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Use of animated videos through mobile phones to enhance agricultural knowledge among bean farmers in Gurue District Mozambique

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Use of animated videos through mobile phones to enhance agricultural knowledge among bean farmers in Gurúè District, Mozambique

by

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DEDICATION

To my wife Lurdes, my kids Nwaneso Mocumbe and Kimani Mocumbe, my mom Helena Manganhela, and my siblings Dirce, Bernardo and Edilson, especially to my little daughter, Kimani, who was born while I was away from home pursuing my studies.

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ACRONYMS

IIAM	Agricultural Research Institute of Mozambique
NGO's	Non-Governmental Organization
MASA	Ministry of Agriculture and Food Security
MINAG	Ministry of Agriculture
INE	National Institute of Statistics
UNDP	United Nations Development Program
USAID	United States Agency for International Development

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ABSTRACT

The current study focuses on the use of animated videos delivered through mobile phones to enhance agricultural knowledge and adoption among bean farmers in Gurúè District, Mozambique. Access to information is one of the key requirements that farmers need to improve their production. Extension workers are one of the main means through which farmers obtain accurate agricultural information. However, extension agents in Mozambique are too few and consequently only cover a small portion of farmers across the country. The theoretical approaches of Information Processing and Knowledge Gap guided this study. This study is a field experiment with a pretest-posttest design involving 314 bean growing farmers. Farmers were randomly assigned to each of the four experimental treatments: (1) Extension ONLY, (2) Animation ONLY, (3) Extension THEN Animation and (4) Animation THEN Extension. The topic of the experiment was the use of sealed containers such as Jerrycans to safely store beans. Farmers were assessed on knowledge gain and intent to adopt the proposed technique. Regardless of the experimental treatment, all farmers had a significant increase in knowledge regarding the topic. Men and women learned about the same. Although participants in Extension ONLY had the lowest scores and those in Animation THEN Extension had the highest, the Animation ONLY group scored as well as both combined methods and significantly better than those in Extension ONLY. These results suggest that the use of animated videos through mobile phones can potentially complement or replace extension in delivering agricultural topics.

CHAPTER I: INTRODUCTION

Agriculture supports the livelihoods of the majority of the population in rural areas and plays a crucial role in the income generation of many smallholder farmers' households in developing countries. Low productivity is still the curse of many smallholder farmers in developing countries. Access to appropriate information and knowledge is one key factor for successful agricultural production, but the traditional approach of providing agricultural information through extension services is overstretched and under-resourced (Masuki, K., Tukahirwa, J., Kamugisha, R., Mowo, J., Tanui, J., Mogoi, J. & Adera, E., 2010).

The Agricultural Research Institute of Mozambique (IIAM) is the country's main public agricultural research institution, accounting for two-thirds of national agricultural research investments and human resource capacity. As stated in its Strategic Plan 2011-2015, IIAM aims to create knowledge and technological solutions for sustainable development of agribusiness and food and nutritional security. The national extension system is the most commonly used means through which farmers receive the knowledge generated at IIAM. However, in Mozambique there are only 1.3 extension workers per 10,000 farmers country-wide (Coughlin, 2006; Kondylis, Mueller & Zhu, 2014).

The lack of extension agents and the emergence of new portable electronic devices that can supplement or in some cases replace personal visits by extension agents are driving experimentation with use of mobile phones, smartphones, and other devices to reach farmers. In Mozambique, the ability of the country's agricultural extension agents to reach farmers via face-to-face training is severely limited due to lack of personnel and support (Uaiene, Arndt & Masters, 2009).

In the process of supplementing the efforts of extension agents, a number of new communication technologies have been tested successfully in several developing countries. Mobile-phone-based systems using text messaging (Parker, Ramdas & Savva, 2012; Kachelriess-Matthess, Keller, Orleans, Agbo, Baro, Frankel, Shantz, & Huelss, 2011), interactive voice-based services (Agarwal, Kumar, Nanavati & Rajput, 2010; Kulkarni & Karwankar, 2012; Mishra, Chavan & Gourkar, 2012; Cole, Fernando, & Nilesh, 2012; Siraj, 2011; Masuki et al., 2010), market information (Pimentel, Mocumbe & Francisco, 2009), and other services are now being widely used. As smartphones begin to penetrate rural areas, their video and information storage capabilities make them capable of storing, playing, and sharing agricultural information.

