FINAL TECHNICAL REPORT / RAPPORT TECHNIQUE FINAL

SCALING-UP IMPROVED LEGUME TECHNOLOGIES IN TANZANIA (SILT): FINAL TECHNICAL REPORT

Hampson, Karen;Sones, Duncan;Watiti, James;

et al;

IDRC Grant / Subvention du CRDI: 108127-001-Scaling Up Improved Legume Technologies in Tanzania (CIFSRF Phase 2)

Summary of findings from the SILT project outcome evaluation survey on common beans in northern Regions of Tanzania
March 28, 2018

1. Introduction

An important component of the SILT project was the implementation by Farm Radio International and partners of radio programs on improved practices for common beans to be aired in the northern Regions of Tanzania – Arusha and Manyara. These radio programs were aired on two radio stations Radio 5 and Habari Njema in 2016. An outcome evaluation survey was administered in January and February 2018 to assess the number of farmers in the project area that were reached by these radio programs, and the extent to which listening to the radio programs influenced their knowledge and up-take of improved practices for common beans.

2. Objectives of the outcome evaluation

Main objective: Assess the reach and impact of interactive rural radio programs on farmers' knowledge and up-take of improved common bean technologies promoted by the SILT project

Secondary objective: Assess potential synergies between SILT extension activity types (Radio, Demonstration plots, Leaflets, Campaign around Shujaaz comics).

It is important to highlight that the primary focus of this outcome evaluation was to assess the impact of the interactive radio component of the SILT project. To capture information about the reach of the radio program there was thus a need to implement a sampling strategy that would cover the entire area reached by the radio. By working across such a wide geographical scope, however, it was difficult to ensure that a sufficient number of households involved in other SILT activities would be included in the sample. Although some efforts were made during the sampling strategy to capture some information about the demonstration plots, the leaflets, and the Shujaaz comic book campaign, more in-depth assessments of these practices will be coming from other SILT partners.

3. Sampling strategy

The sampling strategy included two components.

3.1 First component of sampling procedure

A two-stage cluster sampling procedure was implemented in the five Districts in the North that were located within the zone covered by the two radio stations (Radio 5, Habari Njema). These included Arumeru and Karatu in the Arusha Region, and Hanang, Babati and Mbulu in the Manyara Region.

In each District, we randomly selected a number of communities – the Primary Sampling Units (PSU), for which we then randomly selected a number of households – the Secondary Sampling Units (SSU).

The number of households to be sampled in each District was determined using the following equation:

$$n = (\frac{Z^2 pq}{e^2} \text{ X DEFF})/(1\text{-NRR}) \sim 275 \text{ households/District}$$

- Z = 1.96; z-score for 95% confidence interval
- *p* = 0.09; expected proportion of 'adopters' among rural adult age population within areas covered by radio; *q* = 1 - *p*
- *e* = 0.05; margin of error
- *DEFF* = 2; design effect associated with use of cluster sampling design
- NRR= 0.10; non-response rate

The proportion of expected 'adopters' *p* = 0.09 was obtained by dividing 50,000 by 567,315 with the 50,000[1] coming from equally dividing the target of 100,000 farmers up-taking one or more of the promoted practices between the common bean and soybean components of the project. The 567,315[2] was based on an estimation of the rural adult population living within the zone covered by the radio stations.

In each District, the 275 households were to be randomly sampled across 11 communities at 25 households per community. Using information gathered from the radio broadcasters involved in the project, communities in each District were initially classified into those being able to receive the radio signal (and hear the radio program) and those not receiving the signal. Out of the 11 communities in each District, 7 were randomly selected among those receiving the signal and 4 among those not receiving the signal. In total, this first component of the sampling procedure included 1375 households – 5 Districts X 11 communities/Districts X 25 households/community.

3.2 Second component of sampling procedure

The second component of the sampling procedure involved the selection of communities that had hosted the demonstration plots implemented by AFAP and communities that had received Shujaaz comics from WTS. The six villages that hosted demonstration plots in the North were included in the survey, each of them located in a different Districts in Arusha, Manyara and Kilimanjaro. From the list of villages that had received Shujaaz Comics, we randomly selected two villages for each of the Districts involved in the project in the North.

In each of the 20 villages included in this second component, we randomly selected 25 households for a total of 500 households.

The total sample size for the survey was thus planned to be 1875 households.

3.3 Sampling of households within individual communities

At the level of individual communities, the 25 households were selected randomly from list of farmers provided by local authorities. A quota of 50/50 female vs. male respondents was implemented. In communities hosting a demonstration plots, we also attempted to have 50% of respondents from those who had visited the demonstration plots.

[1] We later revised this idea of splitting the target equally between the two crops because of the large difference in the proportion of farmers cultivating each of them. In effect, the common bean component is likely to contribute a greater share of that target.
[2] This estimation was later revised to be 699,704.

3.4 Important note about sampling strategy

Upon implementation of the survey on the ground, we realized that the classification provided by the radio broadcasters to determine whether a community was located within the zone covered by the radio stations did not correspond exactly to what was encountered in the field. Several communities initially classified as being able to receive the radio signal were not, in fact, receiving it. Inversely, some of the communities that were considered 'controls' seemed to be able to listen to the program. Since it was important for our extrapolation procedure to determine whether a household was able to listen to the radio program or not, we decided to proceed as follows:

- Using the GPS of individual households, identify and include the ones falling within the area reached by the radio stations (using radio coverage maps – see Extrapolation section below).
- Also, include communities that (i) were located within 5 km of the area reached by the radio stations and (ii) had at least 4 households listening to the program. We considered these communities as being able to listen to the program.

Using this approach, we identified 1166 households (out of the 1886) that could be viewed as being able to listen to the radio programs.

It should be noted that we are currently working towards developing a 'ground truthing' procedure that would permit us to determine, while conducting the survey, whether a household is able to listen to the radio station or not.

4. Characteristics of respondents and households

4.1 Gender and Administrative Units

As per the design of the survey, the percentage of male and female respondents was about 50/50. The distribution of households across the Districts followed the initial sampling strategy.

Table 1. *Distribution of sampled households according to gender of the respondents and Districts*

Regions/Districts	Female	Male	Total
Arusha	**372**	**332**	**704**
Arumeru	187	165	352
Karatu	185	167	352
Kilimanjaro	**68**	**83**	**151**
Moshi rural	34	46	80
Rombo	34	37	71
Manyara	**500**	**531**	**1031**
Babati	177	174	351
Hanang	160	196	356
Mbulu	163	161	324
Total	**940**	**946**	**1886**

4.2 Information about respondents

The following tables provide information about age, years of farming experience, education levels of the respondents, and ownership of a mobile phone. Relatively few respondents could be found among the younger age category (15-24). Overall, female respondents tended to be younger than male respondents. In terms of years of farming experience, respondents were well distributed across the various categories, with no gender difference. For their educational level, the majority (~70%) of farmers indicated that they had completed primary school. A significant difference between male and female respondents was observed ($p < 0.001$) in ownership of mobile phone with 82.7% of male respondents owning a cell phone compared to 67.1% for female respondents.

