nitrogen content) with the highest readings in pigeonpea (Fig 3).

Maize and legume grain yields in 2008 were lower than in 2009 due to the dry spell that occurred when groundnut was at pod filling stage and maize at grain formation stage in year 1. Maize intercropped with pigeonpea yielded 829 kg ha^{-1} compared to sole maize 984 kg ha^{-1}. Grain yield from sole and intercropped groundnut averaged 645.70 kg ha^{-1} and 466.63 kg ha^{-1} respectively.

Table 1 in Appendix 2 shows maize yields from 2009, which were high due to the favorable season with sufficient and well distributed rainfall. The key finding was that response of maize to legume residues incorporated in 2008 was consistently higher for legume + 24 kg of N fertilizer than for fertilizer applied alone to a continuous sole maize system. The legume technologies performed similarly, in any combination which was somewhat surprising as maize following doubled up (pigeonpea + groundnut) was predicted to be higher yielding. The ratooned pigeonpea (pigeonpea second year growth, after being harvested and cut back in year 1) was a farmer-designed system that we added to the experiment upon consultation with farmers. Interestingly, farmers have expressed considerable interest in this multi-cropping system, despite the moderate decrease in maize yield in this high rainfall year presumably due to competitive growth of the ratooned pigeonpea. Presumably the advantages of dual crops (pigeonpea grain harvested twice, groundnut once and maize once) over several years outweighs the competitive impact of ratooned pigeonpea growth on maize yields. A third year of maize response will need to be measured in this complex, farmer-designed cropping system.

A key finding which is being disseminated through engagement with policymakers is that N-fertilizer equivalency from maize-legume rotation ranged from 0 to 36 kg N/ha; and in the integrated soil fertility management system maize plus 24 kg of N fertilizer the **ppea+gnut rotation improved fertilizer efficiency by over 100% compared to sole cropped, continuous maize.**

Preferred technologies - Ekwendeni

A questionnaire was administered to farmers provide feedback on preferred technologies and constraints. A scale of 1-4 was used to rate each technology whereby: 1= very good technology; 2= good; 3= very poor; and 4= very poor technology. In year 1, the doubled up legumes (groundnut/pigeonpea intercrop) and sole groundnut were rated as the best because of good crop stand, high expected grain yields and soil fertility benefits (Fig 4). Sole pigeonpea was rated second, followed maize/pigeonpea and lastly sole maize. Farmers indicated that intercropping technologies save labor, provide diverse food products, and conserve soil moisture. The poor performance of maize in year 1 was attributed to the dry spell and low soil fertility (as legumes provide benefits in year 2 not year 1, and farmers were knowledgeable about this delay in soil fertility enhancement). Farmers were also asked to list the technologies that they are planning to expand. Over 80% of the farmers indicated that they would like to grow more of the doubled-up legume technology, followed by maize+pigeonpea intercrop (20%). The major constraints to use of these technologies are lack of seed, unreliable rainfall, pests and diseases, labor availability, and high cost of inorganic fertilizer for ISFM maize production (combinations of legumes plus targeted fertilizer application was the preferred method of production by farmers, presumably in part due to the economic benefits of subsidized fertilizer availability in Malawi due to government programs which partially offset the otherwise cost-prohibitive expense of applying fertilizer to maize).

In year 2, the top three technologies ranked in order of preference were groundnut+pigeonpea intercrop–maize rotation, pigeonpea-maize rotation and maize+pigeonpea-maize rotation (Table 2).

Dissemination and farmer outreach activities in Ekwendeni. Field days and farmer-to-farmer visits were an important means used to disseminate research findings by the Farmer Research Group, in collaboration with SFHC and University scientists. Three field days reached a total of 443 men, 607 women and 497 children. Participants included farmers who had not participated with the project or with trying out new legume varieties in the past, as well as hospital staff, village headmen, participating farmers (already experimenting with legumes). A group of ten farmers from Mkanakhoti Extension Planning Area working with MALEZA project attended field days in Ekwendeni organized by the SFHC project March 17-19th, 2009.

Action Plan by farmers from Kasungu after attending field day in Ekwendeni. The activities included learning about nutritional recipes (processing legumes into meat, milk and coffee-like products through roasting, grinding and incorporation into traditional dishes). As well, the field days included visits to legume fields and fields which were managed with soil fertility enhancing practices, such as timely incorporation of crop residues.

Participatory on farm trials/demonstrations, Mkanakhoti EPA, Kasungu District, Central Malawi

1. Austin Phiri, first MSc student

Like in Ekwendeni, the participatory on farm trials/demonstrations in Kasungu were preceded by a baseline survey in order to identify preferred legumes, cropping systems and characterize soils. The baseline survey revealed that the major legumes grown in the area include soybeans, common beans and groundnuts which are widely grown for food and sale. These legumes are grown in pure stands. In general farmers of the Kasungu study area have been found to prefer legumes that are edible, early maturing, high yielding, soil fertility improving and resistant to pests and diseases.

On the strength of the above background knowledge, a participatory technology development approach involving Community Agriculture Workers was used to identify Legume Best Bets for the Kasungu study area. From this approach groundnut and pigeon pea were identified as having the potential for legume best bets technology testing.

Mother and Baby Trials, Crop measurements and Yields

The Master's student (Austin Phiri), conducted field trials during the 2007/2008 growing season, working with the Malawi Local Enterprise Zone Association (MALEZA) educators and farmers. The 'mother-baby' approach was used. Ten farmers were involved in the mother trial research and were treated as replicates.

Mother Trial

The overall objective of his trial was to improve soil nitrogen and phosphorous using regume residues from groundnut and pigeonpea, applied singly or in combination, with or without Tunduru Rock Phosphate (TRP). A maize variety (ZM 621) was used as a test crop. Eleven treatments were imposed on each mother trial. Of the eleven treatments, one plot of Maize received 92 kg N per hectare using urea as a source of N while another plot did not receive anything to serve as a control. In the second year all plots except the control received half rate (46 kg N/ha). The Nitrogen fertilized treatment received full rate (92 kgN/ha).