There also has been innovation in message design, including video or participatory video using local farmers and the use of animations. The use of video/animation/photovoice in messages has received special emphasis since many farmers are not literate (Gandhi, Veeraraghavan, Toyama & Ramprasad, 2007; David & Asamoah, 2011; Woodard, 2013; Bentley, 2013; Gervais & Rivard, 2013). In addition, at least some videos have been effective even when extension agents are not present (Bentley, 2013; Bentley, Van Mele, Okry & Zossou, 2014; Cai, Abbott & Bwambale, 2013). Van Mele (2011) found that 77% of organizations training rural farmers are now using video as a part of their training. However, video produced to meet the needs of each local community can be very expensive, and many areas lack technical equipment and staff needed to edit and produce them. While small-scale devices are becoming more capable of producing video, animation has special promise because a single animation can often be used across a number of different cultural/language

areas (Bello, Seufferheld, Agunbiade, Steele, Guillot, German & Pittendrigh, 2011). Sound tracks using local languages can easily be attached to animation files at low cost.

The process of providing effective extension and advisory services involves much more than technical solutions (Manfre, Rubin, Allen, Summerfield, Colverson & Akeredolu, 2013). Illiteracy and gender play key roles in shaping the way that the message should be delivered. Overlooking gender differences and inequalities may lead to dramatic losses in agricultural efforts. Reducing gender inequalities in access to productive resources and services could produce an increase in yields on women's farms of between 20 percent and 30 percent, which could raise agricultural output in developing countries by 2.5 percent to 4 percent (FAO, 2011). Cai, Abbott and Bwambale (2013) in their experiment on the effectiveness of videos to either complement or replace tradition extension approach in Uganda, found that this technique has the potential to decrease knowledge gaps between men and women.

At present, published literature includes many studies reporting on experiments with these new approaches. However, as Duncombe (2015) noted in his comprehensive review, most of the time research focuses on effectiveness of only one innovation rather than systematically comparing different approaches. Thus, the current study is a field experiment that compares an extension-only approach with either an animation-only approach or a combination of extension and animation together, utilizing animation delivered through smartphones as a new method of communication in Mozambique that takes advantage of the diffusion of smartphones in rural areas. This study also tests the ability of these approaches to narrow the existing knowledge gap among bean farmers. Additionally, the research findings will add to the existing body of knowledge about farmer knowledge gains and the

contribution of animated videos and mobile phones in disseminating information in rural areas.

CHAPTER 2: CONCEPTUAL FRAMEWORK

Information Processing Theory

Information processing theory states that people usually process information and store it in memory for later use if needed. The model posed by Atkinson and Shiffrin (1968) assumes that information comes in from the environment, is processed by a temporary sensory memory system and sent to short-term memory where it can be either displaced (forgotten) or moved to long-term memory. This process explains how human beings hold information in memory and remember it to perform a wide range of tasks.

Cai and Abbott (2013) observe that information processing theory emphasizes cognitive learning, which is considered to involve receiving, processing, extracting, and remembering information initially stored in short-term memory. Individuals learn quickly by relating stimuli with previous knowledge.

People or entities with information to share are interested in how humans learn, acquire, and retain information because it may guide selection of long-term learning objectives and methods of effective instruction (Lutz & Huitt, 2003). A significant amount of information is made available to targeted users. However, only a portion is effectively utilized. Audiences have the freedom of choice as to what they store in long-term memory. Every single person's mind has the task to displace the useless information and keep the important information in long-term memory. Thus, information should be relevant for the end-user in order to be selected and maintained for much longer.

In communication procedures there are several cues that can be used to increase interest and eventually influence effective learning. Among them, visuals seem to have more

impact. Graphics such as animations may be aesthetically appealing or humorous, attracting attention, maintaining motivation and, as the saying goes, may be “worth a thousand words” (Tversky, Morrison & Betrancourt, 2002).

Illiteracy is one of the most challenging constraints in sharing knowledge among farmers in rural areas of developing countries to improve their livelihoods. Face-to-face oral training is the main modus operandi of the extension system to provide relevant knowledge to farmers.

