



Harnessing ICT to scale up agricultural solutions

**Intervention Research: An Assessment of ICT strategies that
are most effective and efficient in scaling agricultural
solutions in Malawi**

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Photo: Several community listener groups gathered together with the research team at a project feedback session in Mchinji, Malawi in April, 2019

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List of acronyms

AI SL	Agricultural Input Suppliers Limited
EPA	Extension Planning Area
FGD	Focus Group Discussion
FRI	Farm Radio International
FRT	Farm Radio Trust
ICT	Information Communication Technology
IVR	Interactive Voice Response
MBC	Malawi Broadcasting Corporation
NACDC	National Agricultural Content Development Committee
NASFAM	National Smallholders Farmers' Association of Malawi
NCRSH	National Committee on Research Ethics in the Social Sciences and Humanities
NGOs	Non-Governmental Organizations
NSO	National Statistics Office
PICS	Purdue Improved Crop Storage
PRC	Participatory Radio Campaign
SMS	Short Message Service
SPSS	Statistical Packages for Social Sciences

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Executive summary

Farm Radio Trust (FRT) and Farm Radio International (FRI) implemented ‘Harnessing ICTs for Scaling-up Agricultural Solutions (ICT4Scale)’ project to examine the roles and contributions of information and communication technology (ICT) in scaling agriculture improvements for food, nutrition and income security to achieve sustainable impact focusing on sub-Saharan Africa. The project was divided in four major phases: literature review, meta research, case studies and intervention research. The intervention research was implemented to test, refine and validate early findings, of the meta research, literature review and the case studies to assess ICT strategies that are most effective and efficient in scaling agricultural solutions. Farm Radio Trust implemented the intervention research where specific and discrete ICT interventions were tested and compared in the promotion of soybean inoculation in Mchinji district, Malawi. The intervention research was guided by the following research questions:

- a) Was scale up of soybean inoculation improved?
- b) What was the role of the ICT tools in the scale up?
- c) What was the relative role of the different ICT tools used for supporting the scale up?
- d) What was the role of institutions supporting soybean inoculation in the scale up?
- e) What was the impact of inoculation on soybean yield?

A Participatory Radio Campaign, enhanced by SMS push and pull platform and a farmer call center, was adopted for the promotion of soybean inoculant. The ICTs that were used contributed to 10% and 4% increase in use of soybean inoculant among men and women respectively in the intervention site. At district level, Mchinji agro dealers registered to have sold 87,000 packets of inoculant which was more than 50% increase from the previous growing season of 2017/2018.

The main sources of inoculant messages, in order of dominance, were radio, extension workers and SMS push platforms. The ICTs used in the intervention worked best in combination for complementarity for instance, radio programming amplifying feedback from the call center as part of content; the SMS platform influencing listenership of the radio programs; and the call center expanding messages on radio and SMS platforms by providing detailed real time advisories demanded by farmers about soybean inoculant. In essence, ICTs played a role of providing the farmers the needed information that enabled them to use soybean inoculant.

It was, however, difficult to attribute the intervention research alone in the scale up of soybean inoculant as there were other radio programs promoting soybean inoculant even in the control sites. As such, ICTs were looked as a whole in the promotion of soybean inoculant. By design the study was planned to be implemented for two agriculture seasons to track properly the adoption of technology, however, the intervention research was delayed and only engaged farmers for one agriculture season. This affected the analysis of technology adoption bearing in mind that adoption of technology is slow process and requires adequate time.

Both formal and informal institutions played a role in supporting the scale up of soybean inoculation. Of the farmers that had applied soybean inoculant, 24.6% had received support from various government and non-governmental organizations including the private sector in the scale up of soybean inoculant. The support included physical demonstration on the correct use of soybean inoculant and its impact to yields; provision of free inoculant for trials and demonstrations, and provision of credit/cash loans for buying inoculant. This

was common in farmer groups (cooperatives and associations) thereby aiding the process of acquisition. Other institutions played a role of generating and validating content on the ICT platforms and making inoculant available for use by the farmers.

Inoculation of soybean also had an impact on the yield where there was a 103% and 86% increase in soybean yield among listeners and non-listeners of the radio program respectively that had applied soybean inoculant. Government crop production estimates of soybean in the EPAs under which the intervention took place also demonstrate that there has been an increase in yield of soybeans in the intervention sites.

The intervention research integrated gender pathways and good practices in its implementation to ensure women participation and enhance their uptake of the technology. These included airing of the program, with a repeat, during convenient times for women; a combination of different ICTs taking into account access to the tools and illiteracy levels; and empowerment initiatives through various radio programming approaches allowing women's voice on air. Barriers and opportunities for different gender groups in using ICTs for adoption of agriculture solutions were identified and a gender theoretical framework for ICT-for-scale initiatives was developed. The study found that the opportunities in using ICTs to access and adopt agriculture solutions were farmers' access to ICTs, willingness to pay for the ICTs to access agricultural solutions, quick feedback, gender awareness, trust in agricultural messages accessed through ICTs and the message sharing behavior among the farmers. The hindrances were cost of ICTs, lack of knowhow on use of ICTs, cultural and gender barriers, illiteracy, ICT infrastructure, inadequate supply of inoculant and lack of interest.

The conceptual framework illustrates the transformative pathways that enable women, and different gender groups in rural areas to take advantage of the ICTs for innovative agriculture. These include: adult literacy among the rural women, men and youth; improving access to the ICTs through provision of loans; provision of training on the use of ICTs for agriculture development; critical examination of gender norms and conducting gender training (training both husbands and wives together) to improve women access to ICTs and resources and empowerment.

1.0 Introduction

Farm Radio Trust (FRT) and Farm Radio International (FRI) implemented ‘Harnessing ICTs for Scaling-up Agricultural Solutions’, a 30-month research initiative funded by the International Development Research Centre (IDRC), Canada. The research project aimed to examine the roles and contributions of information and communication technology (ICT) in scaling agriculture improvements for food, nutrition and income security to achieve sustainable impact with a focus on sub-Saharan Africa. The project was implemented from April 24, 2017 to October 24, 2019, guided by the following research questions:

1. What combination of ICTs, actors and institutional arrangements are most effective and efficient in scaling agricultural solutions?
2. What strategies for the use of ICT are successful in facilitating the scaling of agricultural solutions, e.g. interaction with audiences, type and quality assurance of information and content?
3. What are the gender equality considerations of ICT-enabled scaling of agricultural solutions?
4. How and by whom are ICT technologies and applications being designed, applied and tested as part of business models that lead to successful scaling of solutions and practices?
5. What barriers may limit the reach and/or effectiveness of ICTs in scaling initiatives?

In order to do this, the research project was divided in four major phases: literature review, meta research, case studies and intervention research.

2.0 The Intervention Research

The intervention research was implemented to test, refine and validate early findings, of the meta research, literature review and the case studies to assess ICT strategies that are most effective and efficient in scaling agricultural solutions. The hypothesis for the intervention research was that for a solution to scale up, the necessary enabling factors such as financial, policy and legal framework, institutional, and the partnerships necessary to expand the solution must be in place. Successful scale up also requires “drivers” such as key mandated government institutions that champion the expansion and community demand for the services provided by the innovation. As such, the study examined how the use of ICTs supports the scaling up of soybean inoculation in Malawi and help smallholder farmers increase their yield.

The intervention research was guided by the following research questions:

1. Was scale up of soybean inoculation improved?
2. What was the role of the ICT tools in the scale up?
3. What was the relative role of the different ICT tools used for supporting the scale up?
4. What was the role of institutions supporting soybean inoculation in the scale up?
5. What was the impact of inoculation on soybean yield?

2.1 Implementation of the Intervention research

Farm Radio Trust Malawi implemented the intervention research where specific and discrete ICT interventions were tested and compared in the promotion of soybean inoculation. Inoculation is a process of adding effective bacteria to the host plant seed before planting with the purpose of ensuring that there is enough of correct type of bacteria present in the soil for a successful establishment of legumes-bacterial symbiosis. Inoculation is a significant technology for the manipulation of Rhizobia, nitrogen –fixing soil bacteria, for improving crop productivity and soil fertility through Nitrogen fixation. The use of inoculants is a proven biotechnology for enhancing legume production such as soybean, based on the relatively inexpensive cost of inoculants compared to the high cost of nitrogen fertilizers.

2.1.1 Research Ethics and Approval

An approval, granted in October 2018, for the implementation of the research protocol for the intervention research was sought from the National Committee on Research Ethics in the Social Sciences and Humanities (NCRSH) which reserves the right to carry out compliance inspection of approved research protocols. The initial application was on Purdue Improved Crop Storage (PICS) bags, however, an amendment was made which was a shift of focus from PICS bags to soybean inoculant. This was necessitated by FRT and FRI after noting that PICS bag awareness was very high in the communities unlike soybean Inoculant. Therefore, focusing on soybean Inoculant the study aimed to measure any significant changes among farmers' in the adoption of the technology through the use of ICTs.

Soybean inoculant was opted, guided by an evaluation of the intervention options in [Table 1](#), as it, among others, addressed practical needs of farmers, was a low cost technology, implementable within the 2018/19 cropping season (production), measurable, and had supporting systems, institutions and infrastructures in place to aid the scale up process.

Table 1: An evaluation of intervention research options

	PICS Bag	Inoculant	QPM	OFSP	Drip Irrigation	Agro-climatic Information	Conservation agriculture
Should be implementable in the 2018/19 cropping season (production)	x	✓	✓	✓	x	✓	✓
It should also be scalable	✓	✓	✓	✓	✓	✓	✓
It should be seasonal crop based solution and not livestock or perennial crop	✓	✓	✓	✓	✓	✓	✓
It should have the supporting systems, institutions and infrastructure	50%	50%	30% (access problem)	60%	25%	25%	75%
It should be implemented by a partner already in contact with FRT	✓ F T F	✓ FT F	X	✓ FTF ✓ CIP	✓ FT F	✓ W F P ✓ F T F	✓ SIM LES A ✓ WFP

For convenience, it should be technological/ implemented in short term, so as to allow measurability	✓	✓	✓	✓	X	✓	X
It should have a gender dimension	Negative (access)	Negative (access)	Positive (nutrition)	Positive	Negative	Negative	Neutral
It address a practical need of farmers	✓	✓	✓	✓	✓	✓	✓
Low cost/ affordable at smallholder level and project level as well	High cost	Medium cost	Medium to high cost	Low cost	High cost	Low	Medium cost

2.1.2 Rapid Assessment of Status of soybean inoculant

A rapid assessment was commissioned in order to assess the suitability of the intervention for the research project. In particular, the assessment aimed at determining the current state of inoculant promotion and use in Malawi; the institutional framework surrounding both the demand and supply of inoculant; the policy environment; knowledge and information systems; associated challenges and opportunities relating to inoculant promotion and use in Malawi, specifically in Mchinji district.

Major findings of the assessment indicated that:

- i. Few farmers used inoculant due to inadequate information on how to use and where to find soybean inoculant as there were no distribution points
- ii. Most farmers had received inoculant and trainings from Non-Governmental Organizations (NGOs) 2 years ago and some farmers failed to continue using inoculants without NGO support due to unavailability of inoculant in trading centers within their residence
- iii. Majority of the agro dealers supplying inoculant were found only at big trading centers in the district and most of the agro dealers, especially local business men, had not yet discovered the inoculant business and some lacked proper training on the use and storage of inoculant.
- iv. Other barriers faced by the agro dealers included loss of customers due to low supply or supply with already damaged/expired inoculant
- v. Extension workers lacking proper training on the use of inoculant

The assessment established that the use of ICT based tools proved to be a good channel of disseminating inoculant information. Most farmers preferred both the use of radio and cell phones as a way of accessing information, and when using cell phones, most farmers indicated preference in calling to receiving text messages.

2.1.3 Participatory Radio Campaign for Soybean Inoculant

A Participatory Radio Campaign (PRC), a series of programs produced and broadcasted by radio that follows a specific, dramatic, time-bound, four-stage process that involves farmers in understanding, considering, deciding upon, and implementing an improved farming practice, was adopted for the promotion of soybean inoculant. The PRC was enhanced by SMS push and pull platforms and the farmer call center also known as the Mlimi hotline.