Table 2. *Age of female and male respondents*

Age categories	Female	Male	Total
15-24	5.0%	2.4%	3.7%
25-45	55.4%	48.0%	51.7%
46-60	29.7%	35.1%	32.4%
>60	9.9%	14.5%	12.2%
Total	**100.00%**	**100.00%**	**100.00%**

Table 3. *Years of farming experience of female and male respondents*

Years Farming Experience	Female	Male	Total
0-5	17.4%	15.5%	16.5%
6-10	16.0%	15.2%	15.6%
11-15	12.9%	10.8%	11.8%
16-20	13.8%	13.7%	13.8%
21-30	19.6%	20.2%	19.9%
more than 30	20.3%	24.5%	22.4%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4. *Education level of female and male respondent*

Education level	Female	Male	Total
No formal education and cannot read and write	5.85%	4.65%	5.25%
No formal education and can read and write	4.47%	4.33%	4.40%
Some primary	5.74%	4.97%	5.36%
Completed primary	70.85%	69.87%	70.36%
Completed secondary	10.96%	11.10%	11.03%
Completed post-secondary	2.13%	5.07%	3.61%
Total	**100.00%**	**100.00%**	**100.00%**

Table 5. *Respondent's ownership of a mobile phone*

Ownership of mobile phone	Female	Male	Total
Yes, it is mine.	67.13%	82.66%	74.92%
Yes, I use someone else's mobile phone.	15.32%	6.98%	11.13%
No, I do not have access to a mobile phone.	17.55%	10.36%	13.94%
Total	**100.00%**	**100.00%**	**100.00%**

4.3 Household headship

There were significant differences between female and male respondents in terms of the type of household headship they belonged to. On the one hand, practically all male respondents (97.6%) belonged to a male-headed household. On the other hand, although male-headed households were also the dominant type (74%) for female respondents, 23.2% came from either female-headed households or female-managed households (male is away most of the time).

Table 6. *Type of household headship for female and male respondents*

Type of household headship	Female	Male	Total
Male-headed household	74.0%	97.6%	85.8%
Male-headed, female-managed household (male away most of the time)	7.6%	1.7%	4.6%
Female-headed household (widow, single, divorced, etc.)	15.6%	0.7%	8.2%
Joint male- and female-headed household	2.8%	0.0%	1.4%
Total	**100.0%**	**100.0%**	**100.0%**

4.4 Household size

Table 7 shows the number of people per household suggesting an average around 5.5, which is in-line with national statistics for Tanzania.

Table 7. *Number of people in households for female and male respondents*

Number of people in households	Female	Male	Total
1 to 2	5.1%	7.4%	6.3%
3 to 4	25.2%	23.7%	24.4%
5 to 6	33.8%	32.1%	33.0%
7 to 8	21.8%	22.2%	22.0%
9 to 10	8.8%	9.2%	9.0%
more than 10	5.2%	5.4%	5.3%
Total	**100.0%**	**100.0%**	**100.0%**

4.5 Land ownership and size

Respondents indicated that most of the land was owned either through a formal title (48%) or customary rights (31.5%). Most respondents (79.7%) indicated that their farmland was 5 acres or less.

This percentage was 84.7% for women respondents compared to the men (74.8%; $p = 0.001$, chi-square test)

Table 8. *Ownership of the land for female and male respondents*

Most of the land is …	Female	Male	Total
… owned through a formal title	48.51%	47.57%	48.04%
… owned through customary rights	30.21%	32.77%	31.50%
… rented from the owner	10.43%	9.41%	9.92%
… considered owned by the household without formal allocation	8.94%	6.87%	7.90%
… borrowed from the owner	0.74%	1.27%	1.01%
… part of communal or "trust" land allocated by local authorities	0.53%	1.06%	0.80%
… given temporary free access from the owner	0.43%	0.42%	0.42%
Other	0.11%	0.53%	0.32%
I don't know	0.11%	0.11%	0.11%
Total	**100.00%**	**100.00%**	**100.00%**

Table 9. *Size of farmland for female and male respondents*

Size of farmland (acres)	Female	Male	Total
Less than 2 acres	38.94%	28.33%	33.62%
2-5 acres	45.74%	46.51%	46.13%
More than 5 but less than 10 acres	11.06%	17.34%	14.21%
10 acres or more	4.15%	7.61%	5.89%
I don't know	0.11%	0.21%	0.16%
Total	**100.00%**	**100.00%**	**100.00%**

4.6 Characteristics of the dwellings

Most households obtained their water from a public tap, well or borehole, followed by piped water into their dwelling, yard or plot. No gender differences were observed. Most households lived in dwellings with an iron sheet roof (88.9% - results not shown). For the wall material, 46.4% used baked bricks, compared to 26.3% for poles and mud and 17.6% for cement bricks (results not shown). Results about the characteristics of the dwelling are in line with the statistics provided by the government of Tanzania for these Regions[3].

Table 10. *Source of drinking water for female and male respondents*

Source of drinking water	Female	Male	Total
Public tap/well/borehole	42.7%	42.2%	42.4%
Piped water into dwelling/yard/plot	28.3%	29.4%	28.8%
Surface water (river, lake, dam, etc.)	10.1%	10.9%	10.5%
Neighbour's tap/well/borehole	7.0%	6.8%	6.9%

[3] Basic Demographic and Socio-Economic Profile, Statistical Tables, Tanzania Mainland. 2014. National Bureau of Statistics, Ministry of Finance, Dar es Salaam & Office of Chief Government Statistician, Ministry of State, President's Office, State House and Good Governance, Zanzibar.

Spring	5.0%	4.5%	4.8%
Well in own yard/plot	3.7%	4.4%	4.1%
Other	3.2%	1.8%	2.5%
Total	**100%**	**100%**	**100%**

4.7 Household assets

Information about various household assets was collected. In future analyses, using the data on assets, types of dwelling, sources of water and energy, we will be examining the potential to create some wealth index to be used as an explanatory variable for listenership and adoption in regression analysis.

In Table 11, we see that significant differences between female and male respondents were observed for household ownership of mobile phones, radios, bicycles and ox-ploughs, with more male respondent's households owning these assets.