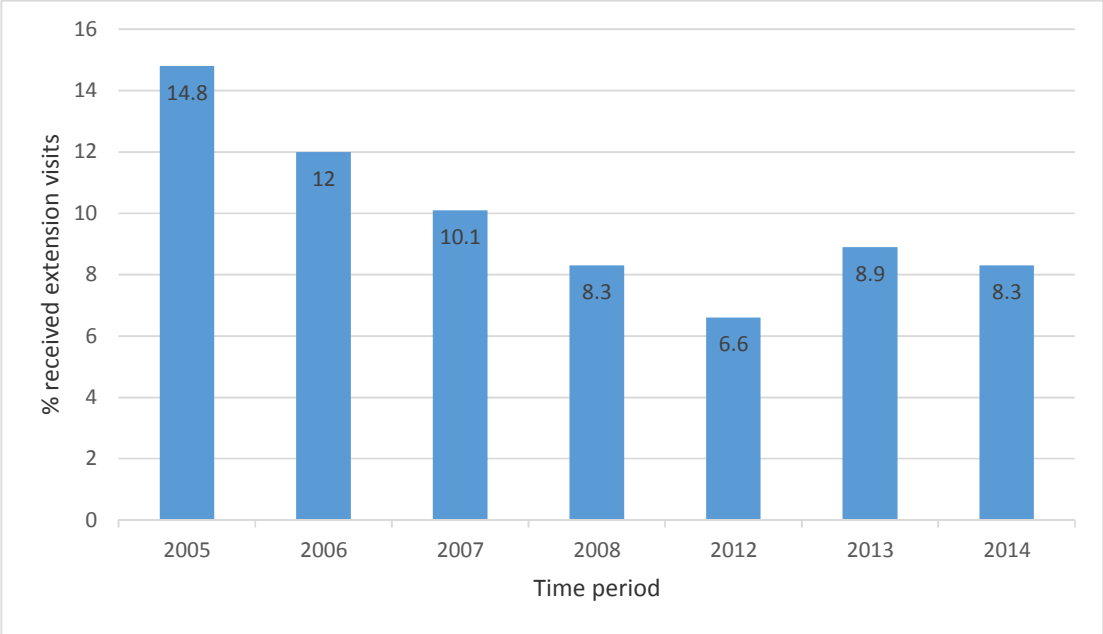
Low Coverage of Extension Services

In Mozambique, the “training and visit” method is the most diffused low cost approach the extension system uses for disseminating agricultural knowledge (Kondylis, Mueller & Zhu, 2014) besides television, radio, pamphlets, posters and radio listening groups (DNEA, 2007). In turn, as stated by Goertz (2014), agricultural research is instrumental in developing technology packages that are adapted to the different agro-ecological regions in Mozambique. Most of these much-valued technologies do not even reach half of the targeted population, which means that in many contexts the knowledge generated does not serve its purpose. Indeed, the extension coverage in Mozambique has been declining from 13% to 8.3% (Davis, 2008, 2009; MASA, 2015).

Extension services all over the world have been crucial in providing farmers with relevant information and knowledge on how to produce and increase their productivity. According to Masuki et al. (2010) access to appropriate information and knowledge is an overriding factor for successful agricultural production and thus rural development.

However, the majority of farmers still not are benefiting from the support of the extension system mainly due to overstretched and under resourced services.

Extension workers are too few in numbers and do not have the required resources to actively help farmers. In Mozambique the ratio of extension workers to farmers is only 1.3 extension workers per 10,000 farmers country-wide (Coughlin, 2006; Kondylis, Mueller & Zhu, 2014). The Agricultural Statistics Yearbook published by the Ministry of Agriculture and Food Security (MASA, 2015) confirms that in 2014 only 8.3% of the entire population of farmers across the country were reached by the extension services. In those conditions it is hard to imagine providing farmers with timely and good quality knowledge. For Cunguara (2014), in his analysis on impact of extension services on farm incomes in rural areas of Mozambique, the percentage of farmers who received extension visits has declined over time.



Source: Combined data from TIA 2005-08 & Agricultural Statistics Yearbook 2012-14

Figure 1. Percentage of farmers reached by the extension services

In Mozambique, efforts over the years have been undertaken to increase extension system capacity by allocating new motorcycles and bicycles, and by training new extension workers to enlarge their operating range (DNEA, 2006). However, those are long-term interventions requiring significant financial support. Meanwhile, farmers are still at the same stage or getting worse and demanding short-term initiatives. Households are going hungry in rural areas of Mozambique waiting for the extension system to improve and reach the needed point. As reported by the UNDP (2015), Mozambique's Human Development Index for 2014 is 180 out of 188 countries.