Interactions with farmers in the implementation of the intervention research was done in three Extension Planning Areas (EPAs): Kalulu, Mkanda and Chioshya in Mchinji district. Specifically, the programs were recorded in Mphanga, Chimteka, Chioko and Kamangira sections in Chioshya EPA; Mkanda South, Mkanda East, Fanuel North and Fanuel South sections in Mkanda EPA; and Kapiri South, Kapiri North, Chankhanga, Chitunda and Kalulu sections in Kalulu EPA. Information Communication Technology (ICT) listening hubs that were previously provided with radio sets and phones in these areas were engaged in radio programming and were encouraged to listen to the programs.

2.1.3.1 The Radio Programs

The radio programs were aired from 6 November 2018 to 22 June 2019 on ‘Mudzi Wathu’ community radio station in Mchinji on Tuesdays at 2:00 PM with a repeat on Saturdays at 16:10 PM. The rapid assessment and a baseline survey informed the ICT tools to be used; farmers’ access to ICT tools; farmer’s preference of communication channel and preferred time for airing the radio programs to ensure maximum listenership.

a) Type of information received

Content for the PRC on soybean inoculant was generated through the National Agricultural Content Development Committee (NACDC) which is a pull of knowledge partners from research, governmental and non-governmental institutions, private sector with expertise in various value chains. This ensured technically sound, validated, evidence based, scientifically proven, accredited and farmer friendly content. The meeting also had a representation of farmers to allow their input on the content as they are better positioned to determine what works for them being the recipient of the technology. The outcome of the meeting was a message matrix (1: Participatory Radio Campaign for Soybean Inoculant) to guide the radio programming of the PRC. Key messages were on benefits, access, storage and utilization of soybean inoculant. A value chain approach was later adopted for the PRC focusing on inoculated soybean from production to harvest and marketing. Key messages were on crop stand and management of inoculated soybean in the field; post-harvest preparations and handling & marketing of soybean including reminders on time of airing of the radio program. A total of 22 radio programs were aired. The PRC was modified based on feedback from the other ICT platforms including the call center.

b) Estimated farmers reached with ‘Tipindule ndi inoculant’ program

To establish the number of farmers reached with ‘*Tipindule ndi inoculant*’, a radio reach exercise was done using data for transmitter population reach based on signal reception. [Figure 1](#) shows the green parts of the map where the signal of Mudzi Wathu Community Radio was strong and the yellow shows where the signal was weak. It is important to note that the signals went beyond Mchinji district, however the calculations are based on the reach in Mchinji. FRT used data from the National Statistics Office (NSO) population census of 2018 to determine the actual population of Mchinji district for calculation of the estimates (

Table 2).

Table 2: 2018 Population Census and estimated radio listenership for Mudzi Wathu Radio

2018 Population Census		Radio Listenership in Malawi (96%)	Listenership to Inoculant Programs (41%)
District	Population		
Mchinji	602,305	572,190	234,598
Total	602,305	572,190	234,598

According to the NSO 2018 population census, Mchinji population was at 602,305[2]. MACRA 2015 National ICT Usage Survey indicated radio listenership at 96% across Malawi¹. According to FRT's 2016 cohort tracking exercise, regular listenership to agricultural programs, including FRT radio programs, was at 41% [4]. It is therefore estimated that 234, 598, representing 39% of Mchinji population, was able to listen 'Tipindule ndi inoculant' radio program.

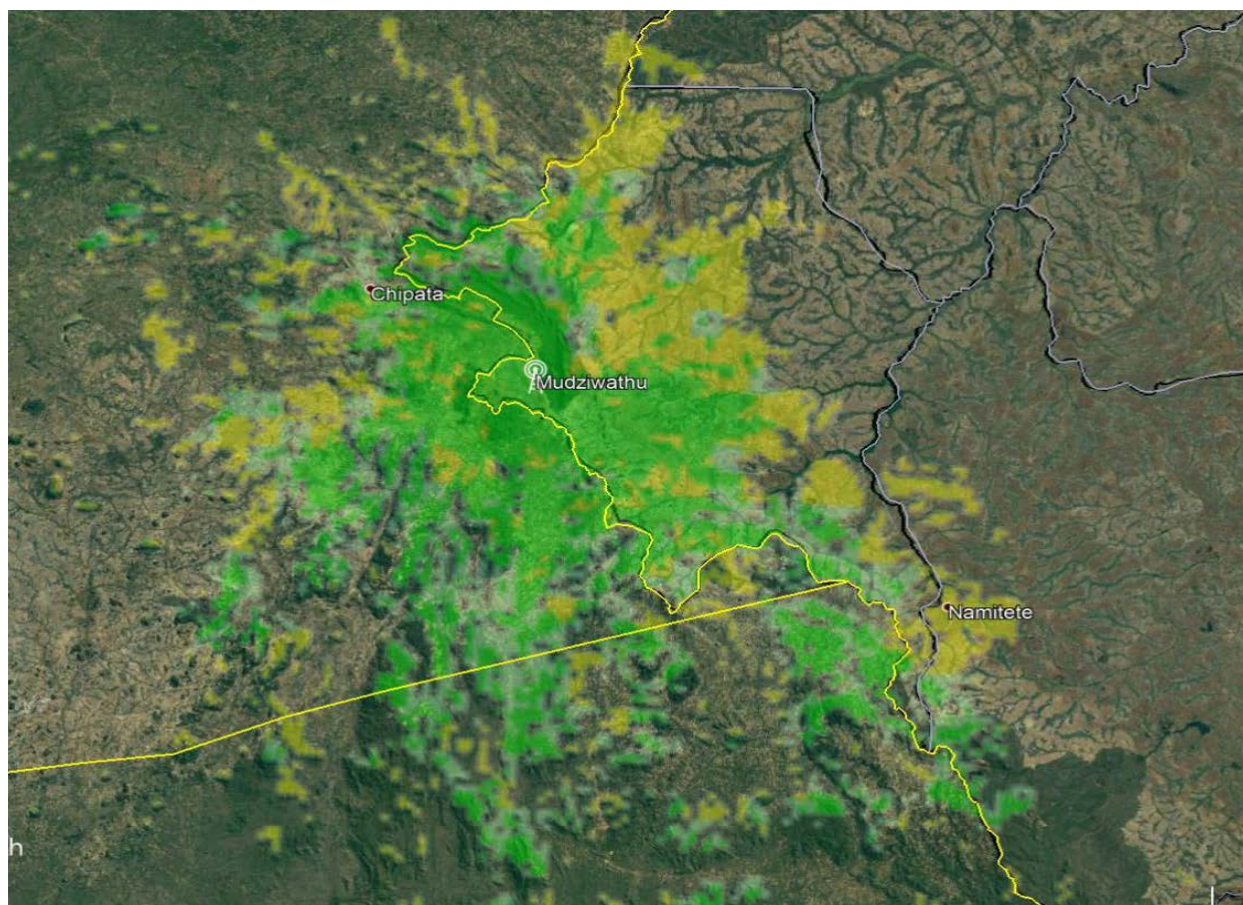


Figure 1: Mudzi Wathu Community radio Coverage

¹ National Statistics Office, Malawi Communication Regulatory Authority (2015). Survey on Access and Usage of ICT Services in Malawi.

To assess number of farmers listening to ‘*Tipindule ndi Inoculant*’, farmers were asked to beep during the airing of the program. December and March had more beeps compared to April and November (Figure 2). A test was done in March where farmers were sent a message informing them of the next radio program indicating the time of airing, place of recording and the topic to be covered. This induced more farmers to beep during the program indicating more farmers listening to the program. In December, the radio programs had messages on access and utilization as it was a planting period; this motivated more farmers to listen to the program. Less beeps in November were attributed to frequent blackouts which affected signal transmission of the radio station. April also had less farmers listening as they were busy preparing for/harvesting their soybeans hence less listeners. In essence, the ICTs (radio and SMS platform) demonstrated complementarity. Frequent reminders using other platforms, for instance the SMS push, was necessary since the PRCs was relatively a new.

The use of a community radio station meant that stories were coming from the farmers’ locality which motivated them to listen to their fellow farmers on air, thereby motivating listening. Farmers calling the call center for agricultural advisories on inoculant from Mchinji were also encouraged to listen to the radio program.

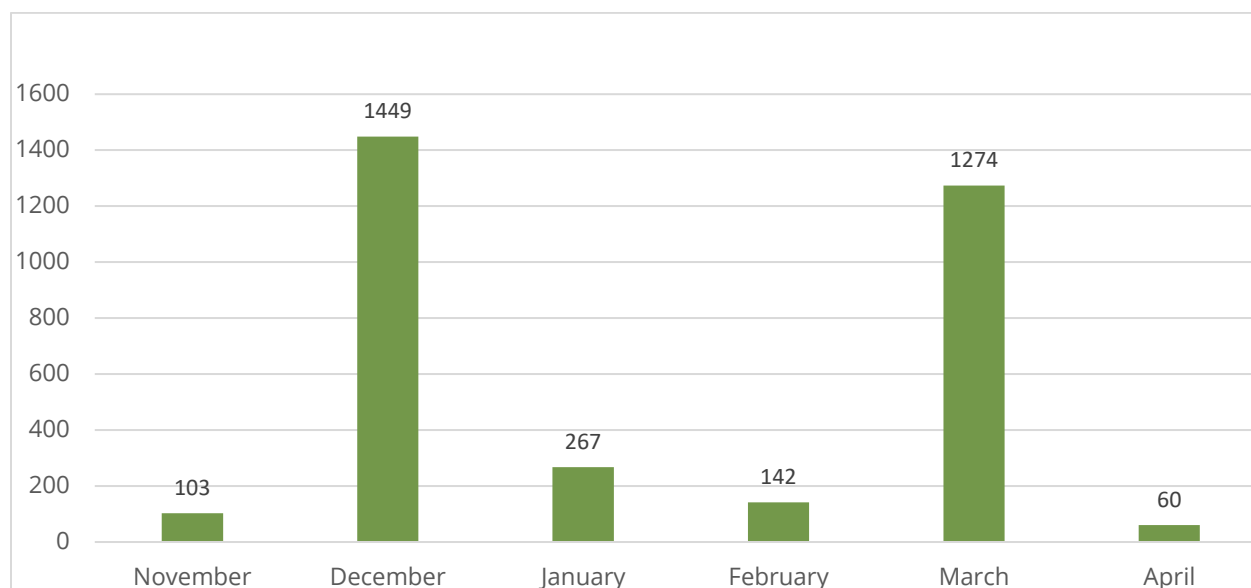


Figure 2: Farmers beeping during the radio program

2.1.3.2 The Mlimi hotline

The FRTs call Centre, also known as the *Mlimi* Hotline, was used to provide real time advisories to farmers on soybean inoculant and soybean production. The service was delivered by e-extension officers through toll-free lines, 7111 for TNM and 8111 for Airtel service providers, taking advantage of the rapid infiltration of mobile phones in Malawi.

a) Type of information received

Specific inquiries received from farmers were on access and utilization, agronomic aspects of inoculated soybeans and benefits of using inoculant (Figure 3). A total of 259 cases on soybean inoculant were received of which more were from men compared to women. Women inquired more on access and utilization and agronomic aspects of inoculant indicating that they are more involved in production phase within the soybean value chain.