Table 11. *Percentage of households owning the different assets for female and male respondents*

Assets	Female	Male	Total
Mobile phone*	78.2%	85.2%	81.7%
Radio*	58.6%	65.0%	61.8%
Bicycle*	37.1%	49.0%	43.1%
Ox plough*	34.0%	39.4%	36.7%
Cooker	28.7%	28.8%	28.7%
Motorcycle	21.7%	25.2%	23.4%
Television	18.2%	21.7%	19.9%
Car Truck	3.1%	3.7%	3.4%
Refrigerator	1.9%	2.7%	2.3%
Tractor	1.7%	2.4%	2.1%

* Difference between female and male respondents significant at $p < 0.05$ level

4.8 Sources of income

Most respondents indicated that their main source of household income came from selling produces from their own farm (88.3%), followed by running their own business (19.0%) and earning wages through a regular job (14.3%). These results highlight the great dependence of these farming families on agricultural and livestock production, and the relatively low diversification of income.

Table 12. *Sources of household income for female and male respondents*

Sources of household income	Female	Male	Total
Selling produces from own farm	87.4%	89.2%	88.3%
Running own business	18.9%	19.0%	19.0%
Earning wages regular job	13.3%	15.3%	14.3%
Earning wages from occasional job	9.9%	13.2%	11.6%
Loan credit	7.0%	5.9%	6.5%
Receiving gifts remittances	3.0%	2.5%	2.8%

Renting out own land	2.4%	2.9%	2.7%
Receiving subsidy of some sort	2.1%	2.3%	2.2%
Other	1.5%	2.3%	1.9%
No income	1.6%	1.2%	1.4%

4.9 Food security

A few survey questions were included to provide basic information regarding food security, dietary diversity, and food sources. Table 13 shows that about half of the respondents indicated to have experienced some form of food insecurity during the year. Most of the households lacking food part of the year indicated that this situation occurred 'sometimes'. The difference between sex was significant (p = 0.024) with slightly more female respondents indicating that they had experienced food insecurity.

On average, respondents indicated that they were having a source of protein (meat, eggs, legumes) 3 days per week (standard deviation = 1.75) with no significant difference between sex (results not shown). Finally, practically all respondents (96.9%) indicated that they were getting their food from their own land, with 42.9% stating getting food from the markets. Other sources of food (gifts, aid, food for work, harvest from outside the farm) were all below (3%).

Table 13. *Frequency of household not having enough food in last 12 months for female and male respondents*

Frequency of household not having enough food in last 12 months	Female	Male	Total
Never	48.1%	53.5%	50.8%
Seldom	10.2%	6.4%	8.3%
Sometimes	38.9%	37.3%	38.1%
Usually	2.2%	2.3%	2.3%
Always	0.5%	0.4%	0.5%
Total	**100.0%**	**100.0%**	**100.0%**

4.10 Livestock

Farming systems in the project area can be characterized as mixed crop-livestock systems. Table 14 illustrates the ownership of the main types of livestock. Birds, including chicken, turkey, pigeons, etc., are owned by a majority of households (85.2%), followed by cattle (70.4%) and goats (58.7%). The difference between female and male respondents was only significant (p < 0.001) for goats. Among households owning cattle, over 50% owned five animals or more (Table 15), suggesting the importance of cattle ownership in the project area.

Table 14. *Percentage of households owning the following livestock types for female and male respondents*

Livestock type	Female	Male	Total
Birds – chicken, turkey	86.3%	84.0%	85.2%
Cattle	68.9%	71.9%	70.4%

Goats	54.7%	62.7%	58.7%
Sheep	25.9%	28.3%	27.1%
Pigs	10.4%	9.3%	9.9%
Donkeys	7.0%	6.9%	6.9%

Table 15. *Number of animals owned by households owning cattle for female and male respondents*

Number of cattle owned	Female	Male	Total
1	12.4%	9.0%	10.6%
2	27.9%	26.9%	27.4%
3-5	8.2%	8.2%	8.2%
More than 5	51.5%	55.9%	53.7%
Total	**100.0%**	**100.0%**	**100.0%**

4.11 Common beans and other crops

As per the design of the survey, all respondents grew common beans. Although more households tended to use common beans at home, many were also selling them at the market or doing a mixture of home consumption and selling at the market (Table 16). The difference was significant among female and male respondents (p = 0.003), with women more likely to use common beans at home. Among households selling common beans, about 47.2% indicated that these were their main cash crop (results not shown). Close to 74% of respondents indicated that they were intercropping beans with maize compared to 19% for monocropping (Table 17). Table 18 further illustrates the domination of the maize-bean cropping system in the project area. No significant differences between female and male respondents were observed in the percentage of households growing the different crops. In the context of the SILT project, it is interesting to note that the use other legumes was relatively low.

Table 16. *Common beans consumed at home or sold at market*

Common beans used at home or sold at market	Female	Male	Total
All or almost all is used at home	24.9%	19.9%	22.4%
Most is used at home	27.0%	23.4%	25.2%
About an equal amount is used at home and sold	15.7%	16.8%	16.3%
Most is sold	31.2%	38.5%	34.8%
All or almost all is sold	1.2%	1.5%	1.3%
Total	**100.0%**	**100.0%**	**100.0%**

Table 17. *Percentage of respondents intercropping beans with maize vs. growing beans in monocrop*

Intercrop vs. monocrop	Female	Male	Total
Intercrop with other crops	75.6%	72.2%	73.9%
Monocrop	16.9%	21.1%	19.0%
Both	7.4%	6.7%	7.1%

Total	**100.0%**	**100.0%**	**100.0%**

Table 18. *Percentage of households growing the following crops for female and male respondents*

Crops	Female	Male	Total
Maize	99.4%	98.2%	98.8%
Sunflower	30.1%	32.8%	31.4%
Vegetables	16.1%	15.5%	15.8%
Bananas	15.2%	14.6%	14.9%
Soybeans	12.8%	13.7%	13.3%
Sorghum	11.8%	10.7%	11.2%
Sweet potatoes	4.1%	5.4%	4.8%
Green grams/mung beans	4.0%	3.4%	3.7%
Rice, paddy	3.2%	3.3%	3.2%
Irish potatoes	3.2%	3.2%	3.2%
Cassava	3.1%	3.2%	3.1%
Wheat	2.0%	2.4%	2.2%
Pearl millet	1.3%	1.9%	1.6%
Finger millet	1.5%	1.5%	1.5%
Plantain	1.4%	1.2%	1.3%
Groundnut	1.2%	1.1%	1.1%
Pigeon peas	0.6%	0.5%	0.6%
Rice, lowland	0.2%	0.7%	0.5%
Cowpeas	0.3%	0.3%	0.3%

4.12 Source of agronomic information

Most farmers included family, friends and other farmers as one of their main sources of agriculture information (75%). This was followed by extension services at 31% and radio programs at 14%.