The second year results of this trial confirmed the findings from Ekwendeni that a doubled up technology has potential to give yields of comparable magnitude to inorganic fertilizer (see table 3 in the appendix) This table shows that the maize grain yield from the doubled up (pigeon pea + groundnut) plot which was top dressed with 46 kg N/Ha averaged 1321 kg/ha which is comparable to the 1,327 kg/ha obtained from the plot that received a full complement (92 kg N/Ha) of nitrogen from urea fertilizer. It is also interesting to note that those treatments that received Tundulu Rock Phosphate the previous year benefited from this rock. For example, maize yields from the Maize plus TRP and Maize plus Pigeon pea plus TRP yielded 1399, and 1472 kg/ha, respectively. Soils of the Kasungu study area are generally severely depleted of soil nitrogen and phosphorous and hence maize response to added N and P. As has been reported from the previous studies in the same area the maize yield from the control was below 1 ton per hectare.

Initially, baby trials were established in with 24 farmers in the study area, expanded to 100 baby trials in 2008/09. Farmers selected up to 5 treatments to manage: intercropping pigeon pea, groundnut and maize and application of leaf biomass, TRP and UREA in different combinations, where the primary cropping systems of interest to farmers were the doubled up legumes and pigeonpea intercrops, as described below. This interest was based in large part on the observations of farmers who visited Ekwendeni and saw legume 'best bet' options there.

Preferred Technologies

During harvesting of the trials, the participating CAWS from Kasungu were issued with a questionnaire on preferred technologies used in the Mother Trial approach. As was the case in Ekwendeni the questionnaire requested the CAWS to rate the eleven technologies on a scale of 1 to 4 whereby 1 represented a very good technology while a 4 represented a very poor technology. Overall the CAWS gave the pure groundnut and the doubled-up (pigeon pea + groundnut) technologies 1.5 and 1.7 ratings, respectively, whereas the Maize +Urea and the Maize + Pigeon pea Biomass + TRP tied for the third place with a rating of 1.8. These farmer ratings are in agreement with those presented in Table 3 in the appendix. From these findings and indeed those from Ekwendeni it can be deduced that these technologies which have received high ratings in both the Ekwendeni and the Kasungu study areas are the candidates for scaling up and scaling out in our next phase of the McKnight study.

Baby Trial

Baby Trials were based around the treatments of most interest to farmers: 1) Maize only (Control), 2) Maize + Urea fertilizer at 92 Kg N/ha (recommended rate), 3) Maize + *Pigeonpea* intercrop at 92 Kg N/ha, 4) *Pigeonpea + groundnut doubled up legume intercrop and* 5) Maize + *groundnut intercrop.*

The data was collected at mid- and end of the growing season, plant samples for maize and ground nut during tasselling/podding stages and harvesting (analysed for N, P, K); stand count at harvest; average cob length; cob, grain, stover, groundnut haulms' and unshelled groundnut dry weight in a net plot. Data analysis is in progress and a summary of results to date are presented below.

2. Keston Njira, second MSc Student

Another MSc student (Keston Njira) is also studying under the same McKnight Best Bets project in Mkanakhothi EPA, Kasungu.. His key research question is to compare whether sole cropped and doubled-up legume technologies fix significantly different amounts of N and to investigate the effect of cropping systems on legume crop yields and subsequent maize yields. In addition to the groundnut and pigeon peas his study added soybeans based on the farmers demand for this legume plus the fact that the legume in question is widely used in food recipes in the study areas of both Ekwendeni and Kasungu.

Identification of farmers was done using participatory action research depending on farmers' interest in collaboration with partner, MALEZA, an organization that is promoting composting making in the area. Fields selected were those that were not planted to legumes in the previous years. Soil samples were collected for laboratory physical and chemical analysis. The pH of the top soils (15-30cm) ranged from 5.1 to 7.0 with a mean of 5.5 (SE=0.2) and the sub soil ranged from 5.0 to 6.5 with a mean of 5.5(SE=0.1). The textures indicated sandy loam soil for the top soil and sandy clay loam for the sub soil. Other soil chemical properties including N, P, K, Ca, Mg, Zn, B, Mo and organic matter are currently being analysed.

Legumes were planted in sole and doubled-up cropping systems whereby pigeonpea, soybean and groundnuts were planted in pure stands and in pigeonpea + soybean and pigeonpea + groundnut intercrop with maize as a control crop. A summary of the treatments is in Table 4. Destructive plant samples and harvest samples have been collected, oven dried and are currently being analysed for different nutrients including N, P, K, Mg B, Ca, Mo and S.

Preliminary findings indicate that mean number of nodules were as follows: Groundnuts (89), Groundnuts intercropped with pigeonpea (90), Soybean(inoculated) (7) and Soybean(inoculated) intercropped with Pigeonpea (5). Uninoculated soybean and pigeonpea in all treatments failed to show significant nodulation. Sole groundnuts and sole soybean showed significantly higher grain yields than in their pigeon pea intercrops but Land Equivalent Ratios (LERs) are very high for both intercrops. This demonstrates the complementarity of the crops, and multiple benefits derived. Tables 5 and 6 show grain yields and LERs. Pigeonpea failed to reach yield potential.

Soil characteristics and Rainfall, 2007/2008 season

Soil pH ranged from 5.2 to 5.8 for topsoil while the subsoil ranged from 5.1 to 5.7 (strong to medium acidity, Brady 1974). Texture classes ranged from Loamy Sand, Sandy Loam to Sandy Clay Loam with Sand loam being the most dominant texture class across sites. Soils have low to medium levels of OM, mean=1.5% top soil and 1.4% sub soil available P (2 to 62 ppm). There is high variation in available P across sites (2 to 60ppm). Overall, soil available P was low to very low, in top soils (mean=18ppm) and subsoil (mean= 9.6ppm), where available phosphorus at 40ppm would be an adequate phosphorus level. Across sites total N was low, 0.07% for both top and sub-soil. This is consistent with earlier findings that these soils are severely depleted in both phosphorus and nitrogen.

Rainfall for the 2007/8 cropping season averaged 1068mm across 3 sites in Mkanakhoti EPA, with considerable internal variation (Figure 5). This is above the 7-year average of 889mm (Figure 6), but the precipitation was not distributed well. Heavy rains were experienced in December-February, after which precipitation fell sharply, resulting in a shorter than average growing season.

Crop performance and yields

Data analysed from the baby trials to date (n=8) shows maize intercropped with pigeonpea+leaf biomass applied yielded more (1014 kg ha^{-1}) than sole maize (836 kg ha^{-1}) but less than maize+urea (1902 kg ha$^{-1)}$. Maize intercropped with groundnuts yielded only 410kg ha^{-1}, which indicates that moisture competition between maize and groundnuts was high, not surprising in a year with rainfall ending early. Average groundnut yield from maize-groundnut and pigeonpea-groundnut were 1081 kg ha^{-1} and 1110 kg ha^{-1} respectively, and pigeonpea harvest data is in the process of being finalized.