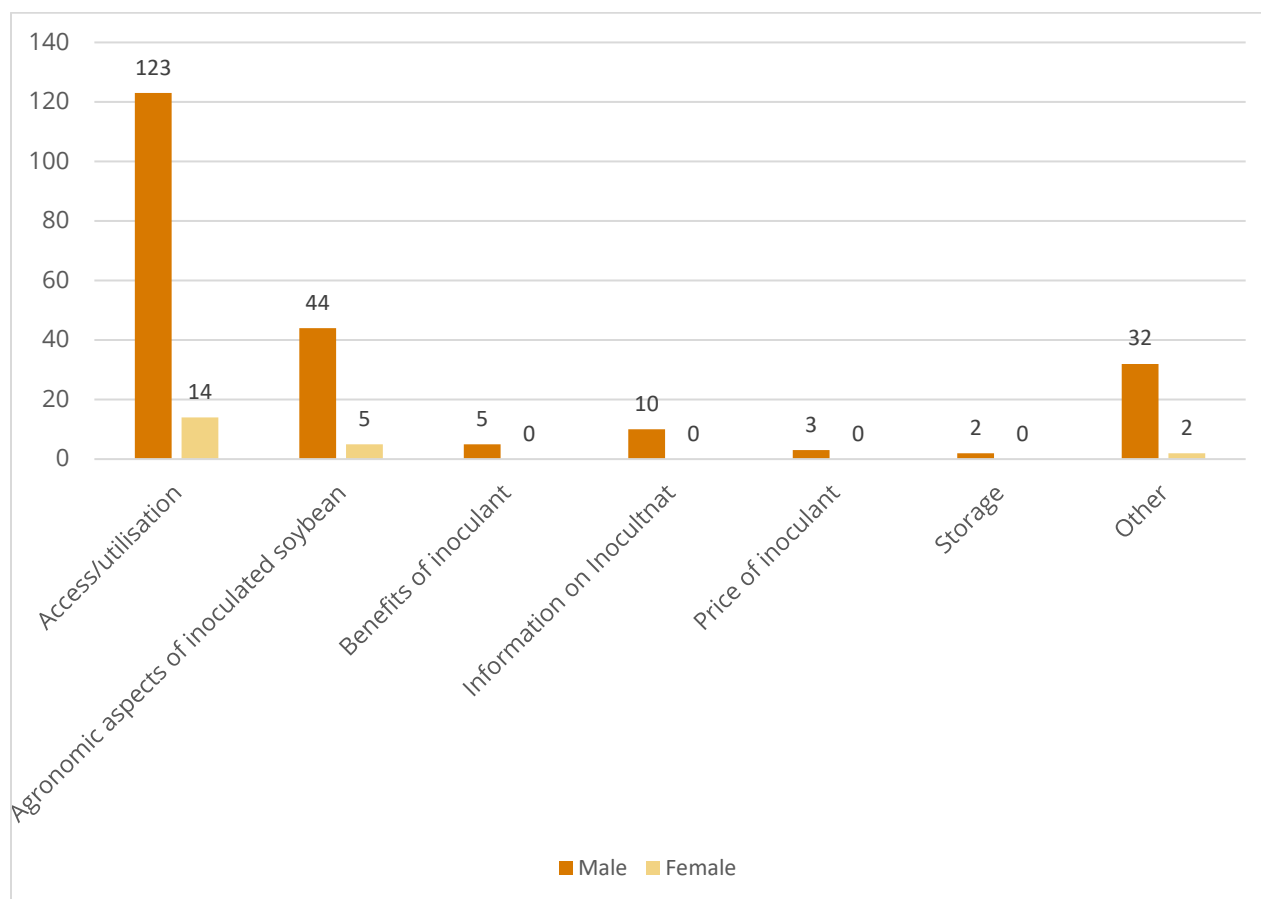


Figure 3: Specific inoculant inquires

2.1.3.3 SMS Push and Pull platform

Short Message Service push and pull platform was also used to complement the radio programs. A total of 21 messages were pushed to 2317 farmers (2067 males: 250 females). Key messages were on benefits, access, storage and utilization of inoculant, crop husbandry practices of inoculated soybean, post-harvest management, and airing time of the program, among others.

Table 3 provides the content of the messages that were pushed during the PRC.

Table 3: Messages sent through the SMS push platform

No.	English	No.	Chichewa
1	Listen to <i>Tipindule ndi Inoculant</i> program on Mudzi Wathu radio, Tuesdays at 2:00 PM and a repeat on Saturdays at 16:10 PM. Farm Radio	2	Inoculant is bio-fertilizer that promotes plant health and increases yield of soybean. Farm Radio
3	Inoculant increases yield, household incomes, nutrition and enhances soil health. Farm Radio	4	Inoculant is sold by reliable agro dealers at affordable prices. Call 8111 on Airtel; 7111 on TNM; or ask an extension worker in your area for more information. Farm Radio
5	Store your inoculant in a cool dry place. Call 8111 on Airtel; 7111 on TNM; or ask an extension worker in your area for more information. Farm Radio	6	Follow instructions at the back of the inoculant packet for usage and storage. Farm Radio
7	Plant your inoculated soybean seed within 24 hours (same day after inoculation). Farm Radio	8	Plant your inoculated soybean with the first reliable rains. Farm Radio
9	Please inform us if you have used inoculant by beeping 0995032111 or call 8111 on Airtel, 7111 on TNM. Farm Radio	10	Weed your soybean field soon after observing weeds. Farm Radio
11	Listen to <i>Tipindule ndi Inoculant</i> program on Mudzi Wathu radio, Tuesdays at 2:00 PM and a repeat on Saturdays at 16:10 PM. Farm Radio	12	Control pests and diseases in your soybeans by following good agricultural practices. Farm Radio
13	Harvest your soybeans when its fully mature where leaves turn yellow then brown and fall to the ground. Farm Radio	14	Harvest your soybeans when majority of the pods are brown and dry, but before they are brittle and shatter. Farm Radio
15	Harvesting of soybeans before maturity can cause molds and eventually rot due high moisture presence; compromising the quality. Farm Radio	16	Timely harvesting of soybeans helps maintain seed quality and avoids infestation by insects. Farm Radio
17	Harvest your soybeans in the morning hours when temperatures are low to avoid shattering. Do not harvest on a rainy day. Farm Radio	18	When harvesting your soybeans, cut the mature plants just above ground level so that the roots with the nitrogen fixing bacteria stay in the soil to aid future planting. Farm Radio
19	Store your soybeans in a dry and well ventilated place to avoid molds that affect quality. Farm Radio	20	In today's program of 'Tipindule ndi Inoculant', we will hear testimonies about the use of inoculant from Chioshya EPA. Farm Radio
21	Can women set prices and find markets for their soybean? Listen to 'Tipindule ndi Inoculant'		

	program today as we will be discussing with farmers from Kalulu EPA. Farm Radio		
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On the pull service, which is a costed, a total of 566 messages which were on access, utilization and storage. Other messages were appreciation of the radio program and testimonies for using inoculant whilst others were inquiring about markets for their soybeans. Despite the few numbers of the messages sent, this demonstrates farmers' willingness to pay for a service that gives them value as they had to incur the cost of sending an SMS.

2.1.4 Gender equality considerations in the use of the ICTs

The intervention research had a strategy to Integrate gender pathways and good practices in the implementation of the project by developing criteria for establishing effectiveness of the gender component; ensuring at least 50% of respondents in interviews during site visit, field recordings and surveys are women and integrating gender-related questions on ICTs and the agricultural solutions in the research tools.

The PRC had several strategies put in place to ensure women participation and enhance their uptake of the technology. These included airing of the program, with a repeat, during convenient and less busy times for women to give them a chance to listen to the program; a combination of different ICTs taking into account access to then tools and illiteracy levels; empowerment programs through various approaches including quizzes, women call in sessions, women led advisories to empower other women, incentivized quizzes targeting women and prioritization of women participation in the radio program to share their experiences and bring in discussions on the technology and mainstreaming of gender in the radio programming focusing on gender roles, equal distribution of farming resources and household expenditures, among others. Debates on gender sensitive issues were also included to allow farmers, especially women, to air out their voices. This was enhanced by use of already existing ICT listening hubs for targeted radio listening and use of women groups and families (both wives and husbands) to contribute to content on the gender aspect of the program.

2.1.5 Intervention Research Baseline and End line survey

A baseline and end line survey was done in September 2018 and July 2019 respectively, in Mchinji and Kasungu districts, with Kasungu district as a control. The baseline was done for the purposes of providing benchmark information on research questions and informing the upcoming intervention research. The end line evaluation was done to assess if the ICTs used in the implementation of the intervention research resulted in the scale up of soybean inoculant. Both studies were guided by research questions and variables of assessment in [Table 4](#). Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), CARTIE surveys and household questionnaires were done to provide both qualitative and quantitative data. The qualitative data was analyzed using Atlas ti. and the quantitative data was analyzed using excel sheets and Statistical Packages for Social Sciences (SPSS). Field recordings for radio programming were also used in the analysis to bring the discussion of results into context.

Table 4: Intervention research variables of assessment

Research Questions	Variables for Assessment
Was scale up of soybean inoculation improved?	<ol style="list-style-type: none"> 1. Number of farmers using soybean inoculants 2. Factors that influenced farmers decision to apply soybean inoculation
What was the role of the ICT tools in the scale up	<ol style="list-style-type: none"> 1. ICT tools used 2. Access to ICT-based communication channels 3. Farmers preference of communication channel 4. Type of information received
What was the relative role of the different ICT tools used for supporting the scale up?	<ol style="list-style-type: none"> 1. Number of farmers using the ICT tools 2. Farmers preference of communication channel 3. Type of information received by each channel 4. Number of farmers who acted on information received (for each channel)
What was the role of institutions supporting soybean inoculation in the scale up?	<ol style="list-style-type: none"> 1. Formal and informal institutions involved in the scale up process 2. Type of support provided by the institutions 3. Number of farmers accessing institutional support
What was the impact of inoculation on soybean yield?	<ol style="list-style-type: none"> 1. Soybean yield with and without inoculants (from published reports and self-reporting of farmers)

2.2 Limitations of the Intervention Research

The initial design of the invention research designated Mchinji district as the implementation site and Kasungu district as a control in view that Mudzi Wathu radio station had no coverage in Kasungu. However, Kasungu had other radio programs on inoculant from radio stations having a national coverage, reaching even Mchinji making it difficult to consider Kasungu a total control and also attribute the PRC alone to the scale up of soybean inoculant in Mchinji. As such, comparisons of change have been made within Mchinji by looking at the status of scale up before and after the inoculant PRC to minimize the cofounding factors. The ICTs have been looked as a whole in the promotion of soybean inoculant considering that the other programs were also disseminated through radio which is an ICT.

By design the study was planned to be implemented for two agriculture seasons to track properly the adoption of the technology (soybean inoculant), however, it was delayed and only engaged farmers for one agriculture season. This affected the analysis of technology adoption bearing in mind that adoption of technology is slow process and requires adequate time and so does radio programs for farmers to get used to them to enhance maximum and routine listenership.

Among the research questions of the of the intervention research was to assess the impact of inoculation on soybean yield. Several factors affect the yield of a crop including variety of seeds, the soils, the environment (rainfall, temperature, humidity, etc.), and usage, among others. The intervention research did not control all these factors apart from promoting the use of soybean inoculation. This has also made it difficult to attribute increase in yields to inoculation in the intervention sites. However, inoculation is a technology that has already been tried and tested and approved to increase yields in Malawi.

2.3 Results and Discussion of the Intervention Research Findings

2.3.1 Relative role of ICTs in the Scale Up

2.3.1.1 Access to ICT-based communication channels

The most common ICT-based communication channels in the intervention research site were mobile phones and radio with ownership at 41.9% (57.2% Male: 29.3% Female) and 38.3% (53.4% male: 25.9% female) respectively. Despite low ownership, access to these ICT-based communication channels was slightly higher; for mobile phones alone, access was at 68.8% (78.3% male: 61.1% female) (see [Figure 4](#)). This indicates that a good number of the farmers had a chance to access information on soybean inoculant through the ICT channels used in the intervention.