Table 19. *Sources of agronomic information for female and male respondents*

Source of agronomic information	Female	Male	Total
Family/friends/other farmers	76.0%	74.7%	75.3%
Extension services	27.1%	34.0%	30.6%
Radio programs	12.8%	15.9%	14.3%
NGOs	8.6%	11.2%	9.9%
Other	10.2%	8.4%	9.3%
Demonstration plots	7.3%	9.3%	8.3%
Farmer group/co-operative	5.1%	6.8%	5.9%
Agro-dealers	4.5%	6.9%	5.7%
Leaflets, posters, flyers	2.6%	4.7%	3.6%
Farmer field days	0.7%	2.2%	1.5%

Comic books	0.0%	0.8%	0.4%
Cell phone messages	0.3%	0.6%	0.5%

In total, 256 farmers indicated that they had listened to the radio program. When only considering the 1166 households located within the radio coverage area, the percentage of listening households corresponded to 19.55% of the households. This is lower than what we have observed in many other FRI projects. In part, this may be explained by the gap in time between the administration of the survey and the project activities.

As indicated above, relatively few households from the sample had been exposed to the demonstration plots (116), the leaflets (57) and the comics (17). Note that in the case of the comics, an additional section was included in the questionnaire to specifically ask whether a youth (15-24) could answer a few questions. Including this additional section, the total number of households exposed to the Comics was 47.

4.13 Factors influencing listenership to radio program

Relationships between listenership and other household characteristics were examined to get a better understanding of factors potentially influencing listenership. For the sake of this summary, these relationships were explored using simple cross-tabulations combining listenership with one or two other variables. Future work will include the use of regression analysis that can consider potential correlations among independent variables. For these analyses, we are limiting the sample to the 1166 households that were located within the area covered by the radio stations.

Overall, many of the variables tested did not show a significant relationship with listenership. Gender (p = 0.004), however, was significantly related to listenership with 23% of male respondents listening to the program compared to 16.4% for women. Education level (p = 0.001) was also significant with listeners having a higher educational level. More of the respondents who listened to the program also owned a mobile phone. A higher percentage of listeners came from households that owned the following assets (using gas for cooking, radios, mobile phones, refrigerator, car, bicycle), suggesting that listeners may be, on average, relatively wealthier than non-listeners. Expectedly, the effect of radio ownership by the household was particularly strong with 90.4% of listeners belonging to households owning a radio compared to 61.3% for non-listeners. This potential relationship between wealth and listenership is also suggested by the higher percentage of listeners earning income from a regular job (22.8%) compared to non-listeners (12.6%; $p < 0.001$). No relationship was observed, however, between listenership and ownership of livestock or the size of the farm.

5. Impact of project activities

5.1 Assessing impact of project activities on farmers' knowledge of improved practices

The survey included nine questions aimed at capturing farmers' knowledge of issues related to improved common bean technologies and practices.

The knowledge questions were addressing the following topics:

K1. Recommended spacing for row planting

K2. Planting time for prevention of bean fly/bean stem maggot

K3. Recommended number of times for weeding
K4. Knowledge that common beans improve soil fertility
K5. Use of fertilizer with common beans
K6. PICS bags being most effective storage method to reduce yield losses
K7. Better to not grow beans in the same field season after season
K8. Aphids can be controlled with soapy water
K9. No need to chemically treat seed against storage pests with PICS bags

In addition to examining knowledge questions individually, we calculated an average score, expressed as the percentage of correct answers across the 9 questions.

For each project activity (radio, demonstration plots, leaflets, comics), performance on the knowledge questions was compared between respondents being exposed or not to the activity. We used a chi-square test to test difference in proportion of correct answers between the two groups. For the average score, the comparison was performed with a Mann-Whitney U test. P-values obtained in SPSS were divided by two to treat the tests as one-tailed statistical tests – i.e., we were interested to examine whether farmers involved in SILT project activities had a HIGHER knowledge score than that of non-participants. Differences with a *p*-value of 0.05 or less were considered significant.

Figures 1, 2 and 3 present the results for the radio program, the demonstration plots, and the leaflets, respectively.

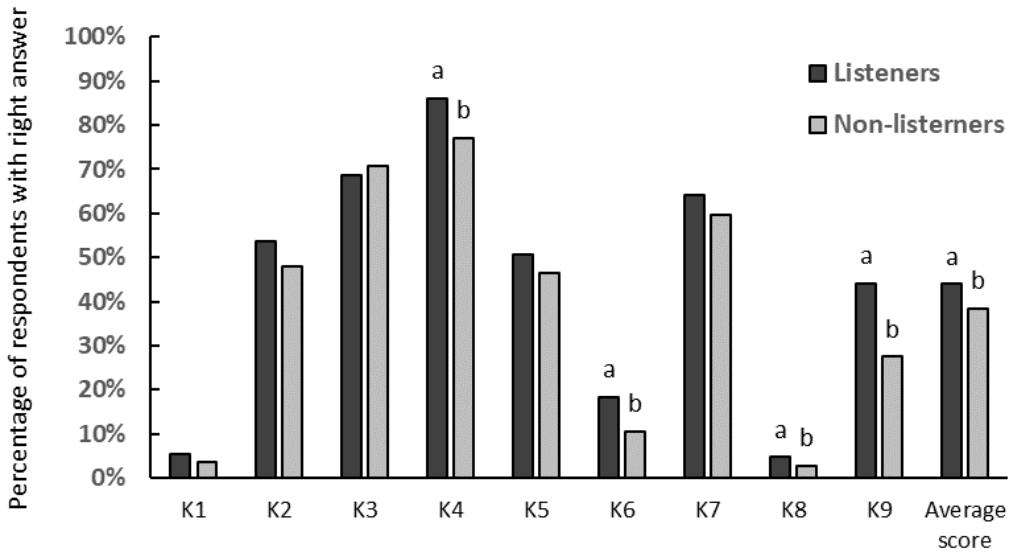

Figure 1 *Percentage of respondents with the correct answers for each of the nine knowledge questions, and for the average score across the 9 questions, comparing listeners and non-listeners of the radio programs. For each individual question, bars with a different letter are considered significantly different.*