Preferred technologies - Kasungu

Farmer assessment of the technologies was carried out mid-season using a checklist and ranking (Figure 7). End of season farmer assessments will be carried out after harvesting of pigeonpea. A scale of 1-4 was used to rate each technology whereby: 1= very good technology; 2= good; 3= very poor; and 4= very poor technology. Farmers' preferred technology was the 'doubled-up' legume pigeonpea/groundnut which was rated as very good or good by 85 and 8 percent of farmers, respectively. This was followed by maize/pigeonpea intercrop which was ranked as very good by 60 percent and good by a further 18 percent of farmers. These rankings exceed those of sole cropped maize with urea which was ranked as very good by 55 percent and good by 35 percent of farmers. Maize intercropped with groundnuts was the least preferred technology with 40 percent ranking it as very good and 15 percent as good. Reasons given by the farmers for their preference include: production of two crops (the staple, maize, and relish, pigeonpeas) on the same plot without compromising maize yields; soil fertility boosted for next year's maize crop; vigorous maize plants and good yields expected.

Farmers were also asked which technologies they would be interested in growing more of (Figure 8). Over 70 percent of farmers involved in the trials were interested in pigeonpea-groundnut intercrop and 50 percent in maize-pigeonpea, which is quite similar to the findings from Ekwendeni. Fifty-two percent would be interested in growing more maize with fertiliser, if the fertilizer was affordable. A minority (15 percent) expressed interest in maize-groundnut intercrops. Constraints faced by farmers during the 2007/8 season included: poor seed viability (85 percent), pests (50 percent), diseases (30 percent), striga – weed (18 percent) and inadequate rainfall (40 percent).

2.5 Objective 2: Promoting legume diversification of farm family diets

Nutrition training

Recipe days are organized by the Nutrition Research Team and the Farmer Research Team of the Soil Food and Healthy Communities working in different villages, and in mobile clinics to promote and demonstrate diversified diets with nutritious recipes in Ekwendeni. The days involve cooking, learning about and eating different meals. This year, primary school teachers requested our services to train their students in nutrition and processing of soybean. Training was done in two primary schools. About 105 and 98 male and female students respectively, 7 female teachers and 5 male teachers have been trained in soya processing. In preparation are recipe and nutrition training materials; 15 recipe training materials 'farmer pamphlets' were developed with input from the farmer researcher team including drawings and recipes, and have been shared with some farmers. More will be developed, and all will be distributed broadly next year. Further innovative approaches are being explored with farmers to develop in a participatory manner training materials, including poems, drama and pamphlets.

Farmer to farmer exchange visit and training on food recipes

Recipe training days were held in order to teach farmers from Kasungu and non participating farmers different recipes, processing and utilization of different locally available foods including legumes.

In April 2008, five farmers (3 women and 2 men) from Kaluluma EPA of Kasungu district, working with MALEZA project participated in a field day organized by the Soils, Food and Healthy Communities Project (SFHC) in Ekwendeni. The group was accompanied by staff from Bunda College. Field day activities included visit to Mc Knight Legume best bet demonstrations on legume and maize technologies, SFHC demonstrations, food recipes and preparation (Fig 9 and 10). Farmers learnt about planting pattern in intercropping versus sole stands, field hygiene, and how the community deals with the problem livestock grazing in pigeonpea. They appreciated the good crop stands, clean fields and associated high yields. On utilization of legumes, both men and women were actively involved in food preparation and documentation of recipes. The role of legumes in diets and human nutrition was highlighted. On the way forward, the visiting farmers from Kasungu held a field day to share their experiences with a larger community back home, and plan a second farmer exchange in 2008 (Table 2).

SFHC and FRT members conducted a number of meetings where research findings were disseminated to farmers through drama, poems, power point presentations. Farmers have are working on pamphlets to document their activities in agriculture or nutrition. These pamphlets will be distributed to farmers, and a number of organizations that attended the dissemination meetings including World Vision International, Hospital, Plan International, and ASMUG.

Training in food preparation

One of the activities done by farmers working with the SFHC project is nutrition education. These farmers have been trained in utilization of legumes to improve family nutrition. During the field day, a recipe training session was organized by SFHC farmers to teach fellow farmers from Kasungu food recipes from legumes and other crops. The legumes included soyabean, common bean and groundnut. Other ingredients were pumpkin leaves, pumpkin flowers, bananas and cassava. Both men and women participated in this activity. Groundnut and soybean flour were used to season bananas and cassava. The dishes made included soya meat, soya coffee, soya milk (Fig 2), boiled green beans from soya, meat balls from common bean, bananas seasoned with soya bean flour, cassava seasoned with groundnut flour, snack from pumpkin flowers. A description of recipes learnt by visiting farmers is explained in the following paragraph. At the end of recipe session, participants to the field day tested the various dishes. People acknowledged that the food was very tasty. Other comments highlighted include the need to promote these legume production and utilization to improve family nutrition.

Farmer to farmer learning, summary of farmer assessment in Kasungu after participating in Ekwendeni field day and nutritional workshops

a) Preparation of various dishes from legumes or use of flour from legumes to season other foods will be tried on a larger scale in Kasungu
b) Legumes can be used to reduce malnutrition of young children was a fundamental finding. Farmers were motivated to grow more legumes for child health.

2.6 Objective 3: Quantify the effect of legumes on soil P, N organic matter and yield of subsequent crops

Summary of research trials conducted in 2008/9, to test soil nutrient enrichment in addition to on-farm demonstrations.

Ekwendeni Research Trials – 20 trials sited on low and high fertility soils (10 of each)

1. Maize sole cropped
2. Maize intercropped with Pigeonpea
3. Maize sole cropped after doubled up legume technologies

Nitrogen fixation by natural abundance method (maize as reference plant) tissue is being ground, analyzed, and nutrient budgets are underway.

Kasungu Trials – 10 `mother` trials;

1. Maize sole cropped
2. Maize intercropped with Pigeonpea (Cajanus cajan)

3. Pigeonpea sole cropped

Kasungu - 50 `baby` trials:
1. Maize only
2. Maize + N fertilizer
3. Legume intercrop (Farmers choose Maize intercropped with Pigeon pea or Pigeonpea intercropped with Groundnut)
4. Maize + compost manure*

* Compost to be included in Baby trials where available on-farm (10+ farmers)
'Mother' trials have the complete set of treatments.
'Baby trials': Farmers have 10m x 10m plots with up to 4 treatments.
All systems were planted to maize in year 2 of the trial
Maize planting stations 0.9 m planting station, 3 plants per station

Soil samples were collected from baseline survey transects, and from farmers' fields in the on-farm trials underway in Ekwendeni and Kasungu. Soil analyses are underway as part of Keston Njira's MS thesis research, and for Wezi Mhango's dissertation. Initial results are shown in the appendix.