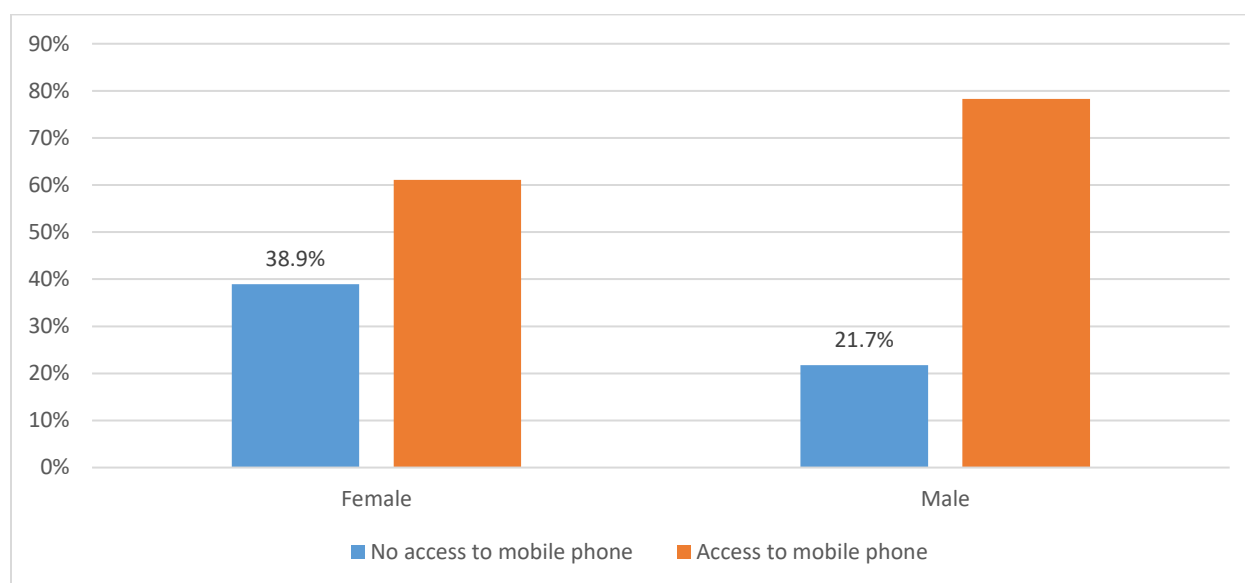


Figure 4: Percentage of respondents who have access to a mobile phone by gender

However, women still registered low ownership and access to these ICT tools. Feedback from FGDs and field recordings for radio programming indicate that ICT tools are mostly considered complex in usage hence associated with men. This was also reflected in the priorities of household expenditures where purchase of any ICT, for instance mobile phone, in the household will prioritize ICT needs of men before women. This was attributed to low illiteracy levels among women to operate ICT tools, lack of demonstration on how to use the ICT tools, lack of interest since ICTs are associated with men.

2.3.1.2 Farmers preference of communication channel

In terms of preferred channel of receiving inoculant information, majority of the participants indicated radio (33.0%) followed by extension workers (32.9%) and mobile SMS (21.8%) (see Figure 5).

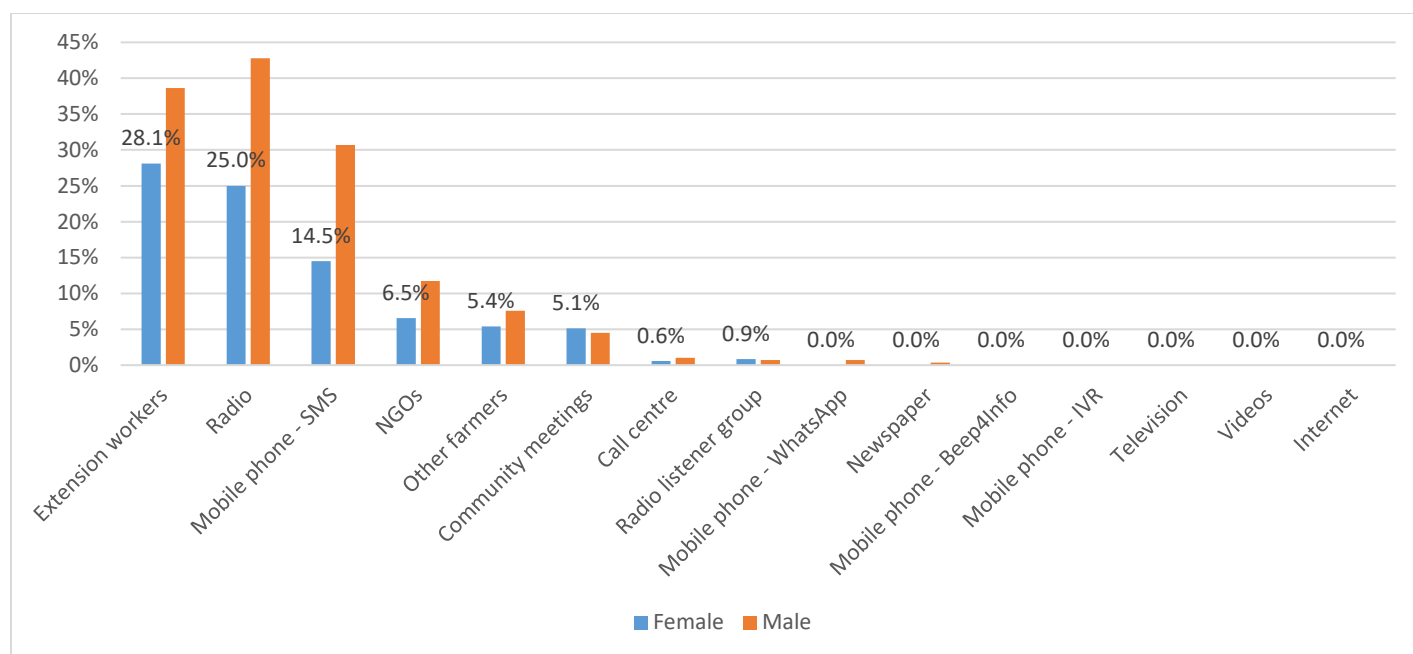


Figure 5: Preferred methods/channels of receiving information about inoculant

This suggests a combination of ICTs and extension workers (both public and private) to work with farmers on the ground to provide extension services on soybean inoculant and other technologies. Discussions from FGDs and KIIs suggests that a combination of these channels counteracts shortfalls faced by each of the channels. For instance, extension workers offsetting shortfalls on limited access to ICT tools due to low ownership, cost of ICTs, and poor infrastructure (poor network, signal/transmission, etc.) and lack of physical demonstration on the use of the technology in some of the ICT tools used in the intervention whilst the ICTs were offsetting shortfalls on low number of extension workers on the ground.

The ICTs were also considered convenient by the majority of the farmers and others indicated that the ICTs had real time extension advice. For others, they indicated that the ICTs were saving them costs of travel for seeking agricultural advisories or accessing soybean inoculant. For instance, they could ring the call center or listen to the radio programs to know where to find inoculant. Considering the distances travelled to access soybean inoculant, others indicated that calling helped them know if inoculant was in stock. This helped them save time and resources as they could only travel when inoculant was in stock.

2.3.1.3 Listenership to ‘Tipindule ndi Inoculant’ radio program

The radio program was aired on Mudzi Wathu community radio Station as it had coverage only in Mchinji and not Kasungu, the control district. Furthermore, despite the popularity of radio stations with national coverage, discussions from FGDs indicated that majority of the farmers like to listen to community radio stations for information from their locality which they can easily relate to. Further to this, it is exciting for the farmers to listen to people who they are likely to know, or better still, listen to themselves on air. One KII

informed that radio stations with national coverage are popular for news, hot topics (e.g. politics) and entertainment, but for information that has a direct impact on a farmer's livelihood, for instance agriculture or health, farmers tend to tune to their community radio stations. One FGD suggest a feeling of ownership and pride from farmers in their community radio stations.

Of the farmers who were aware of the '*Tipindule ndi Inoculant*' radio program, 78.2% (78.9% male: 76.9% female) indicated to have listened to the program (see Figure 6). The results also show that a good percentage of women were able to listen to the program despite having low ownership of the ICTs. Discussions from FGDs indicate that women were able to listen to the program as most of the radio sets were left at home where they could do other household chores whilst listening to the radio. Recent development has seen the rise of mobile phones with built in radios increasing the number of farmers accessing radio to listen to agricultural programs. The advantage of having a radio enabled mobile phone is that it allows for the actual radio to be left in the house, where women can listen, instead of it being taken to the field or elsewhere.

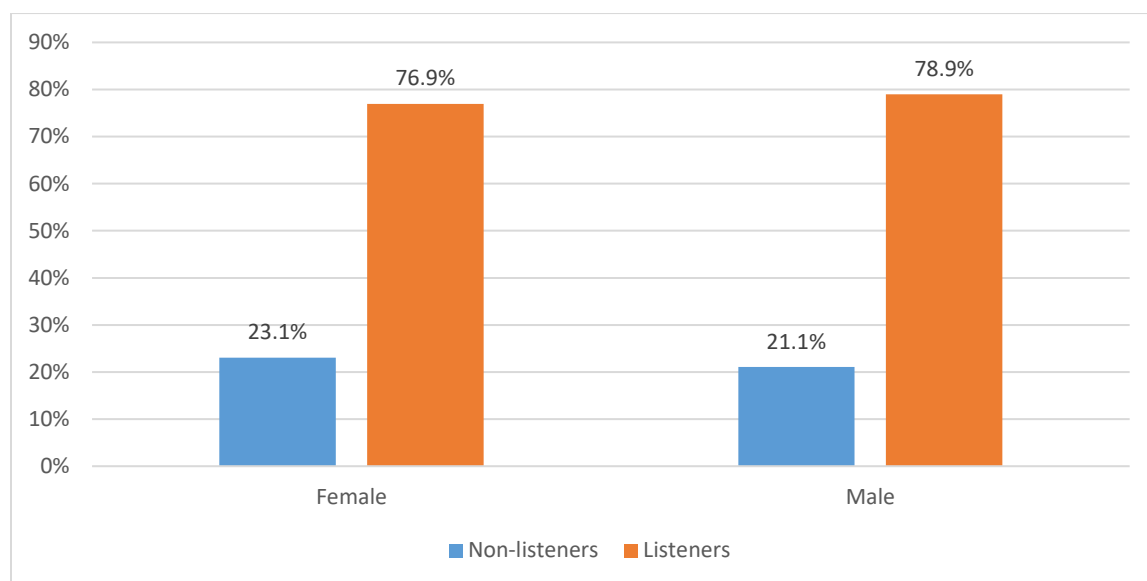


Figure 6: Percentage of '*Tipindule ndi inoculant*' listeners of those who are aware of the program '*Tipindule ndi inoculant*' by gender

In terms of the radio stations that aired the '*Tipindule ndi inoculant*' radio station, the majority of the listeners did indicate Mudzi Wathu radio station (see Figure 7). However, some farmers failed to differentiate the program with other programs listened on other radio stations such as Zodiac and Malawi Broadcasting Corporation (MBC). Others failed to recall the radio station from which they had listened to the program. This could be because the program was new hence some of the farmers could not recall.