The INE (2012) report on national data for monitoring the Millennium Development Goals found that in 2009 about 55% of Mozambique's population was living below the daily national poverty line of $1.25 purchasing power parity or less. In rural areas, poverty levels have slightly increased, due to the underperformance of the agricultural sector (Cunguara & Moder, 2011). There is a need to develop strategies to strengthen or complement the regular extension system's ability to provide relevant knowledge to farmers.

Several alternatives with promising results around the world, mainly in developing countries, have been tried to complement and/or replace the extension workers (Masuki et al, 2010; Martin & Abbott, 2011; Das, Basu, & Goswami, 2012; Cai & Abbott, 2013). Today, farmers are benefiting from services that provide them with relevant and timely agronomic information, agronomic diagnostics, precision farming, relationship management, financial services, data collection, traceability, and trade and marketing (Woodard, 2013). Many of these new services take the advantage of mobile phones since mobile phone penetration is increasing at an impressive rate.

Use of Animations in Education

Animations have been the subject of several educational programs, and researchers agree that animation is a powerful approach in learning processes due to its dynamic way of displaying topics (Koning, Tabbers, Rikers & Paas, 2010; Lin & Atkinson, 2011; Barak, Ashkar & Dori, 2011). Cai and Abbott (2013), agreeing with previous research, found that video can be effective for training purposes. However, real people in videos may elicit cultural questions such as body language and style of dress. Animations tend to be more universal. Additionally, the length and the quality of the video determines the way it should be delivered. In cases where smartphones are the channel through which the video has to be delivered, it is necessary to cover the topic in a way that can be viewed on a small screen. Animations can contribute to a better understanding of learning material in two ways: (1) They enable the creation of mental representations of concepts, phenomenon, processes; and (2) They can be used to simplify challenging cognitive processes (such as abstraction, imagination, or creativity) (Barak et al., 2011). A number of studies have demonstrated the effectiveness of animations for education. Koning et al. (2010) studied whether learners construct more accurate mental representations from animations when instructional explanations are provided via narration than when learners attempt to infer functional relations from the animation through self-explaining. The authors realized that whether explanations are generated or presented might be less important than the provision of cues that enable focused processing of presented or produced explanations. Lin and Atkinson (2011) investigated the potential benefits of using animation, visual cueing, and their combination in a multimedia environment designed to support learners' acquisition and retention of scientific concepts and processes. They found that participants provided with

animations retained significantly more concepts than their peers provided with static graphics, and those afforded visual cues learned equally well but in significantly less time than their counterparts in uncued conditions. Barak et al. (2011) focused their study on the effect of animated movies on students' learning outcomes and motivation to learn. Findings indicated that the use of animated movies promoted students' explanation ability and their understanding of scientific concepts. Bello-Bravo et al. (2013) found that animations were well received as a training tool for agriculture and prevention of diseases amongst populations with diverse literacy levels.

To sum up, animations have potential for training farmers in rural areas of developing countries. Animations enable producers to insert sound tracks of a local language into a previously produced animation. Aligned with that, according to Cai and Abbott (2013), illiterate farmers might benefit from training materials that are presented visually in their local language. Mobile phones in rural areas of developing countries can carry and deliver animations, dramatically increasing their potential for reaching farmers.

Diffusion of Mobile Phones

Mobile phones are one of the most rapidly diffusing technologies around the world. Diffusion of mobile phones is also occurring in rural areas of developing countries where farmers in very remote areas can keep themselves up-to-date with what is going on in the world beyond their environment (Masuki et al, 2010).

Mobile phones have moved from being a luxury product to a widely diffused social product enabling people to enlarge their communication possibilities, which means that people can now talk with one another from everywhere at any time as long as they have a

mobile phone service (Kalba, 2008). Uses of mobile phones can vary from very complex business operation and/or transactions to simple phone calls between relatives, bringing people together at all levels of relationships and locations.