Composite soil samples from 0-15cm and 15-30 cm depths were collected for analysis of soil properties. Soils are being analyzed in the laboratory for N, P, K, Fe, Organic Carbon, Mg, Ca and pH. In the field 'soil test kit' information was conducted with farmers to provide a rapid assessment and immediate feedback, which will be followed up by the laboratory results. Initial assessment included soil pH using Hellige TRUOG pH tester and texture using the feel method were done insitu in a participatory manner with farmers. Verification will include using lab tests at Bunda College.

2.7 Objective 4: Strengthen farmer, Research, Extension and NGO capacity in Legume production and Utilization including Gender Issues

Capacity building/training

In addition to the research trials described above, 40 baby trials were carried out in Ekwendeni and 100 baby trials in Kasungu, included farmer research group designed experimentation primarily with different combinations of soybean and pigeonpea with maize. These will be surveyed, farmer assessment and knowledge gained documented in 2009/2010.

2.7.1 Field day and farmer exchange visits and demonstrations on legume soil fertility technologies and crop residue incorporation training. The FRT members and SFHC staff carried out this activity in each to promote crop residue incorporation. Farmers met in a central location and FRT members demonstrated how to bury crop residues and its role in soil fertility.

2.7.2 MSc and PhD students at Bunda College and MSU

Austin Phiri successfully defended his MSc thesis on Friday, June 26, 2009 and graduated from the University of Malawi on 10 September, 2009. He is now working as a research scientist in agro-forestry at Chtedze Research Station in the Ministry of Agriculture and food Security. Wezi Mhango (PhD student at MSU) is in the third year of her PhD Program, She is currently analyzing second year soil and plant samples to quantify biological nitrogen fixation and assess soil quality. She has also written one chapter of her dissertation. Keston Njira is a second masters student after Austin Phiri, studying at Bunda College, University of Malawi. He has completed his course work and has been advanced to the second year. He is currently finalizing soil and plant analysis from his first year. He has also analysed some of the first year's data. All students have shown rapid progress in their academic studies .

2.8 Key Outcomes of the Best bet project over three years

1. Legume technologies identified for scaling up and out, and knowledge on these legumes disseminated through extension materials, farmer-to-farmer and training of extension and NGO staff.
2. The doubled up legume technology (pigeonpea intercropped with soybean or groundnut, then rotated with maize) has shown itself superior in terms of multiple crops produced per land and labor invested, and in terms of improving fertilizer efficiency by 30 kg of N per ha (equivalent to an additional bag of fertilizer).
3. Improved capacity of farmers to adopt, manage and use legume and compost technologies. Over 9000 farm families have been reached in Ekwendeni, and over

a thousand in Kasungu. The project has strengthened the capacity of farmer leaders to carry out research including designing their own experiments.

4. Enhanced incorporation of legumes in local diets in Ekwendeni and Kasungu, including understanding of nutrition benefits among farm families
5. Effect of legumes and intercrop combinations determined on soil OM fractions and on biological nitrogen fixation (in progress)
6. Three students trained to PhD and MS level, strengthening Univ of Malawi and Ministry of Agriculture, Chitedze Research Station (in progress)
7. Publications on preferred legume traits; N fixation of legume-legume vs legume-cereal intercrops; maize response to legume cropping systems (1 journal article and two chapters published, three papers presented, one thesis completed, and two additional journal papers in progress)
8. Integrated soil fertilizer management technologies identified, including quantifying on-farm the N equivalency of legume systems and increase in fertilizer efficiency, information presented to Malawi policymakers and subsidy program expanding legume access due to fertilizer efficiency implications. Policy briefing papers are in preparation.

2.9 Implications for future development activities

Promising best bet legume technologies have been identifed, notably the doubled up grain legumes, that show potential for candidates for scaling up to other smallholder farmers especially in areas of similar agro ecologies. The Farmers Union of Malawi, which is collaborating in this project, and technical advice to the government subsidy program are expected to play crucial roles in scaling up the “best bet” technologies by promoting farmer access to pigeonpeas, soybean and groundnuts around the country. The project is working closely with the Ministry of Agriculture and Food Security (MoAFS) to ensure commitment and sustainability. MoAFS has indicated interest in piloting the FROT approach for selected technologies including soil fertility and nutrition, for example in each Extension Planning Area (EPA) in Kasungu Agricultural Development Division (ADD).

- A number of extension materials have been produced by project staff on legume best bet agronomy by Bunda College, by MALEZA on composting, and by SFHC on legume recipes. These were produced in several local languages to be understood by farmers and researchers, and were reviewed with a wide range of partners – including NGOs and farmer research groups - and the information revised based on comments and incorporating research findings, then disseminated widely.
- It is envisaged that those best bets that show potential for adoption will be candidates for scaling up to other smallholder farmers especially in those areas of similar agro ecologies. SFHC and MALEZA, which are collaborating in this project, are expected to play a crucial role in scaling up the "best bet" technologies in their mandated areas of Ekwendeni (Northern Region) and Kalulma, Kasungu (Central Region).

2.10 Implications for policy

- Research findings on farmer preferences for the 'doubled-up' pigeon pea/groundnut legume technology and the maize/pigeonpea intercrop by farmers indicate the importance of legumes in people's livelihoods. A supportive policy environment is needed to promote the technologies and improve availability and access to seed inputs. A policy workshop is one way we will start the process of engaging with policymakers in Malawi in 2008-09 regarding best bet legume technologies, where we will invite collegues in Extension, Ministry of Agriculture, NASFAM, Farmers Union and others.