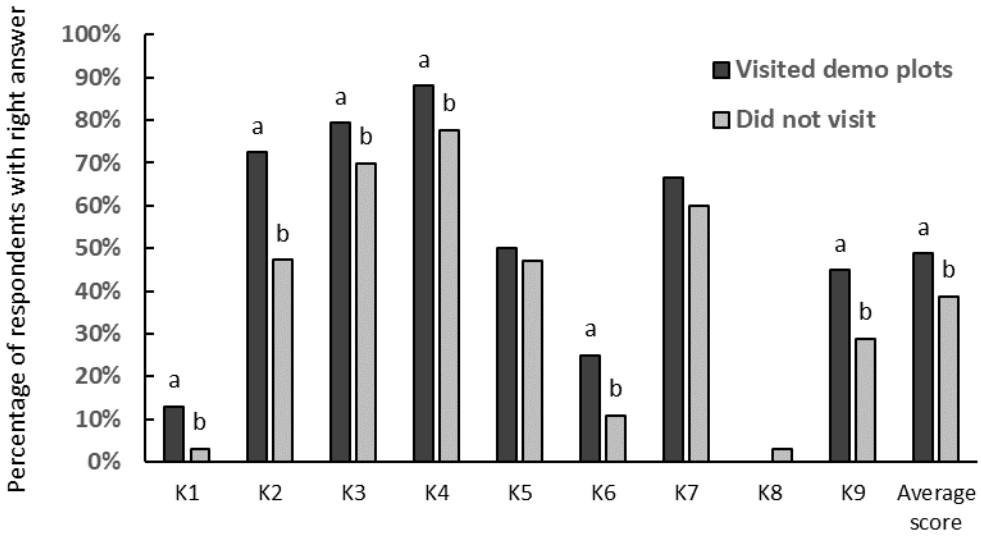

Figure 2 *Percentage of respondents with the correct answers for each of the nine knowledge questions, and for the average score across the 9 questions, comparing respondents who had visited and not visited the demonstration plots. For each individual question, bars with a different letter are considered significantly different.*

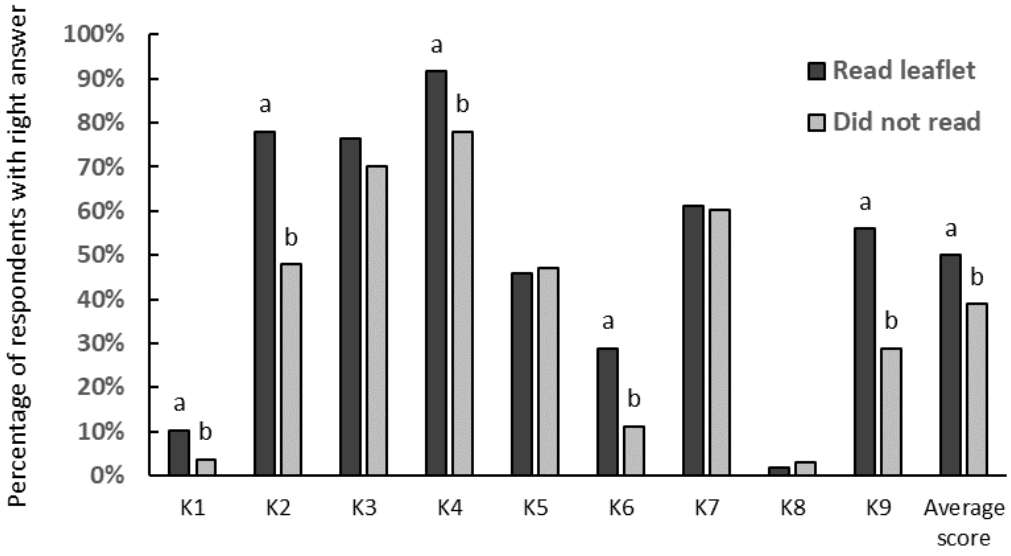

Figure 3 *Percentage of respondents with the correct answers for each of the nine knowledge questions, and for the average score across the 9 questions, comparing respondents who read and did read the leaflets. For each individual question, bars with a different letter are considered significantly different.*

The small sample of respondents who read the Comics (n = 17) limited our ability to perform a reliable analysis. Using a Fisher's Exact test, however, we observed that reading the Comics had a positive effect on K4 (100% vs. 78.1%, p = 0.015) and on the average score (48.3 vs. 39.1%, p = 0.022).

Overall, results for the knowledge quiz were relatively similar among the different project extension activities. On average, all project activity types had a significant effect on the average score calculated across the 9 questions.

In all cases, knowledge questions on row spacing (K1), and the control of aphids (K8) had a very low score. For K1, this suggests that either farmers did not learn much about that practice or, alternatively, that they may have forgotten considering the relatively important gap between the time the survey was administered and when the project activities took place. The K1 question on spacing was quite technical as it was asking for specific measurements. For K8, it suggests that the 'topic' may not have been well covered by the various project interventions. For K6 on PICS bags, although the percentage of correct answers was relatively low, respondents exposed to project activities had higher scores than those not exposed. The project had a significant effect on K4, the knowledge that common beans could improve soil fertility. The percentage of correct answers was, however, also relatively high among farmers not exposed to project activities.

5.2 Effect of project activities on up-take of improved practices

The survey included a series of questions regarding the up-take by the respondents of a variety of practices considered part of the 'package' of improved legumes technologies promoted by the SILT project. Seven (7) practices were considered here:

P1. Incorporation of residues when preparing land
P2. Use of improved varieties of common beans
P3. Use of recommended spacing for row planting
P4. Use of recommended weeding
P5. Use of fertilizer with common beans
P6. Following proper harvest time
P7. Use of PICS bags

We also calculated the number of respondents who had started implementing at least one, two or three of the promoted practices. Attention was also put on P2 – the use of improved varieties of common beans as this was the central piece of the improved legume technologies promoted by SILT.

For each project activity (radio, demonstration plots, leaflets, comics), the percentage of farmers who had started using each of the seven practices was compared between respondents being exposed or not to the activity. We used a chi-square test to test difference in proportion of farmers up-taking the practice between the two groups. P-values obtained in SPSS were divided by two to treat the tests as one-tailed statistical tests – i.e., we were interested to examine whether farmers involved in SILT project activities had a HIGHER uptake of the practice than that of non-participants. Differences with a p-value of 0.05 or less were considered significant.

Figures 4, 5 and 6 present the results for the radio program, the demonstration plots, and the leaflets, respectively.