The big shift in the mobile phone industry has been that besides phone calls and text messages, it has become possible to add value to the device by listening to the radio, sharing music and videos, navigating the Internet, reading and sending emails, ordering food, online shopping, etc. According to Woodard (2013), through mobile phones in very remote areas farmers can get alerts on weather, prices, pests, general tips, and non-agricultural messaging.

Uses of mobile phones by farmers

Information and Communication Technologies (ICTs) have a lot of potential to positively improve the livelihoods and food security of smallholder farmers, as well as everyone else along the agricultural value chain (Woodard, 2013). Farmers almost everywhere have been using ICTs as a tool to leverage their productivity to get the most relevant, valuable and up-to-date knowledge that can assist them in improving their production.

According to the World Economic Forum (2012),

> "Knowing the latest market prices allows farmers to avoid unnecessary middlemen and raise their profits, while getting regular weather updates can help them save crops that would have otherwise been destroyed by storms."

Among several ICT tools farmers have been trying, mobile phones have proven to be the most promising due to their one-on-one assistance and continuous information gathering system giving farmers the opportunity to learn best practices to strengthen their knowledge. Across the developing world, there are programs that give farmers access to research and

best practices, weather information and market prices via SMS, Interactive Voice Response (IVR) or call centers (World Economic Forum, 2012).

These initiatives have had a significant impact due to the high penetration rate of mobile phones even in rural areas of developing countries. Farmers are no longer solely depending on peers and extension workers to obtain and share relevant information and/or perform specific transactions (Masuki et al. 2010). According to Connected Agriculture cited by Palmer (2012), the greatest increase to farmers' incomes will come from mobile phones: mobile payment systems that provide farmers with the ability to exchange capital, mobile information services that give access to critical, targeted information on commodity prices, weather, disease outbreaks, etc., and helpline services providing key tips and real-time advice.

The mobile market in Mozambique is defined by growth. There was a 158% increase over the 2010-2014 period and, in the fourth quarter of 2015 the mobile phone penetration across the country was around 61% (GSMA 2015, GSMA Intelligence, 2016). The country has three mobile phone companies: Mcel, Vodacom and Movitel. Subscriptions in rural areas might be lower than urban areas, but they are visibly increasing. The telecommunication sphere in Mozambique is changing quickly (Mabila, 2013). Muatiacale (2009) has no doubt that more Mozambicans are using mobile phones, which definitively constitutes an alternative to traditional media hegemony. Smartphones' penetration in rural areas is small. However, it is increasing because mobile devices are becoming more accessible and affordable.

To summarize, the increased penetration of mobile phones in rural areas represents a great opportunity for exchanging information and sharing knowledge. This study looks at the

potential of mobile phones for delivering training content among farmers in rural areas. Using mobile phones as a tool through which training messages are delivered makes it possible to overcome the shortage of extension workers.

Knowledge Gaps

The research on this subject started with Phillip Tichenor, George Donohue and Clarice Olien, at the University of Minnesota. The Knowledge Gap hypothesis states the following:

> As the infusion of mass media into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than lower segments, so that the gap in knowledge between these segments tends to increase rather than decrease (Tichenor, Donohue & Olien, 1970).

Viswanath and Finnegan, cited by Heron and Sligo (2005), identified a contentious aspect of knowledge gap theory, which is that those at the lower end of the socio-economic spectrum do not acquire the same level of knowledge as those in upper socio-economic groups and, moreover, attempts to equalize knowledge gaps within a community by releasing information may widen rather than lessen knowledge gaps. For example, in research on the implications of leveling the playing field for low-income and middle-income children, Neuman and Celano (2006) found that providing equal resources to unequal groups may actually exacerbate differences, since those who are somewhat more prepared due to better socioeconomic status benefit more than those from low-income conditions.

The complexity of the content that is delivered puts those who are already familiar with the topic at an advantage compared to those who know little or nothing about it. Thus, knowledge gap goes beyond the skills of those who are exposed to the information. It also

considers the framing of the information. Jerit (2009) found that content is a determinant in increasing or decreasing the gap. The message should be prepared and passed to end users in such way that everyone could easily understand.