- **Legume seeds have now been included in the 'flexible voucher' distributed to up to 1 million farmers to purchase seed.** The best bets project team will continue efforts to engage in dialogue and provide technical input working with the Ministry of Agriculture, Ministry of Finance and seed companies through the Input Task Force on varieties, location and the seed subsidy.
- Inorganic fertilizer landed in Malawi is currently priced at $1200 per tonne– this is now prohibitively expensive for the majority of smallholder farmers, unless in receipt of a subsidy voucher. At the same time the Government is increasingly looking for options to reduced dependency on fertilizer as the subsidy scheme is becoming

increasingly expensive to operate. Composting and legume residue management is being actively promoted by the Ministry of Agriculture in a number of districts including Kasungu, as well as by NGOs, as a means of improving soil structure and reducing requirements for inorganic fertiliser, as well as returns from small doses of fertilizer. Research by the project in the coming season on long-term impacts of technologies, including building soils to enhance fertilizer efficiency is **important in providing science-based information to inform policy on fertilizer alternatives, and on improving fertilizer efficiency** (which can make it more affordable).

3. TEAM REPORT

3.1 Team Activities

3.1 Stakeholders review meetings and field day activities

FIELD DAYS AND FARMER EXCHANGE VISITS IN EKWENDENI KASUNGU AND DOWA, March 17-21, 2009

Brief Background: Field days were conducted in Ekwendeni, northern Malawi and Kasungu, central Malawi to disseminate some of the legume technologies under Legume Best Bets Mc Knight project, and preparation of various dishes from legumes. Representatives of farmers from Kasungu working with working with Malawi Enterprise Zone Associations (MALEZA) traveled to Ekwendeni to participate in the field day. Similarly a few farmers working with the Ekwendeni Soils Food and Healthy Communities (SFHC) project attended field day in Kasungu. In addition to the legume best bets field days, 21 participating farmers from SFHC project and Kasungu were taken to School of Agriculture for Family Independence (SAFI) in Dowa, where farmers are trained in various improved crop and livestock technologies as a family, and how to be independent and food secure throughout the year..

3.2.1 FIELD DAYS IN EKWENDENI, 17th-19th March, 2009

A group of ten farmers from Mkanakhoti Extension Planning Area working with MALEZA project attended field days in Ekwendeni organized by the SFHC project. The group included 3 women and 7 men representing 2 community agricultural workers (CAWs) from 5 villages, Kaunda, Chisazima, Ndaya, Chaguma and Tchezo. The farmers were accompanied by the Prof G. Kanyama-Phiri and Wezi Mhango of Bunda College (Table 8 in Appendix). Other participants to the field days included staff from Ekwendeni Mission hospital, farmers working with the SFHC project, village headmen and group village headmen from surrounding villages, and Inkosana Siwuli Tembo. Farmers from Kasungu attended Ekwendeni field days on March 18th and 19th, 2009.

3.2.2 On farm trials on maize response to legume cropping systems, sole and doubled up legumes under Mc Knight Legume Best Bets project

The group visited two fields, maize response and legume cropping systems trials belonging to village headman Mr Thawe. This is one of the experimental fields by the PhD student, Wezi Mhango. Maize fields were previously planted to sole and doubled up groundnut and pigeonpea, sole maize, and maize/pigeonpea intercrop (Figs 1 and 3). This season (2008/09), the farmer also planted sole and doubled stands of groundnut, pigeonpea, and soybean. The farmer explained all the cultural practices and crops grown in year 1 and current season, crop residue management (timing and how to incorporate), quantity and method of fertilizer application. Maize following legumes received 24 kg of Nha^{-1} as top dressing fertilizer, a ¼ of the recommended area specific nitrogen fertilizer rate in Malawi.

3.2.3 Comments and questions

a) Soil fertility benefits from legumes depend on amount of residues incorporated, timely incorporation of residues (preferably when they are still green), planting with first planting rains, good field management
b) Participants were amazed with good maize stand following legumes plus 24 kg N/ha, a quarter of N requirement in maize (Fig 2). These legume technologies could help to increase food security among the resource poor farmers. Maize following doubled up groundnut and pigeonpea?
c) Why should farmers incorporate crop residues while they are still green?
d) When to incorporate crop residues from groundnut and pigeonpea?
e) From this field, these legume based technologies can help to increase crop yields. But why choose very few farmers to participate in these on farm experiments?
f) What variety of maize was grown? …..answer, MH18

3.2.4 Lessons learnt by farmers from Mkanakhoti EPA, Kasungu

a) Farmers can harvest high maize yield through use of legumes and small amount of inorganic fertilizers
b) More soil fertility benefits from doubled up legumes

c) Crop residues should be incorporated when they are still green to facilitate decomposition
d) Planting with first planting rains increase crop yield

3.3 Training in food preparation and legume diversification in diets

One of the activities done by farmers working with the SFHC project is nutrition education. These farmers have been trained in utilization of legumes to improve family nutrition. During the field day, a recipe training session was organized by SFHC farmers to teach fellow farmers from Kasungu food recipes from legumes and other crops. The legumes included soyabean, common bean and groundnut. Other ingredients were pumpkin leaves, pumpkin flowers, bananas and cassava. Both men and women participated in this activity. Groundnut and soybean flour were used to season bananas and cassava. The dishes made included soya meat, soya coffee, soya milk (Fig 3), boiled green beans from soya, meat balls from common bean, bananas seasoned with soya bean flour, cassava seasoned with groundnut flour, snack from pumpkin flowers. A description of recipes learnt by visiting farmers is explained in the following paragraph. At the end of recipe session, participants to the field day tested the various dishes. People acknowledged that the food was very tasty. Other comments highlighted include the need to promote these legume production and utilization to improve family nutrition.

3.3.2 Recipe session: Lessons - farmers from Kasungu

c) Preparation of various dishes from legumes or use of flour from legumes to season other foods
d) Legumes can reduce malnutrition of under five children.

Table3.1: Action Plan by farmers from Kasungu after attending field day in Ekwendeni

#	Farmer	What to teach the larger community at home	Time
1	Mr Kalemeka Chibwe	How to make meat from pumpkin flowers	March 29, 09
2	Mr Hellings Chinjala	How to make meat from pumpkin flowers	April, 2009
		Will mount a demonstration plot on legumes and invite people to learn	2009/2010 season

		from his field	
3	Mama Josephine Chunga	How to make meat from common beans	March 2009
4	Mr Pick Longwe	How to make meat from pumpkin flowers	March 29, 09
5	Mr Antonnio Mazi	How to make coffee and milk from soyabean	March 29, 09
6	Mama Cecelia Phiri	How to make meat from pumpkin flowers	April, 2009
7	Mr Stanley Phiri	How to grow soybean	2009/2010 season
8	Mr Langtone Banda	How to grow soybean	2009/2010 season
9	Mama Emelida Khruza	Use of manure and residues to improve soil fertility Manure	April, 2009
10	Mr Bright Phiri	How to make soya milk	April, 2009