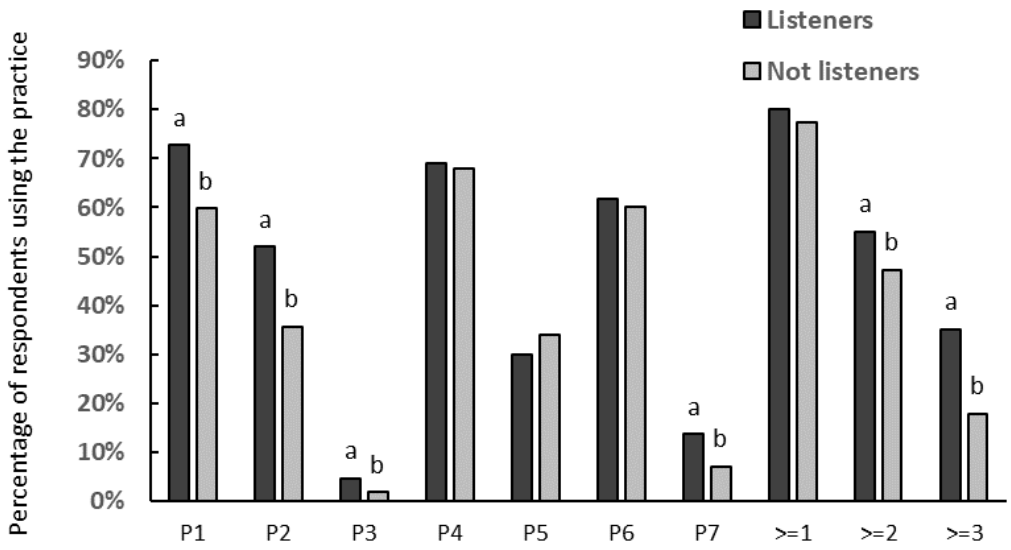

Figure 4 *Percentage of respondents using each of the improved practices and practicing more than 1, 2 or 3 practices, between respondents listening and not listening to the radio program. For each practice, bars with a different letter are considered significantly different.*

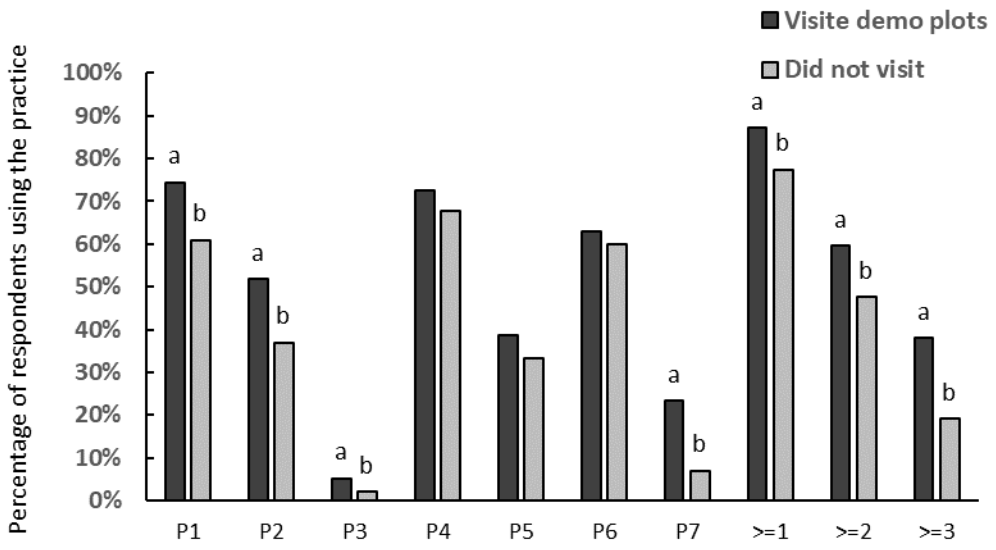

Figure 5 *Percentage of respondents using each of the improved practices and practicing more than 1, 2 or 3 practices, between respondents who had visited and not visited the demonstration plots. For each practice, bars with a different letter are considered significantly different.*

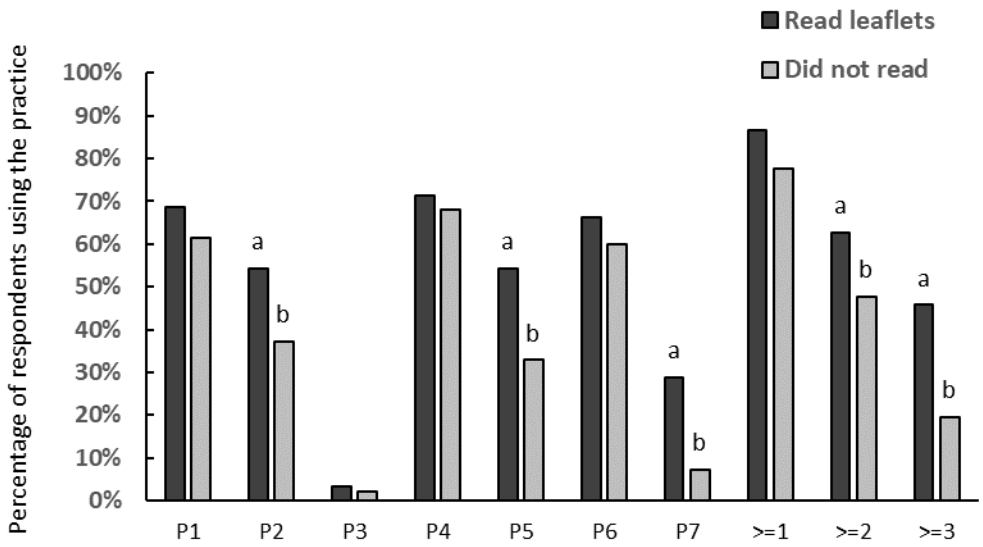

Figure 6 Percentage of respondents using each of the improved practices and practicing more than 1, 2 or 3 practices, between respondents who read and did not read the leaflets. For each practice, bars with a different letter are considered significantly different.

For the Comics, using a Fisher's Exact Test (one-sided test), there was a significant effect for P5 (58.8% vs 33.3%, p = 0.028), P7 (29.4% vs. 7.8%, p = 0.009) and >=3 (52.9% vs. 20.0%, p = 0.003).

Perhaps the most interesting result in Figures 4 to 6 is the positive influence of the three main project activities on the uptake of improved varieties of common beans (P2), a key component of the SILT project. The use of PICS bags (P7) was also significantly influenced by all the types of project activities even though the proportion of farmers using them remains relatively low. The incorporation of residues during land preparation (P1) was also positively influenced by project activities, although the effect was not significant for the leaflets.

Practices such as following the proper harvest time (P6) and the recommended weeding (P4) were used by a high proportion of farmers and were not significantly influenced by the project, suggesting that these practices were already relatively well-established among farmers. For P5, the use of fertilizers with common beans, only the leaflets seem to have had a significant effect.

The effect of project activities could also be seen on the percentage of farmers using at least one, two or three practices, with this effect being stronger as one considers a greater number of improved practices being up-taken.