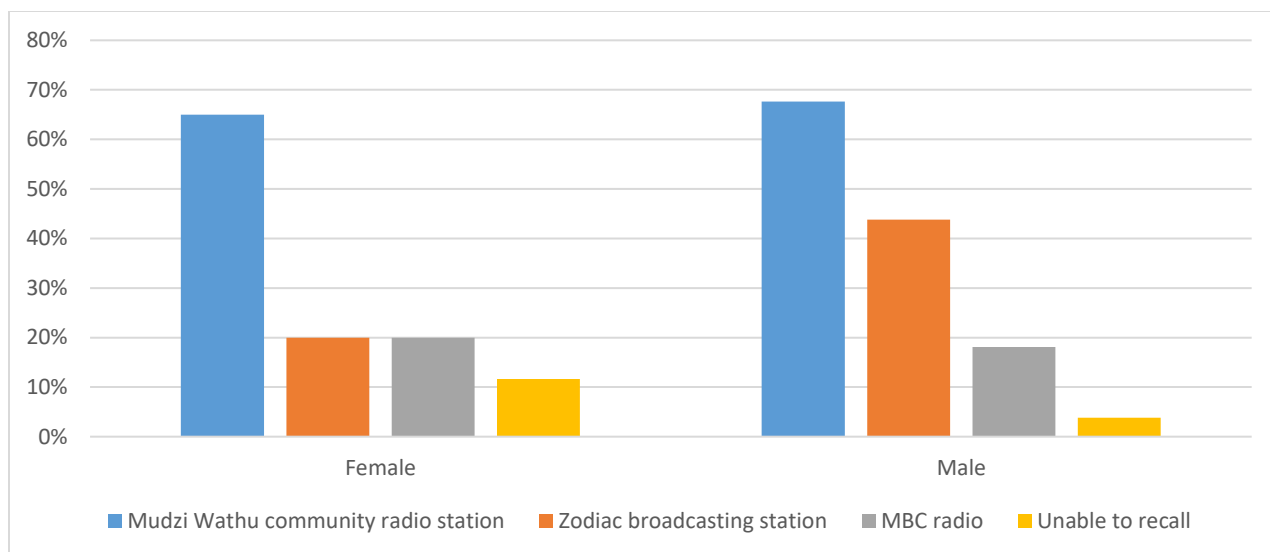


Figure 7: Radio stations that respondents listened to 'Tipindule ndi inoculant'

In terms of method of listening to the radio program, majority of the farmers indicated to have been listening as individuals (67.9%) followed by group listening (26.1%) and using both group and individual listening (6.1%) (see Figure 8). However, preferences for listenership were leaning towards group listening (52.1%) compared to individual listening (47.9%). Discussions from FGDs and KIIs indicated that group listening helped the farmers in discussing the technology further to seek more clarity from other farmers that understood the technology better and reminding each other of the messages. Others indicated that in group listening there is motivation in taking up the technology after seeing fellow farmers adopting the technology. However, meeting as a group was difficult due to lack of radio sets and failure to meet during designated times as people were engaged with other activities. Others sited that in groups conflicts easily arise on ownership of the radio sets which results in disbanding of the listening clubs.

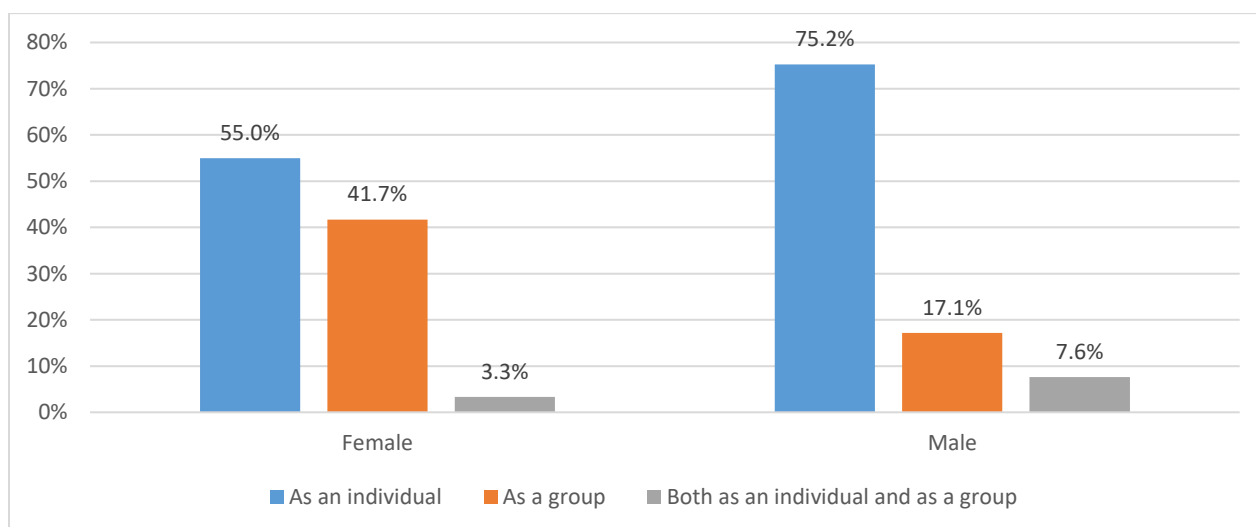


Figure 8: Method of listening to the radio program by gender

2.3.1.4 Type of information received

Key messages cited to have been received through the radio programs included importance of soybean inoculant (20.6%), what inoculant is (13.7%) and application of soybean inoculant (8.3%). Other messages cited were on gender, how inoculant is made, where farmers can source soybean inoculant, storage of inoculant and good agricultural practices for inoculated soybeans, among others (see Figure 9).

In all the ICTs that were used in the intervention research, farmers indicated that they were able to get information from which to access soybean inoculant from registered agro dealers and how to apply soybean inoculant in their fields. Others indicated that through the call center they were linked to markets to sell their produce and avoided post-harvest losses through proper storage practices. In essence, the information enabled them to apply soybean inoculant in their fields.

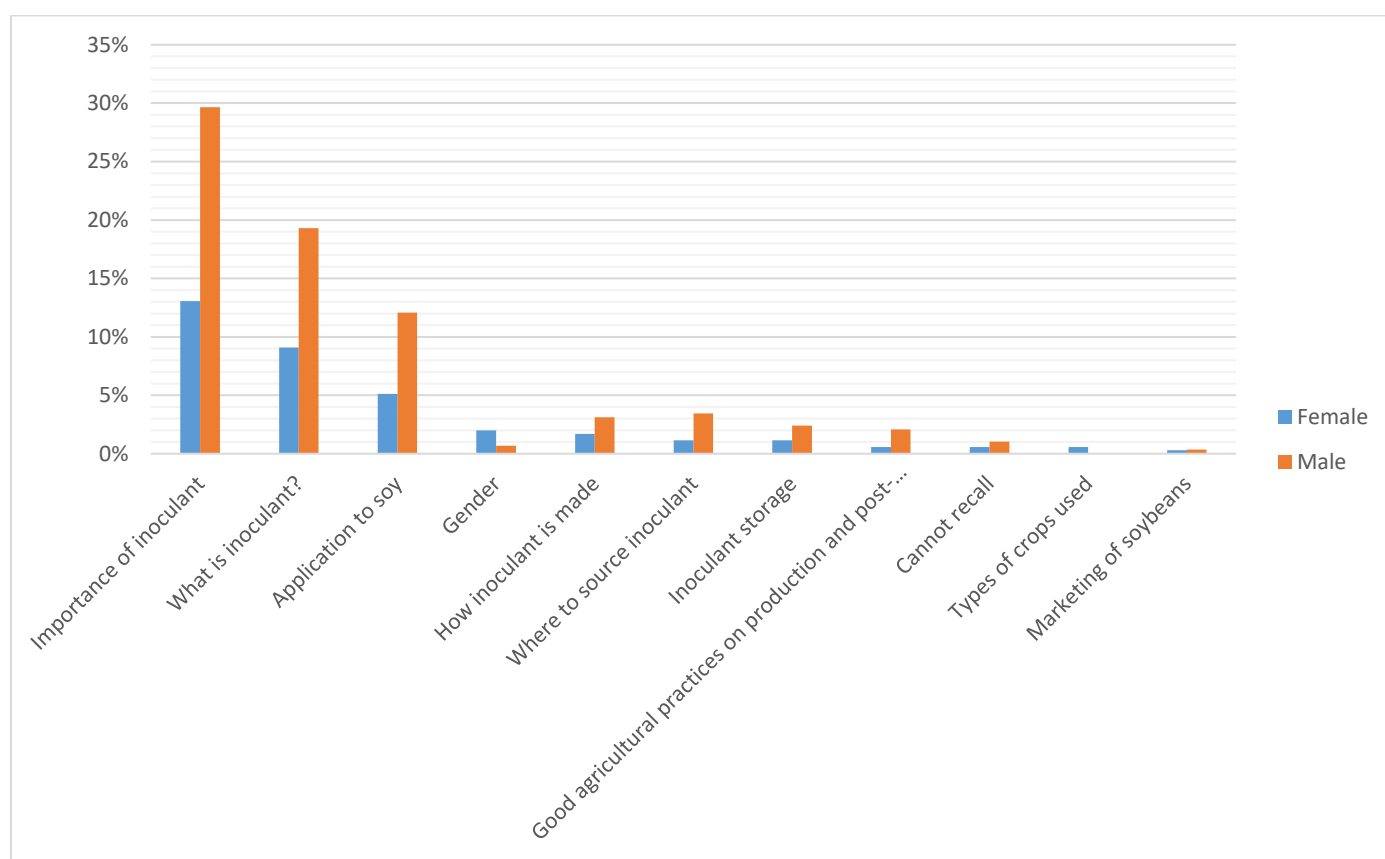


Figure 9: Messages heard in the radio program

2.3.2 Role of Institutions Supporting Soybean Inoculation in the Scale Up

Among the objectives of the intervention research was to determine the role of institutions supporting soybean inoculation in the scale up. Of the farmers that were aware about soybean inoculant, 24.6% (27.5% male: 21.1% females) indicated to have received support in the use of inoculant. Institutions that provided support listed by the farmers included farmer organizations (associations and cooperatives), NGOs, the government

through departments of extension and research, private sector and research institutions among others (see Figure 10).

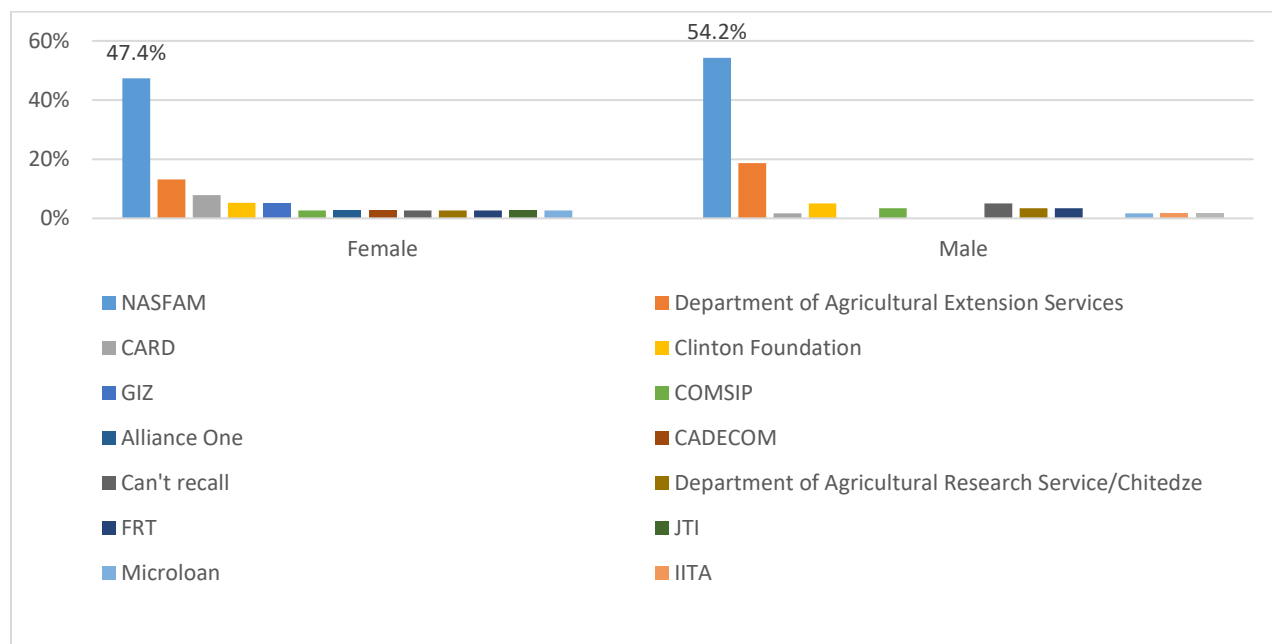


Figure 10: Percentage of respondents who received support from institutions that helped apply soybean inoculant by gender

2.3.2.2 Type of support provided by the institutions

The type of support received from the institutions included physical demonstration on the correct use of soybean inoculant and its benefits to yield, provision of free inoculant and in person advise on how to use soybean inoculant (see Figure 11). The free inoculant for soybean was given for demonstration and trial. Others were given inoculant on credit and providing cash loans for buying inoculant to be paid after harvest. This was common among cooperatives and associations like National Smallholder Farmers' Association of Malawi (NASFAM). The FGDs indicated that during the cropping season of 2018-2019, none of the private institutions or NGOs provided inoculant related credits or loans, but most of the loans were received from cooperatives and associations.