Appendix 2: Photos, Figures, Tables

Table 1.Maize yield in year 2 Ekwendeni onfarm sites (n=21), showing grain performance in response to legume integrated fertilizer management (ISFM) technologies. Maize N fertilizer response was tested for comparison, and provided the N equivalent of the legume component

2007/08 Trt	2008/09 Treatment (N rate in kg/ha)	Yield (kg ha-1)	N equiv. (Kg/ha)
Gnut	Maize + 24N	2503.05B	30.6
Ppea	Maize + 24N	2315.37B	24.7
Gnut+Ppea	Maize + 24N	2221.41B	21.8
Maize+Ppea	Maize + 24N	1852.53C	10.2
Gnut+Ppea	Maize+ratoon'd Ppea +24N	1332.36C	0
Maize	Maize, 0N	800.44D	-
Maize	Maize, 24N	1473.78C	-
Maize	Maize, 92N	3708.48A	-
Grand Mean		2022.07	

Table 2. Farmer ranking of legume best bet technologies in Ekwendeni after two years of experience growing the legumes.

Rank #	Technology	Reasons	Constraints
1	Groundnut+ P'pea-Maize rotation, all pigeonpea uprooted and leafy biomass incorporated.	Soil fertility, Food, income from groundnut, intercropping maximize labor use	▪ Lack of legume seed ▪ P'pea: Low yields, pests, livestock grazing and unreliable rainfall
2	Sole P'pea- Maize rotation	Food, Soil fertility,	P'pea: same as above, plus high labor – weeding is an issue
3	Maize+pigeopea-Maize Rotation	Food, Soil fertility, maximize labor	P'pea: same as above

P'pea=pigeonpea

Fig 1: Field day, Ekwendeni, farmer explains what activities have been done on his field. In the background, maize following legumes and in the foreground doubled up pigeonpea and groundnut.

Fig 2: Nutritional and recipe education at Ekwendeni, milk production from soyabean.

Fig 3: Field day showing pigeonpea in foreground, intercropped with groundnut
Key: GN= groundnut; PP= Pigeonpea; MZ=maize

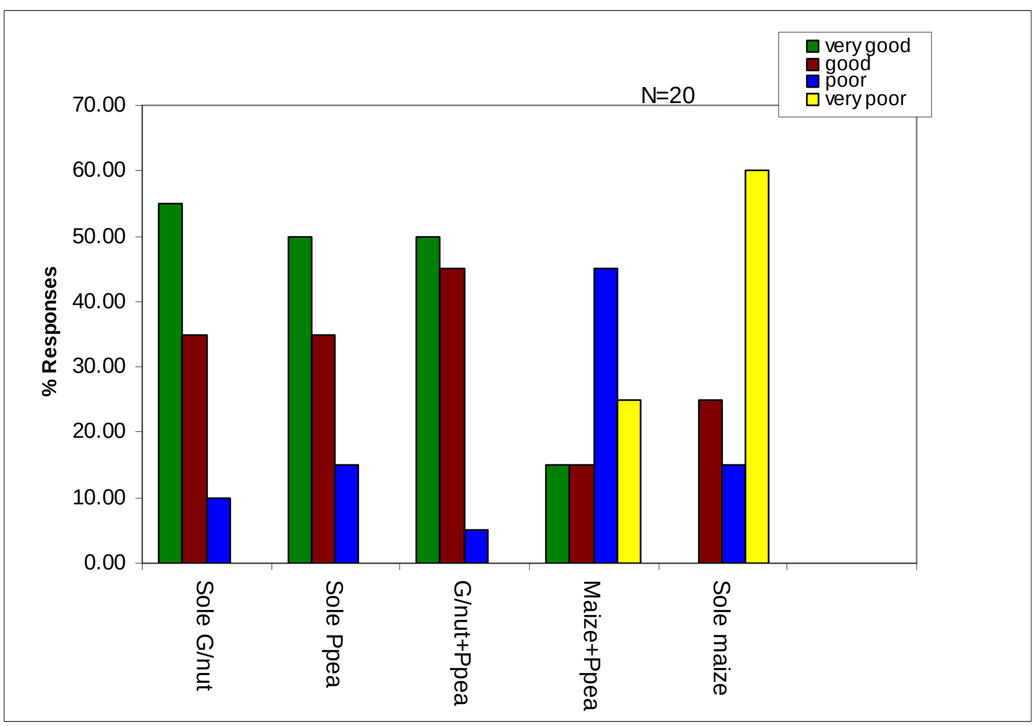

Fig 4: Farmer evaluation of technologies, 2007/2008 season: Ekwendeni

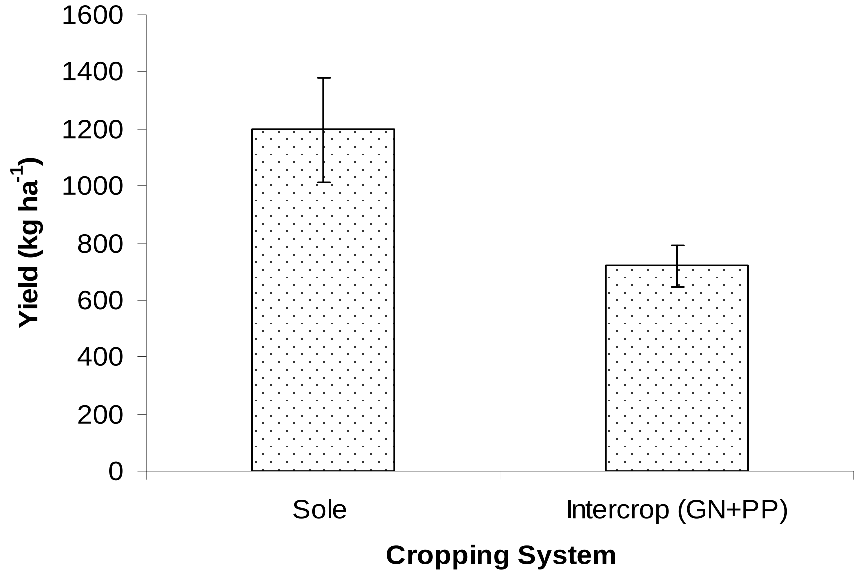

Figure 5: Groundnut yields from two cropping system technologies in 2008/09 Ekwendeni (preliminary data assessment)