5.3 Focus on improved varieties

As indicated in the previous section, SILT project activities seemed to have had a positive effect on the uptake of improved varieties of common beans. Among respondents using improved varieties (n = 713), the most popular varieties were *Jesca, Uyole njano and Lyamungo 90*. Close to 70% of respondents using improved varieties indicated that they selected the variety for its higher yield, followed by the market demands (52%). About 39% of respondents indicated that they had no problem accessing seeds of improved varieties. Among those experiencing some difficulty accessing improved seeds, the majority indicated that they were too expensive.

Table 20. *Percentage of respondents using the different improved varieties and identifying the variety as their main improved variety.*

Improved variety	Percentage of respondents using the variety	Percentage of respondents identifying variety as their main variety
Jesca	65.1%	42.2%
Uyole njano	51.6%	26.5%
Lyamungo 90	34.8%	20.2%
Selian 97	12.6%	2.5%
Selian 94	8.6%	3.1%
Other	8.0%	5.5%

Table 21. *Reasons given by respondents for selecting the improved variety*

Reasons for selecting improved variety	
High yielding	69.8%
High market demand	52.0%
Resistance to drought	39.7%
Available locally	32.5%
Early maturity	28.6%
Tolerance to low soil fertility	16.8%
Disease resistance	14.7%
Other	12.6%
Good leaf texture for consumption	3.9%

Table 22. *Main problems accessing improved variety seeds*

Main problems accessing improved variety seeds	
Too expensive	42.5%
Long distance to get seeds	25.0%
Limited credit to purchase	10.0%
Unavailability of improved seeds	7.4%
Other	5.5%
No problems	39.4%

5.4 Combination of approaches

Because the survey on common beans administered in the Northern Regions included information about project activities other than the interactive radio component, this allowed us to examine how the combination of approaches may have enhanced knowledge and practice of improved legume technologies.

As indicated previously, because the survey was administered randomly across many communities and over a wide geographical scope, the number of respondents who were exposed to other project

activities was relatively small – Demonstration plots (116), Leaflets (59) and Shujaaz Comics (17). As a result, it was not possible to look at all the possible combinations of project activities. To capture this idea of 'synergy' among the four types of project activities, we classified the respondents into those exposed to "none", "one" or "two or more" of the project activities, regardless of what they were. These three levels of project 'intensity' were then compared in terms of their effect on knowledge and uptake of practices of improved legume technologies by farmers.

Figures 7 and 8 below illustrate the effect of the level of intensity of the project – i.e., number of project activities that farmers were exposed to, on knowledge and up-take of improved practices.

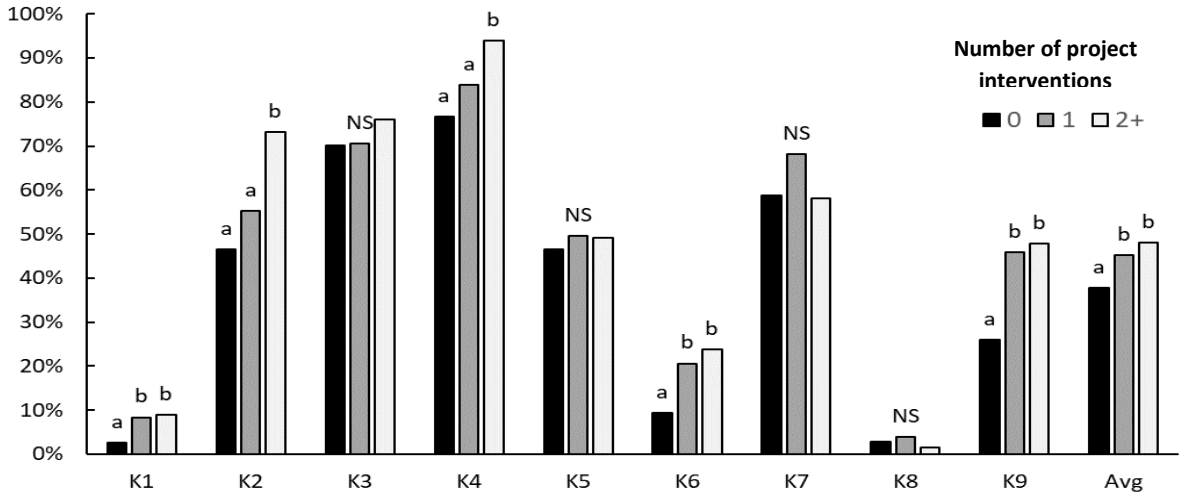

Figure 7 Percentage of correct answers for each of the 9 knowledge quiz questions and average score across all questions for respondents exposed to 0, 1 or 2 or more project interventions. For each question, bars with a different letter are significantly different.

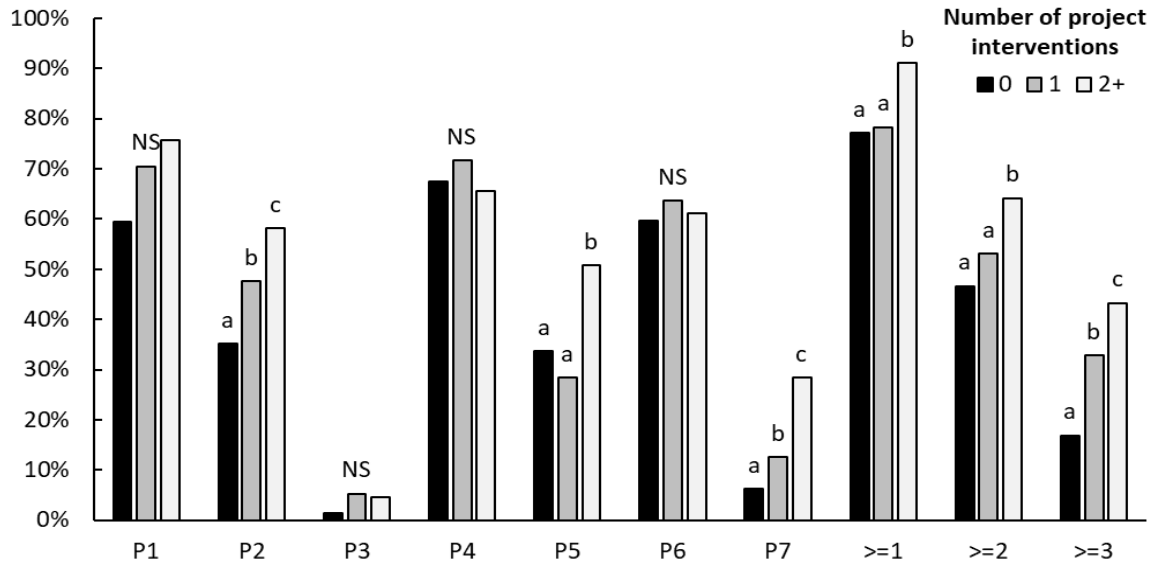

Figure 8 *Percentage of respondents using each of the improved practices and practicing more than 1, 2 or 3 practices for respondents exposed to 0, 1 or 2 or more project interventions. For each practice, bars with a different letter are significantly different.*

Results suggest that, overall, the use of multiple delivery and communication approaches had a positive effect on the knowledge and uptake of the promoted technologies. K1, K2, K4, K6, K9 and the average score were all positively affected by the number of project activities that farmers were exposed to, suggesting some potential synergies between the different extension approaches used in the project.