The other support that the institutions played was to generate, verify and validate the content that was used through the ICT platforms and to act as resource persons in radio programs. Engagement with the suppliers of soybean in the PRC helped to balance the demand and supply of soybean inoculant. The suppliers also provided relevant information about access and usage.

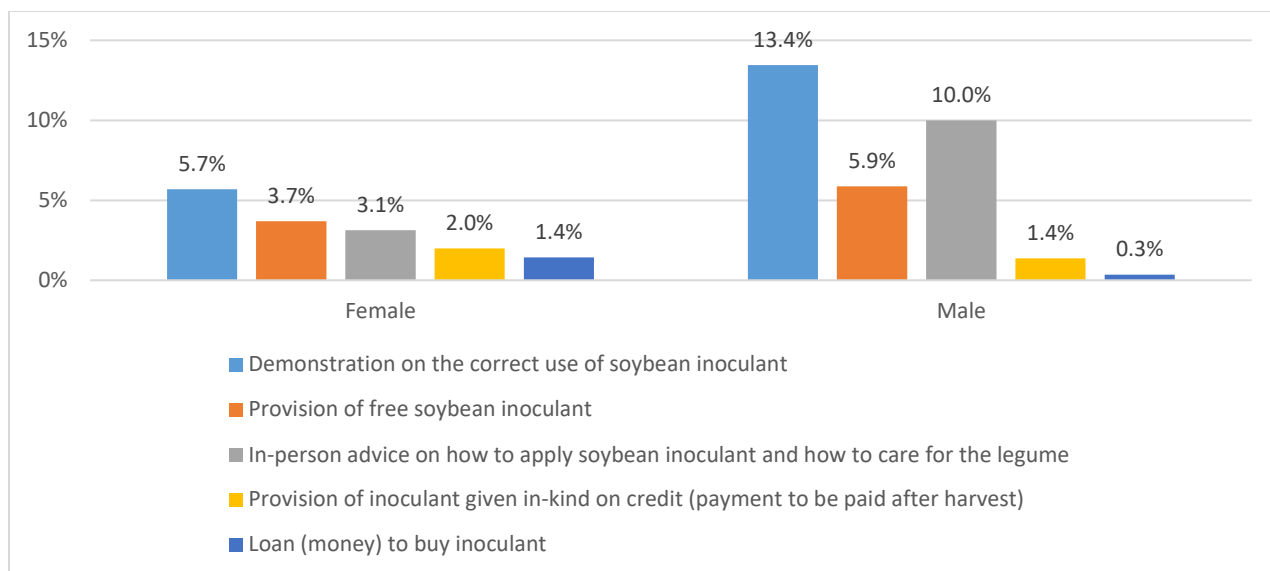


Figure 11: Type of support received from institutions

2.3.3 Scale up of Soybean Inoculant

2.3.3.1 Number of farmers using soybean inoculant

Findings for the surveys done indicates that 62.2% (75.7% male: 51.1% female) were aware of soybean inoculant whilst 37.8% (24.3%male:48.9%female) were not. Of the participants that were aware about soybean inoculant, 30.7% used inoculant (see Figure 12).

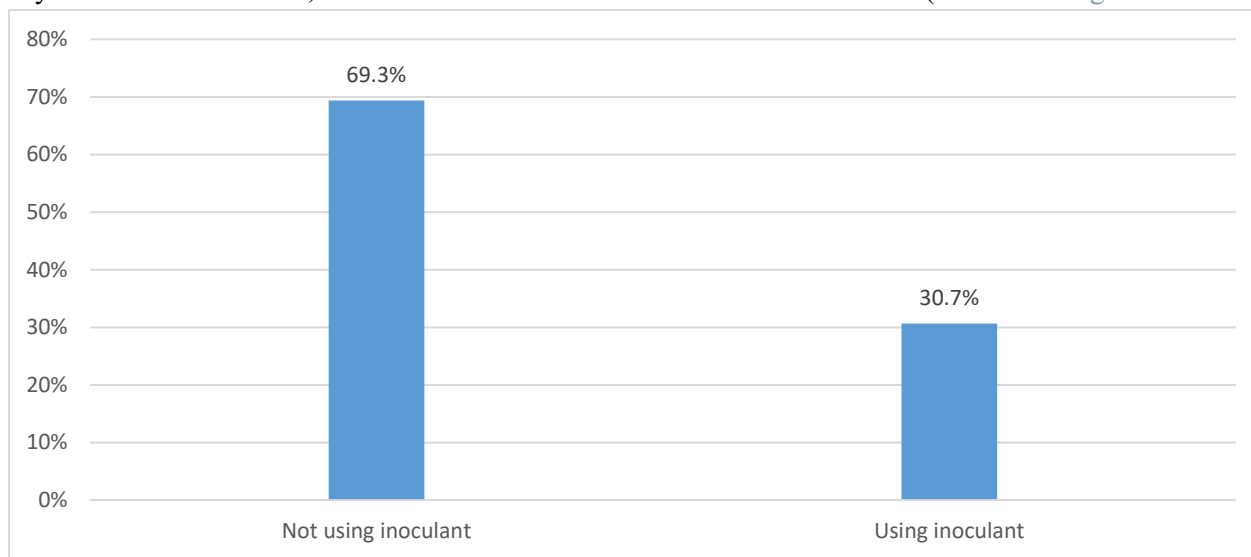


Figure 12: Percentage of respondents who are using soybean inoculants among those who are aware of soybean inoculants

Inoculant is a relatively new technology in Malawi; in particular, to smallholder farmers. Before the intervention only 21% of the male respondents and 18% of the female used inoculant. Figure 13 shows the use of inoculant after the intervention. As can be observed, there is a significant increase in the use of inoculant after the intervention; especially among the male respondents – 21% before the intervention and

31% after. It should also be noted that the intervention started slightly late when some farmers had already planted and it most likely that the results would have been more dramatic if the interventions were done on time.

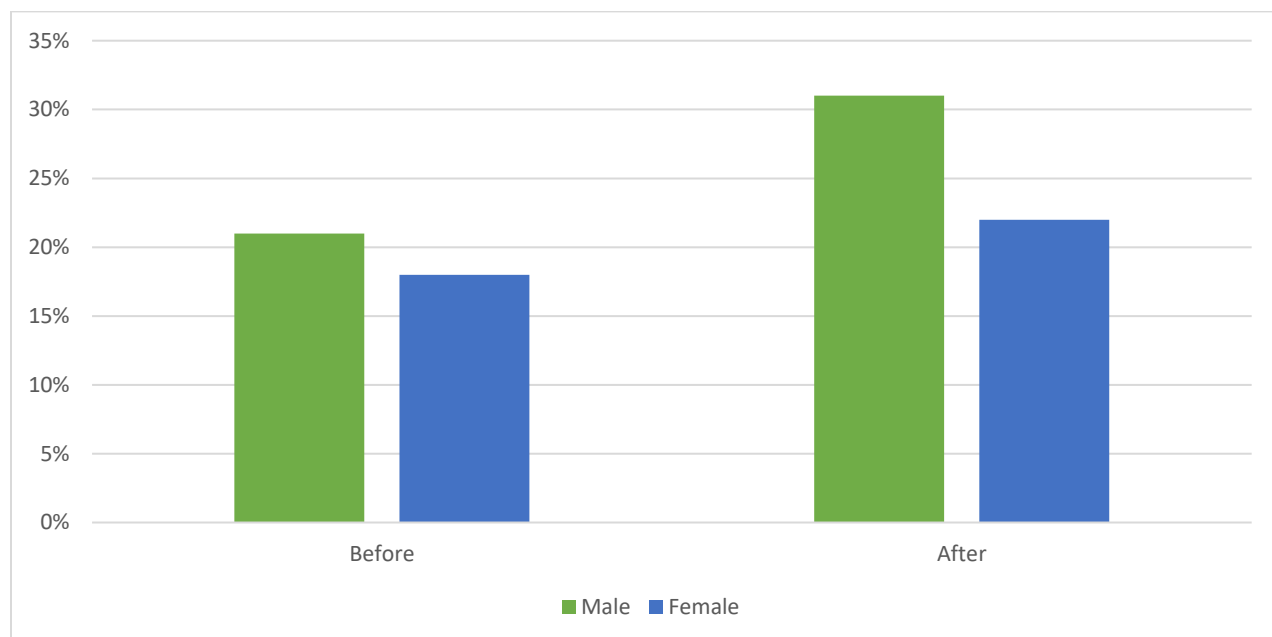


Figure 13: Use of inoculant before and after intervention by sex

At district level, Mchinji agro dealers registered to have sold 87,000 packets of inoculant which is more than 50% increase from last growing season of 2017/2018

“... yes, last year Mchinji had 41,000 packets sold by agro dealers, this season they have 87,000 packets of inoculant sold by agro dealers. This does not include inoculant distributed by NGOs, researchers and other donors. So in terms of acreage, more land has been inoculated for Mchinji. This includes inoculant produced in Malawi and neighboring countries like Zambia” KII, Soil Microbiologist, Chitedze Research Station, Lilongwe

It cannot be ruled out that the campaign is one of the contributors to the increase in adoption of soybean inoculant.

“...yes there has been a change, the PRC enhanced the publicity of inoculant and now more farmers are demanding inoculant especially farmers in cooperatives directly involved with FRT in the inoculant PRC” KII, Agricultural Extension Development Coordinator, Mkanda EPA, Mchinji District.

2.3.3.2 Factors that influenced farmer’s decision to apply soybean inoculant

Majority of the farmers indicated to have applied soybean inoculant to increase their yields and were curious to know how inoculant works. Others indicated that they had access to free inoculant and their fellow farmers persuaded them to apply soybean inoculant. This demonstrates the sharing spirit of information among the farmers expanding on the number of farmers reached to access information about technologies.

Despite being a new technology, the study attempted to find out reasons for non-adoption among farmers that were aware about soybean inoculant. The majority indicated that they heard about inoculant after the

production season had already advanced and could not use it then but felt compelled and decided to use Inoculant in the next production season. Others stated that they did not have money with which to buy Inoculant² followed by those that did not know where to source it and those that knew little about it. Those that had no money indicated that inoculant was mostly available when they had no money. Others indicated that inoculant was still found in big trading centers and that some other agro dealers had not yet discovered the business of inoculant. Some agro dealers indicated that it was very difficult to venture into the inoculant business as some other institutions were previously giving it out for free hence it did not make a viable business sense as others would wait till they get the free inoculant. Nevertheless, female respondents dominated on lack of money as an impeding factor.

2.3.4 Impact of inoculation on Soybean yield

The intervention research attempted to assess the impact of soybean inoculation on soybean yield among listeners and non-listeners of ‘*Tipindule ndi Inoculant*’ radio program. The results indicate that there was an increase in soybean yield from 271kg/acre to 551kg/acre (103%) among listeners and 255kg/acre to 476kg/acre (86%) among non-listeners (see Figure 14).