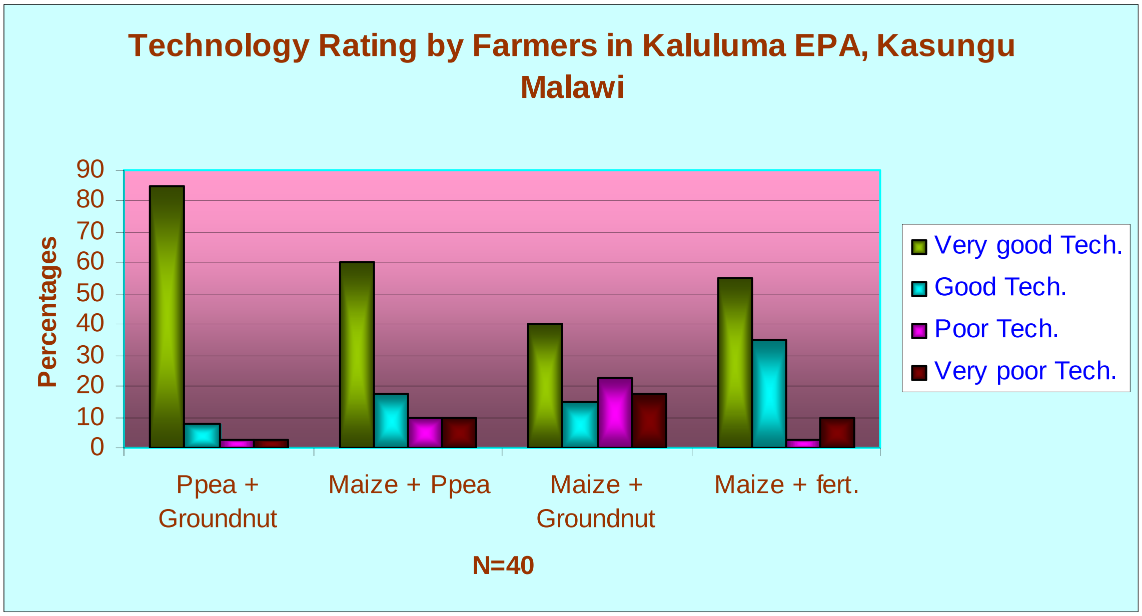

Figure 7: Farmer rating of technologies: Mkanakhoti EPA, Kasungu

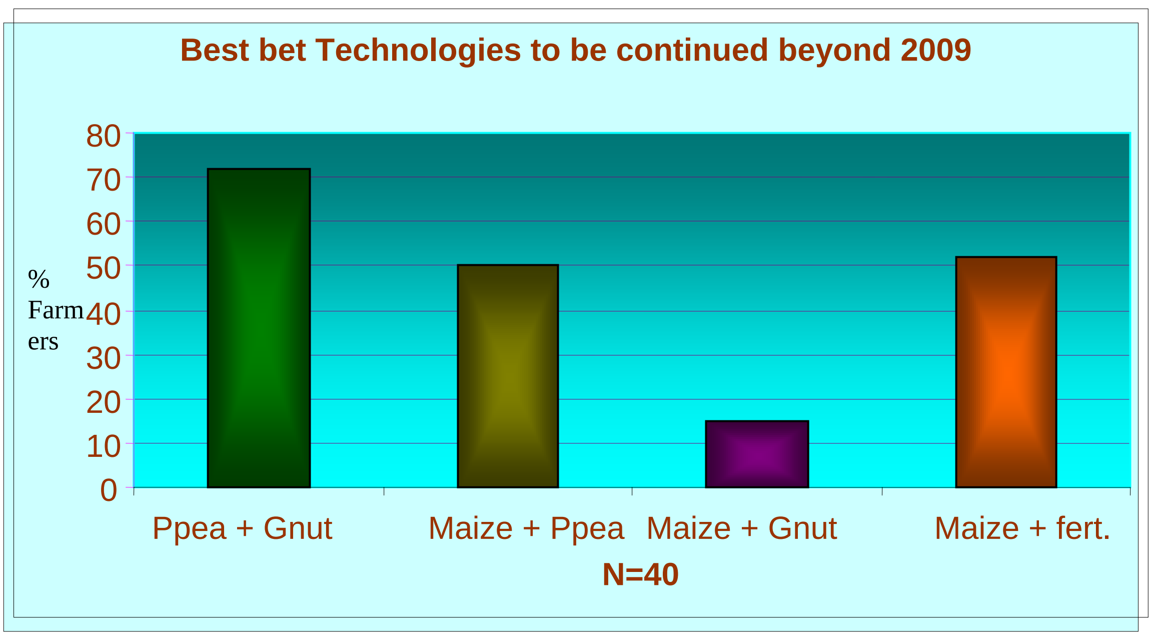

Figure 8: Farmer interest in technologies for 2008/9 season: Mkanakhoti EPA, KU

Fig 9: Visit Legume Best bet plots, Ekwendeni during the field day

Fig 10: Food testing session, recipe day, Ekwendeni.

Table 3: Maize response yields to legume residues and TRP incorporation in Kasungu on-farm trials

Treatments	**Grain yields kgha^{-1}**	
2007/08 season	2008/09 season	mean grain yield kgha^{-1}
1 Maize	Maize	837
2 Maize+TRP	Maize	1399
3 Maize+UREA	Maize	1327
4 Maize+PP biomass	Maize	1023
5 PP+G/nuts	Maize	1321
6 G/nuts	Maize	1578
7 G/nuts+TRP	Maize	1286
8 Maize+UREA+TRP	Maize	1059
9 Maize+PP+TRP	Maize	1472
10 Maize+G/nuts+TRP	Maize	1256
11 PP	Maize	1329

CV(%) = 55.6
SE = 286.4

Table 4: Treatments in 2008/09 cropping season

(i)	Soybean (uninoculated)
(ii)	Soybean(inoculated)
(iii)	Groundnuts
(iv)	Pigeonpea
(v)	Pigeonpea + Soybean (inoculated)
(vi)	Pigeonpea + Groundnuts
(vii)	Pigeonpea + Maize
(viii)	Maize + Urea
(ix)	Maize sole cropped