Although practices such as row spacing, weeding, and harvest time were not influenced by project activities, we can see that the use of multiple approaches influenced the uptake of improved bean varieties, fertiliser use, and the use PICS bags. Residue incorporation during land preparation had a similar trend but was not considered statistically significant. The effect of using multiple approaches was also significant when examining the number of respondents using at least 1, 2 or 3 practices.

6. Extrapolation

To estimate the impact of rural radio campaigns, it is important to know the reach or population covered by rural radio broadcasts. In order to create reliable estimates of potential listeners, actual listeners, and a radio station's "broadcast zone," FRI has developed a process for creating maps that show broadcast coverage zones for its radio station partners.

For each station involved in the project, the following information was collected:

- the location of the radio station transmitter (using GPS)
- the transmitter height above average terrain (HAAT)
- the effective radiated power (ERP) of the transmitter (in watts)
- the gain of the transmitter (dBi)

These four variables were then fed into open-source GIS mapping software that adheres to Federal Communications Commission standards for determining FM radio contours based on the principles of

FM radio signal propagation shown in the Irregular Terrain Model (ITM) (Longley and Rice, 1968)[4]. Population maps were overlaid with these radio contour maps, and two calculations were made in each broadcast zone:

- total potential population – the population in the station's broadcast coverage zone, and
- total potential rural population – the rural population in the station's broadcast zone ("rural" is defined as less than 400 people/km^2).

Total adult population (> 15 years old) is calculated using estimates of adult population percentages in each country from UN data. A procedure is put in place to remove household duplicates in areas covered by more than one radio station.

6.1 Assessing the reach of the radio program

Using this methodology, the estimated number of adults living in rural areas within the zone covered by the two radio stations (Radio 5, Habari Njema) involved in the radio program on common beans was estimated to be **699,704.** This represents the number of potential listeners of the radio program. To estimate the total number of listeners within that coverage area, we multiplied that number of potential listeners by the percentage of listeners among the 1166 households located within the radio coverage area obtained from our household survey (19.55%). The total estimated number of listeners for the radio program on common beans is 136,792 ~ **136,800.**

It is, however, important to highlight that this estimate excludes potential listeners in urban areas, some of whom may be interested in the topic and/or have farms in the rural areas. For example, if we were to consider the entire adult population (**1,749,847**; urban and rural) and assuming a similar rate of listenership, the total estimated number of listeners would reach **342,100** instead of 136,800.

6.2 Assessing number of farmers up-taking improved legume technologies

The total number of farmers starting to practice one or more of the improved legume technologies is estimated by multiplying the number of listeners within the project area (calculated above) by the percentage of listeners in the household survey who are using one or more of the improved legume technologies.

For the common bean component of the project in the Northern Regions, the percentage of listeners in our survey sample who are using at least one of the improved legume technologies was 81.6%, meaning that an estimated total of 111,629 farmers are using one of the improved legume technologies. It should be noted, however, that an important number of non-listeners were also using at least one of the promoted practices (77.1%). This is because the 'package' of improved legume technologies promoted included relatively common practices (e.g., weeding, harvest time) for a crop that is itself very common in the area. Other interventions (past and present), including those of the SILT projects, may have also contributed to enhancing the uptake of these practices by both listeners and non-listeners. Without a baseline study, it is more difficult to assess 'attribution' of impact to project activities.

A similar analysis but considering only farmers who had adapted at least 3 of the improved practices reveals a stronger effect of the radio program. In effect, the percentage of farmers who started using at

[4] Longley, A. G., and Rice, P. L. (1968). Prediction of tropospheric radio transmission over irregular terrain, A computer method-1968. ESSA Tech. Rep. ERL 79-ITS 67. Washington, DC: U.S. Government Printing Office. July 1968.

least three of the promoted practices was 35.1% for listeners and 17.1% for non-listeners. When extrapolating these percentages to the total number of listeners in the project area, we see that the radio program may have contributed to an 'additional' 24,624 farmers adopting at least 3 practices.

When focusing only on the uptake of improved varieties of common beans, a key component of the SILT project, the percentage of listening farmers who started using improved varieties in our survey is equal to 53.1%, which corresponds to an estimated total of 72,640 farmers. Considering that the percentage for the non-listeners is 38.1%, corresponding to 52,120 farmers, we can estimate that the radio program may have contributed to an additional 20,520 farmers up-taking the improved varieties. Considering that the percentage of listeners within the radio coverage area was relatively low at 19.55% (compared to what has been observed in many other FRI projects), we can see that an increase in listenership to levels often observed in other projects -e.g., 40%, would have the potential to significantly contribute to achieving impact at scale.

7. Conclusions

The outcome evaluation survey was designed to assess the impact of the radio programs on increase the knowledge and uptake of improved common bean practices by farmers in the northern Regions of Tanzania. In order for the survey to also explore the effect on knowledge and practice of having multiple extension strategies, information was also collected about other SILT project interventions such as the demonstration plots, the distribution of leaflets and the Shujaaz comic book campaign. In addition, a series of variables characterizing the households and respondents were collected to examine how they influenced listenership among farmers located in the project area.

Some of the key messages from this outcome evaluation are:

- There is an overall positive effect of project activities on knowledge and up-take of improved common bean technologies by farmers.
- There are important differences, however, in the results obtained for different knowledge questions and practices. These would need to be explored further. For example, results related to the spacing to use in row planting were quite low.
- For some of the knowledge questions and improved practices, a relatively high number of non-farmers performed quite well highlighting the fact that common beans are already well known and used by farmers in the project area. This is also a reminder that many initiatives on common beans have been or are being implemented in these areas.
- The percentage of listeners was lower than that usually observed in other FRI projects in the area. This may have been caused by the gap in time between the administration of the survey and the implementation of the activities. Nevertheless, the implementation of the radio programs in the north allowed us to reach a large number of farmers – 342,000 if including both urban and rural populations; 136,800 if only considering the rural population.
- A key finding of the outcome evaluation is the effect of combining multiple extension strategies on knowledge and practice of farmers. Results suggest the potential for such an approach to enhance scaling-up processes.