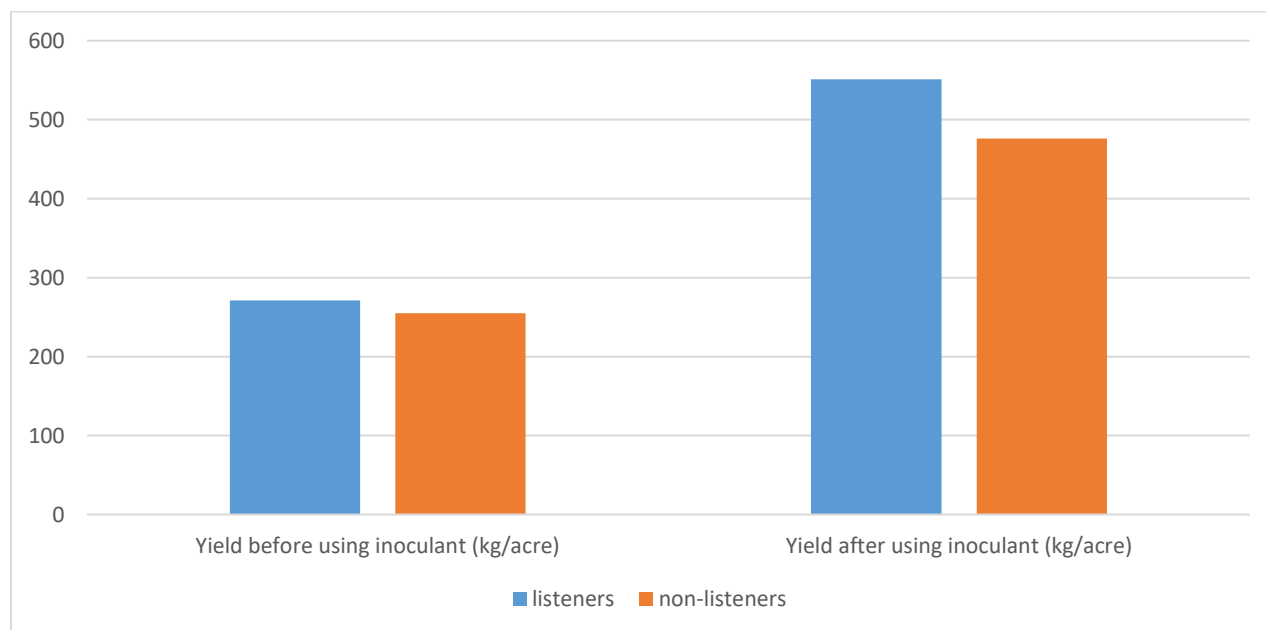


Figure 14: Impact of inoculation on soybean yield between listeners and non-listeners

Government crop production estimates of soybean in the EPAs where the evaluation took place also demonstrates that there has been an increase in yield of soybeans in the intervention sites. Figure 15 show the change in yield of soybeans by making comparisons of two growing seasons; 2017/2018 vs 2018/2019.

²Inoculant is mostly made available during the planting season to minimize issues of storage on the farmers' end. This is the same time most of the resources are already spent on other production activities like buying of seeds and fertilizers, land preparation, etc.

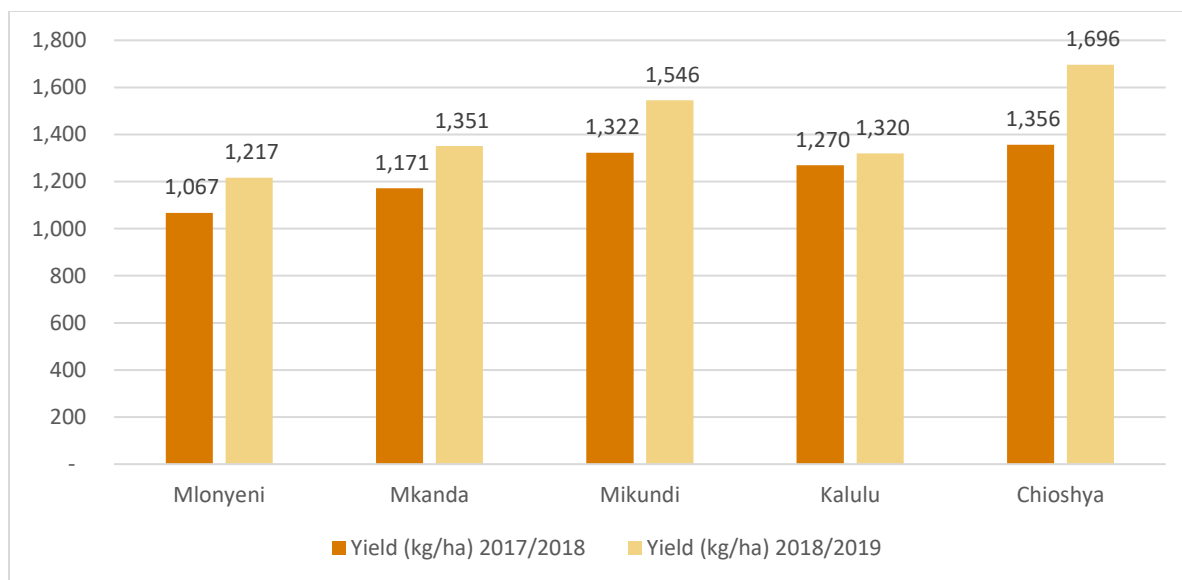


Figure 15: Yield of Soybean in Mchinji for between 2017/2018 and 2018/2019 growing season

Despite the difficulty in attributing the increase in soybean yield to soybean inoculant as there are several factors that influence yields. However, there was an increase in the yield among listeners of the radio program and compared to non-listeners and there was more acreage of land under inoculation in Mchinji and inoculant is a technology that is tried, tested and approved to enhance yields. It is therefore safe to conclude that inoculation contributed to the increase in yields of soybean in the intervention sites.

2.4 Gender Responsive Conceptual Framework for the Efficient Use of ICTs in Scaling-Up Initiative

Despite the development and testing of innovative ICTs that have demonstrated potential to enhance household food and nutrition security, there are challenges in uptake particularly among rural women. This means that scaling up ICTs in agriculture has potential to exacerbate existing gender inequalities. The possibility that ICTs can extend the reach of existing information channels also means that they can be used to overcome barriers that currently limit women farmers' access to information if the ICTs are designed and used to overcome gender-specific constraints. The gender component of the intervention research identified barriers and opportunities for different gender groups in using ICTs for adoption of agriculture solutions and to developed a gender theoretical framework for ICT-for-scale initiatives.

The study confirms what is widely acknowledged that women farmers have less access to information and productive resources than men and lack the authority to adopt new practices that could increase productivity and profitability of their farms. Men's sources of information, were found to be broader, reflecting men's greater mobility and interaction with a wider range of agricultural actors. Men were able to attend seminars and field days and interact with vendors at agricultural shows. They mentioned receiving and consulting literature such as magazines and brochures about any agricultural product due to their literacy levels. Despite that women were less likely to own a mobile phone than men, radio was however more popular and more likely to be accessed by both men and women.

Despite the perceived trustworthiness of information from the phones or the radio, both men and women farmers explained that they seek advice from other sources, such as extension officers or field day demonstrations, to validate what they hear. While there are so many services that can be accessed using the phones, majority of rural farmers have not viewed them as a source of information but instead as a vehicle for connecting farmers with trusted individuals for information. Interviews with extension workers revealed that they lack knowledge about ICT initiatives that could complement and enhance their efforts beyond just the radio and the phone for calling and push messages. Given their role as trusted information intermediaries, building their knowledge of various ICT enabled services can enhance both their role and their knowledge, as well as promote the use of ICTs by farmers.

The study found that the opportunities in using ICTs to access and adopt agriculture solutions were farmers' access to ICTs, willingness to pay for the ICTs to access agricultural solutions, quick feedback, gender awareness, trust in agricultural messages accessed through ICTs and the message sharing behavior among the farmers. The hindrances were cost of ICTs, lack of knowhow on use of ICTs, cultural and gender barriers, illiteracy, ICT infrastructure, inadequate supply of the technology in this case soybean inoculant due to increased demand and lack of interest.

The conceptual framework illustrates the transformative pathways that enable women, and different gender groups in the rural areas to take advantage of the ICTs for innovative agriculture, and these include:

- i. Incorporating education, i.e. adult literacy education among the rural women, men and youth
- ii. Improving access to ICTs such as radio and phones with internet through provision of loans
- iii. Provision of training on the use of ICTs for agriculture development
- iv. Critical examination of gender norms and conducting gender training (using an approach where husbands and wives are trained together) to improve women access to ICTs and resources and empowerment in decision making
- v. Use of agricultural extension workers to promote ICTs
- vi. Providing market information through ICTs to increase uptake

2.3 Policy Environment in Scale Up Initiatives

For scale up initiatives using ICTs, it is important to have a conducive policy environment. Farm Radio Trust ensured that the policy environment was conducive in the implementation of the intervention research by doing activities discussed below:

a) Policy development process

Farm Radio Trust worked with other extension actors to lobby government to recognise the role of ICTs innovations in the transformation of agriculture in Malawi. This led to the 2016 National Agriculture Policy in Malawi to embrace ICTs in transforming agriculture in Malawi. As such, FRT engaged Department of Agriculture Extension Services to spearhead the role of ICT in the National Agriculture Extension Strategy.

The Ministry of Agriculture Irrigation and Water Development embarked the process of developing National Agriculture Extension Strategy to bring effectiveness in the provision of agriculture extension and advisory services. Farm Radio Trust was incorporated in the 18-member team to work closely with the consultants I

developing the strategy. This provided a platform for FRT to lobby for department of Agriculture extension to include the role of ICT in promoting agriculture extension and advisory services. The strategy has also embraced ICTs as key component in transforming agriculture in Malawi. As part of upscaling the use of extension, FRT and other extension actors, are working with the department of Agriculture Extension Services to develop e-extension strategy to outline detailed process of using ICTs in the agriculture extension and advisories. This strategy will ensure that ICTs are given recognition, resources and attention in agriculture transformation.

b) Coordination and harmonization

One of the challenges that faced the extension services was the provision of conflicting messages to farming communities which to an extent affected adoption of agriculture technologies. FRT together with other extension stakeholders championed the establishment of National Agriculture Content Development Committee with the mandate to develop and disseminate the agriculture content to be promoted by extension actors. The committee consists of actors working on different value chains in agriculture and develops and standardize content for every agriculture season in line with season forecast. Farm Radio Trust is the present chairperson for the committee.

c) Institutionalization

As a way of ensuring that the use of ICTs in transforming agriculture and rural development, FRT collaborated with four institutions of higher learning: Lilongwe University of Agriculture, University of Malawi, Chancellor College, The Polytechnic and Malawi Institute of Journalism to review communication and extension curriculum to embrace the role of ICT. A total of eight courses were reviewed in the four institutions and two cohorts of the students have had a change to undergo the revised courses. FRT also act as adjunct faculty to the department of Agriculture Extension at LUANAR where student come to FRT premises to have hands on experience in using ICTs for extension.

d) Capacity building of Agriculture Communication Officers in the Department of Agriculture Extension Services

To ensure continuity of using ICTs in extension, FRT collaborated with Department of Agriculture Extension Services and Lilongwe University of Agriculture to train Agriculture Communication officers from the districts in using ICTs for extension and agriculture advisories. A total of 22 Agriculture Communication Officers were trained and are now working with community radios to provide agriculture extension services. Public private partnerships

e) Involvement of public and private partnership in the use of radio and ICT services

Some of the platforms that FRT uses in disseminating agriculture information and services is through call centre and mobile phones through SMS. At the initial stage, FRT worked with department of Agriculture Extension Services to staff the call centre while the donors invested on the setting of the call centre. However, with time, FRT embraced the private sector who also contributes to the cost of operating the call centre and pushing of SMS messages to farming communities.

f) Advocacy

As part of promoting greater listenership to agriculture radio programs, FRT and other actors promote the concept of radio listening groups or community ICT hubs. In these groups, farmers are provided with solar wind up radios which they use to listen and record programs. However, these radio sets are expensive because government impose import duty taxes which affect the number of radios that can be procured and distributed to farmers. Stakeholders are lobbying the ministry of finance to remove import duty tax on the radio so that the cost of the radio sets could be manageable even by farmers on their own.