Table 5:Grain yields of sole, doubled-up legumes and maize

Treatment	**Mean grain yield (kg ha^{-1})**	**Harvest Index**
G/nuts sole cropped	2479^{a}	0.44^{a}
G/nuts intercropped with pigeonpea	1285^{b}	0.32^{b}
Soybean (inoculated)	2125^{a}	0.49^{ac}
Soybean(uninoculated)	1038^{b}	0.37^{bc}
Soybean intercropped with pigeonpea	1328^{b}	0.43^{c}
Pigeonpea sole cropped	131^{c}	0.02^{f}
Pigeonpea intercropped with G/nuts	116 ^{c}	0.00^{f}
Pigeonpea intercropped with soybean	62 ^{c}	0.00^{f}
Pigeonpea intercropped with maize	95 ^{c}	0.00^{f}
Maize	1391 ^{b}	0.24^{d}
Maize + UREA	2620 ^{a}	0.27^{d}
Maize intercropped with Pigeonpea	1782 ^{b}	0.30^{d}
CV(%)	69	39.9
LSD (0.05)	674	0.08
SED	341	0.04

Table 6: Land Equivalent ratios (LERs) for doubled up legumes compared to monoculture systems

Cropping system	**LER**
G/nuts + Ppea	1.4
Soy + Ppea	1.5
Ppea + Mz	2.0

Table 7: Field day lessons learnt by visiting farmers from Kaluluma EPA, Kasungu

Farmer	LESSONS LEARNT		
	RECIPES	FIELD and OTHER ACTIVITIES	WAY FORWARD
1	Preparation for relish Preparing 'soy coffee', soy milk, soy pieces, soy powder, baking cakes from 'madeya', bean meat preparation, relish from soy and boiled soy.	Planting of Mucuna	Soy relish preparation and boiled soy preparation
2	Relish from soy and boiled soy, Preparing 'soy coffee', soy milk, soy snack, baking cakes from 'madeya', soy mayonise, nsima from millet powder, porridge from sweet potatoes plus pumpkins	Spacing in maize pigeon pea intercrop, existence of communal village plots, village seed banks Commitment, Unity and good organization	Training others on soy recipe preparation.
3	Preparation of soy milk, soy pieces, boiled soy, nsima from soy powder, porridge from millet powder, bean meat, soy coffee, muccuna as a relish seasoning sweet potatoes with groundnut powder and soy plus cassava combination	Mucuna leafy biomass incorporation into the soil, soy pigeon pea intercropping, spacing in maize pigeon pea intercrop	Will train others on how to prepare boiled soy, soy relish, soya pieces and soya milk.
4	Preparation of soy milk, soy relish, soy coffee, soy snacks, nsima from millet flour.	Spacing in maize pigeon pea intercrop, soil fertility improvement using mucuna and soy pigeon pea intercrop.	Will train others how they can make soy milk, soy coffee, soya meat and porridge from millet flour
5	Preparation of soy milk, relish, pieces, boiled soy and bean meat	Application of fertilizer to maize in grooves that are mark along the ridge length, planting maize at 90cm apart with three seeds on a planting station when inter cropped with pigeon peas	Group organization, keeping clean fields Will call for a meeting and brief others of the trip. Will train others on soy milk, soy pieces preparation and boiling soy (chuwa)

Table 8: List of people who traveled from Kasungu and Bunda to Ekwendeni to attend the field day, in addition to hundreds of farmer participants

	Name of participant	Address
1	Prof G.Y.K Phiri	Bunda College/PI
2	Wezi Mhango	Bunda College
3	Mr Kalemeka chibwe	CAW/Farmer, Kaunda village, Kasungu
4	Antonnio Mazi	CAW/Farmer, Kaunda village, Kasungu
5	Mr Piki Longwe	CAW/Farmer, Tchezo village, Kasungu
6	Mr Bright Phiri	CAW/Farmer, Tchezo village, Kasungu
7	Hellings Chinjala	CAW/Farmer, Chaguma village, Kasungu
8	Mama Cecilia Phiri	CAW/Farmer, Chaguma village, Kasungu
9	Mama Josephine Chunga	CAW/Farmer, Ndaya village, Kasungu
10	Mama Emilida Khruza	CAW/Farmer, Ndaya village, Kasungu
11	Mr L. Banda	CAW/Farmer, Chisazima village, Kasungu
12	Mr S. Phiri	CAW/Farmer, Chisazima village, Kasungu

Key: CAW= Community Agricultural Worker

Table 9: List of people who attended field day in Kasungu in addition to hundreds of farmer participants

	Name of participant	Address
1	Prof GYK Phiri	Bunda College, PI, Legume Best Bets Project
2	Dr Charlie Riches	Mc Knight Foundation
3	Mr Bodzalekani	Program Manager, Kasungu ADD
4	Dr Kate Wellard Dyer	Bunda College
5	Ms Wezi Mhango	Bunda College
6	Dr P. Nalivata	Bunda College
7	Mr Keston Njira	Bunda College
8	Dr MAR Phiri	Bunda College
9	Dr D. Kambewa	Bunda College
10	Mr Mtawali	DADO, Kasungu
11	Mr Austin Phiri	Chitedze Agricultural Research Station
12	Mr H. Msusa	Director, MALEZA
13	Mr S. Kateta	MALEZA, Nkhamenya
14	Mr Jere	MALEZA, Nkhamenya
15	Mr P. Thawe	MALEZA, Nkhamenya
16	Ms D. Kafuwa	FAIR
17	Mr A. Chamango	ICRISAT-Malawi
18	T.A. Simulemba	Traditional Authority Simulemba
19	V.H. Ndaya	Ndaya Village
20	V.H. Kaunda	Kaunda Village
21	Mr L. Dakishoni	Ekwendeni Mission Hospital, SFHC project

22	Mr Zimba	Ekwendeni Mission Hospital, SFHC project
23	Mr Nyasulu	Mkanakhoti EPA
24	Mr Tinkhani Gondwe	SHFC, Ekwendeni
25	Mr Mukhala	SHFC, Ekwendeni
26	Mr A. Mafuleka	Farmer/SFHC Ekwendeni
27	Mama J. Chibango	Farmer/SFHC Ekwendeni
28	Mama M. Nyirenda	Farmer/SFHC Ekwendeni
29	GVH Chotha Tembo	Farmer/SFHC Ekwendeni
30	V.H. Zebedia Thawe	Farmer/SFHC Ekwendeni
31	Mr G. Khowoya	Farmer/SFHC Ekwendeni
32	Mama B. Lungu	Farmer/SFHC Ekwendeni
33	Mama L. Kaunda	Farmer/SFHC Ekwendeni
34	Mama E. Mhlanga	Farmer/SFHC Ekwendeni
35	Mama B. Lungu	Farmer/SFHC Ekwendeni
36	Mama L. Kaunda	Farmer/SFHC Ekwendeni
37	Mama E. Mhlanga	Farmer/SFHC Ekwendeni