3.0 Best Practices when using ICTs to enable the scaling up of solutions

Best practices related to use of ICTs to enable the scaling up of solutions have also been identified in the implementation of the intervention research which include:

- i. The ICTs used in the intervention worked best in combination for complementarity for instance, radio programming amplifying feedback from the call center as part of content; the SMS platform influencing listenership of the radio programs; and the call center expanding messages on radio and SMS platforms by providing detailed real time advisories demanded by farmers about soybean inoculant. In essence, ICTs played a role of providing the farmers the needed information that enabled them to use soybean inoculant.
- ii. Involvement of different stakeholders in inoculant from producers of inoculant, researchers, extension workers, suppliers/distributors and farmers, the end user, brings in complementarity in the scale up. This brought credibility of the programs aired; improved access to the technology as farmers were guided; demand of inoculant brought by the campaign was managed because information was shared; motivation as farmers gave out testimonies on the technology and also provided advisories.
- iii. Involvement of farmers in recording of the radio program also enhanced listenership as farmers felt excited to listen to themselves or a fellow member in the program
- iv. The use of a community radio station meant that stories were coming from the farmers' locality which motivated them to listen to their fellow farmers on air, thereby motivating listening
- v. Several mechanisms were put in place to empower women to encourage their participation on radio programming through targeted radio programs, debates on gender sensitive issues and bringing their voices on air to share experiences in the scale up
- vi. Use of already existing ICT listening hubs for targeted radio listening and use of women groups and families (both wives and husbands) to contribute to content on the gender aspect of the program
- i. Engagement with extension workers in the scale up and building their knowledge of various ICT enabled services as they are considered trusted information intermediaries.

4.0 Key Lessons Learned

The following key lessons have been learnt through the implementation of the intervention research

- ii. Frequent reminders are needed when dealing with new radio programs to encourage farmers to listen and have them accustomed to the radio program to ensure maximum listenership
- iii. Promotion and demonstration are necessary to enhance uptake of both the technology and ICTs.
- iv. Many farmers perceive ICTs especially smart phones as being very complex
- v. Ownership of mobile phones is still a challenge, so is the cost of airtime.
- vi. Some ICTs, for instance mobile sets, provide a social status to the owner leading to farmers wanting to own them indirectly having a platform for receiving information about agricultural solutions
- vii. Farmers are willing to pay for an agricultural solution or an ICT platform if it gives them more value than what was invested. This was demonstrated in farmers sending out messages to incurring costs to seek agricultural advisories.
- viii. Institutions can support farmers to act on the knowledge acquired by supporting the method of acquisition for agricultural technologies - for instance farmer cooperatives and associations giving out inoculant as a loan or on credit to member farmers
- ix. It is best to understand the cultural dynamics of communities involved in ICT based scaling up initiatives for instance ownership of ICTs, decision making process in household expenditure and gender roles.
- x. Women are used to letting men lead in decision-making on household expenses despite being given an opportunity to contribute; a push is needed to empower them
- xi. For better participation, it is necessary that all members, including women, have access to the ICT platforms and are equally involved in scale up initiatives as men are considered culturally superior and control expenses of bigger purchases such as ICTs. With such an approach, men see the importance and value of women in scale up initiatives and how it contributes to their household as a whole. Lack of their involvement aggravates the disparities that exist between men and women
- xii. Despite the perceived trustworthiness of information from the phones or the radio, farmers seek advice from other sources, such as extension officers to validate what they hear. While there are so many services that can be accessed using the phones, majority of rural farmers have not viewed them as a source of information but instead as a vehicle for connecting farmers with trusted individuals for information. Given their role as trusted information intermediaries, building their knowledge of various ICT enabled services can enhance both their role and their knowledge, as well as promote the use of ICTs by farmers.

5.0 Conclusion

The ICTs that were used in the project do demonstrate that ICTs have the potential to accelerate scaling of application and potentially adoption of agricultural innovations. This is evidenced by the upscale of soybean inoculation in the intervention site. The ICTs used in the intervention research contributed to 10% and 4% increase in usage among men and women respectively of soybean inoculant. At district level, Mchinji agro dealers registered to have sold 87,000 packets of inoculant which was more than 50% increase from last growing season of 2017/2018. The ICTs played a role of providing farmers the needed information to use soybean inoculant.

Different institutions played various roles in the scale up by providing different types of support including physical demonstration on the correct use of soybean inoculant and its benefits to yield, provision of free inoculant and in person advise on how to use soybean inoculant. Other institutions like farmer organizations aided farmers to act on the information received by aiding the process of acquisition of soybean inoculant through loans/credits. Other institutions played role in content generation for the ICTs and being resource persons for radio programs enhancing credibility. Engagement with the suppliers of soybean in the PRC helped to balance the demand and supply of soybean inoculant by providing relevant information about access and usage.

Inoculation of soybean also had an impact on the yield where there was a 103% and 86% among listeners and non-listeners respectively that had applied soybean inoculant. Government crop production estimates of soybean in the EPAs under which the intervention took place demonstrate that there has been an increase in yield of soybeans in the intervention sites. Despite the difficulty in attributing the increase in soybean yield to soybean inoculant as there were several factors that influence yields that the research did not control, there was more acreage of land under inoculation in Mchinji. It is therefore safe to conclude that inoculation contributed to the increase in yields of soybean in the intervention sites.

In terms of gender considerations, it is best to understand the cultural dynamics of communities involved in ICT based scaling up initiatives for instance ownership of ICTs, decision making process in household expenditure and gender roles. For better participation, it is necessary that all members, including women, have access to the ICT platforms for scale up. As such, both men and women need to be equally involved in scale up initiatives as men are considered culturally superior and control expenses of bigger purchases such as ICTs. Discussions from radio programming with farmers indicate that women are used to letting men lead in decision-making on household expenses despite being given an opportunity to contribute; a push is therefore needed for empowerment.

The gender component of the intervention research identified barriers and opportunities for different gender groups in using ICTs for adoption of agriculture solutions. Opportunities in using ICTs for scale up included access to ICTs, willingness to pay for the ICTs to access agricultural solutions, quick feedback, gender awareness, trust in agricultural messages accessed through ICTs and the message sharing behavior among the farmers. The hindrances were cost of ICTs, lack of knowhow on use of ICTs, cultural and gender barriers, illiteracy, ICT infrastructure, inadequate supply of the technology in this case soybean inoculant due to increased demand and lack of interest.

The conceptual framework illustrates the transformative pathways that enable women, and different gender groups in the rural areas to take advantage of the ICTs for innovative agriculture, and these include: adult literacy training, improving access to ICTs such as radio and phones through provision of loans; provision of training on the use of ICTs for agriculture development; critical examination of gender norms and conducting gender training (husbands and wives trained together) to improve women access to ICTs, resources and empowerment indecision making; development of radio listening clubs to promote debate and discussions on agriculture solutions; use of agricultural extension and also promoting use of ICTs for linking farmers to markets.

6.0 Recommendations

The following recommendations have been proposed in the implementation of the intervention research:

- i. There is need for shift from project approach to formal and institutionalized system to allow sustainability and increase outreach of the intervention research
- ii. ICTs should be complimented by the availability of extension workers. There is a need for Government to increase extension workers or train more lead farmers
- iii. Government may wish to reduce or remove tax on some ICTs such as radios and smart phones. The airtime tariff is also high for rural farmers and it could benefit from a reduction.
- iv. Leadership in driving the ICT agenda
- v. It is important to garner support for ICT agenda and pathways through policy actors to influence a conducive policy environment

ANNEXE 1: Participatory Radio Campaign for Soybean Inoculant

PRC Theme:		Soy bean Inoculant				
Ep. #	Dates	Communicati on Objective (What do you want people to walk away with? What do you want them to know or do after this episode?) (English)	Key Topic (English)	Key messages (English) (specific elements that will be included in this episode)	Resource people (Who are possible appropriate contacts that you could include on the air for each individual episode)	Format (the formats that are the most appropriate for the communication objective of the specific episode)
Phase 1 Introduction – Introduction of the problem and proposed practice (solution), length of campaign, who they will hear from during the program, how they can participate.						
1	6th and 10th Nov. 2018	To introduce and make farmers aware of the inoculant campaign	The soybean inoculant campaign	Introduction of the campaign and its deliverables Brief definition of what inoculant is and its benefits Ways in which farmers can participate in the campaign	FRT, Department of Agriculture Research Services (DARS)	interviews, jingles

2	13th and 17th Nov. 2018	Farmers to be made aware of what inoculant is and the different types of inoculant for soybean	What inoculant is Types of inoculant Varieties and types of seed to be used for inoculation	Definition and description of inoculant Types of soy bean inoculant Seed required for inoculation: - Varieties of Soybeans: - Local vs Hybrid; Type of Seed: Recycled vs Non recycle	DARS, Lead farmers	Interviews, magazine
<p>Phase 2 Discussion – Benefits of proposed practice (solution), challenges or barriers that might be faced when implementing, facilitators (things that are already in place that facilitate the implementation of this proposed solution.</p>						
3	2018/11/20 – 2018/11/24	Farmers made aware of the benefits of inoculant	Benefits of inoculant	Benefits of inoculant: soil health benefits, plant health/increase in yields, nutritional benefits, economic and benefits	DARS, lead farmers, farmers	Magazine, interviews, jingles
<p>Phase 3 Decision – Hear from as many farmers as possible that say they have decided YES they will try the proposed practice. Hear from farmers that have been using it and have had success.</p>						

4	27th Nov. and 1st Dec. 2018	Feedback from farmers who have decided to use inoculant for this cropping season Feedback from farmers who have once used inoculant and the benefits Where farmers can find Inoculant	Feedback from farmers who have decided to use inoculant and benefits of inoculant from farmers who have used inoculant before Where to find inoculant	Farmers who have decided to use inoculant Benefits of inoculant from farmers who have used inoculant before Where farmers can find inoculant	farmers, DARS	Discussion, Mini drama
Phase 4 Implementation – Step by step instructions on how to implement, where to find material, etc.						
5	4th and 8th Dec. 2018	Farmers to be made aware on usage, and storage of inoculant and planting of inoculated soy bean	Inoculant usage storage of planting of inoculated soybeans	how to use inoculant Recommended storage of inoculant Planting of inoculated soybean	DARS, lead farmers, farmers	interviews, group discussions, magazine

6	11th and 15th Dec. 2018	Planting and crop management of inoculated soybean	Modern planting techniques of soybeans and crop management of inoculated soybean	Soybean crop management and planting of inoculated soy	DARS, FOL and LUANAR, Farmers, DAES	Interviews, advisories
7	18th and 22nd Dec 2018	Soy bean crop management	Good agricultural practices of inoculated soybean: weeding	Weeding: timely weeding, methods of weeding	NASFAM, DAES,ITTA, farmers, DARS	Interviews, advisories, songs, mini drama
8	25th and 29th Dec 2018	Soy bean crop management	Good agricultural practices of inoculated soybean: Banding	Banding: timely banding, methods of banding,	NASFAM, DAES, IITA, farmers DARS	Interviews, advisories, min drama
9	1st and 5th Jan 2019	Soy bean crop management	Good Agricultural Practices: pest control	Types of pests that affect soybeans; prevention and control	farmers, DARS, IITA, DAES	Interviews, advisories, min drama

10	8th and 12th Jan. 2019	Soy bean crop management	Good Agricultural Practices: disease control	Types of diseases that affect soybeans; prevention and control	farmers, DARS, IITA, DAES	Magazine,
11	15th and 19 January 2019	How to solve challenges/solutions to non-adoption.	doubts and beliefs about inoculant	Feedback from farmers on why they did not apply inoculant and determine solutions to influence adoption	Lead farmers, DARS	Focus Group discussion, Interview
11	22nd and 26 Jan 2019	Farmers to be aware of other farmers who have adopted use of inoculant so as to influence adoption	Feedback from farmers who have used inoculant	early benefits of using inoculant	farmers	interviews, focus group discussions

[i] Results of the baseline survey

[1] “PRC Manual_DRAFT 3rd Edition.Pdf.”

[2] National Statistics Office: 2018 Malawi Population & Housing Census Preliminary Report, December 2018.

[3] National Statistics Office, Malawi Communication Regulatory Authority (2015). Survey on Access and Usage of ICT Services in Malawi.

[4] Farm Radio Trust (2016) Cohort Tracking Report on Scaling Up Radio and ICTs in Enhancing Extension Delivery (SRIED) Program