In rural areas of developing countries, men and women often have different learning outcomes. According to Gurumurthy (2004), regardless of rich or poor country there is a "gender divide" with women enjoying less access to information than men. The relative positions of men and women in society are also largely influenced by cultural mechanisms that define the distribution of economic goods and productive assets (Bergh-Collier, 2007). The lack of opportunities for women and gender inequalities especially in rural areas of developing countries have been widely discussed (Walby, 2003; Bauer & Shah, 2006; Grigorian, 2007; Bryan & Varat, 2008). Tichenor, Donohue and Olien (1970) in their knowledge gap hypothesis explain that in most cases people with low education, income and limited networks often have limited access to information and/or knowledge.

For Kwak (1999) knowledge gap goes beyond structural aspects such as social-economic status (SES). Social psychological characteristics such as motivation and behavioral involvement play a significant role as well. For this author, motivational variables have the potential to either widen or narrow the knowledge gap such that the gap is significantly smaller among those with a higher level of involvement than those with lower level of involvement. Thus, increasing access to information media can potentially decrease the knowledge gap between those in lower and higher SES groups.

Cai, Abbott and Bwambale (2013) in their experiment on agricultural knowledge gaps between men and women in rural areas of Uganda, found that videos alone improved women's knowledge scores as much as men. They realized men already had higher

knowledge scores before training and thus could not learn more due to a ceiling effect, giving women a chance to catch up.

For the purpose of this study, knowledge gap is the degree to which men and women have unequal knowledge about a certain topic, which likely increases advantages for some and disadvantages for others in learning and accessing resources for improving their livelihoods. Additionally, knowledge gap theory posits the possibility of reducing or closing the gap. Problems caused by differences in learning skills between men and women can be overcome by the use of multiple approaches in delivering knowledge. The use of different training methods increases the chance that materials will match the learning styles of men and women farmers.

Study Variables and Research Questions

This study used the Cai and Abbott (2013) model. These authors tested the effectiveness of video as a complement and/or replacement for the traditional extension lecture in rural Uganda. The authors used basic knowledge test scores and were able to accurately measure the knowledge gains about row planting among farmers exposed to each of three methods, namely: (1) extension alone, (2) video alone delivered through a Pico projector and (3) combination of both extension and video. For each training method, the research measured the participants' knowledge, attitude toward the training topic, and willingness to adopt the innovation before and after the training.

The current research aimed to determine to what extent the use of animated videos delivered through mobile phones influences knowledge gains and adoption intentions among farmers in Gurúè district, Mozambique. As stressed by Cai and Abbott (2013) citing Scott in

the information-processing framework, visual information has established its potential for cognitive impact directly or by representing and allowing the elaboration of concepts, abstractions, actions, metaphors, and modifiers. Thus, the research questions are the following:

***Research Question 1*:** To what extent do two different visual training approaches – extension and animation, plus a combination of the two – result in significant learning? Rationale: Information processing theory suggests that visual techniques can be effective in increasing learning among farmers, and especially among farmers who are illiterate or who have only low levels of education. Both approaches to be tested involve visual learning, but of different types. Will both result in learning?

Research Question 2: Will training approaches that involve more than one visual method result in more learning than approaches that involve only one? Information processing theory suggests that including additional approaches can be more effective since it increases the chance that the learning style of the farmer will match the method used. Thus, two methods might be expected to result in more learning than just one method. In the experiment, one group of farmers received both the extension and animation training methods, while the other groups received only one of the methods. Does the combination result in more learning? Would it be best to include multiple methods in future training?

Research Question 3: Do female farmers in Gurúè have lower initial levels of knowledge about jerrycan storage of beans than male farmers? Research suggests that

women often have lower levels of knowledge about technical agricultural topics because they have fewer sources of information, and also because they often have lower levels of education that limit their ability to absorb new knowledge. If they do have lower levels of knowledge, this might mean that they need additional training or different delivery methods.

Research Question 4: When exposed to visual training approaches such as extension or animation methods, or a combination of the two, can women learn as much as men? Could they actually learn more, closing the knowledge gaps that might exist? If women initially know less than men, and if they can learn from the visual training methods, it might be expected that they might even close the knowledge gap between them and men.

CHAPTER 3: METHODS

Study Design

The study was conducted as a field experiment, with a pretest-posttest design. Groups of farmers were randomly assigned to one of four experimental treatments. The study took place in two Administrative posts (Lioma and Mepuagiua) of the district of Gurúè, Zambezia Province, in Mozambique. In Lioma, research was conducted specifically in the Tetete locality. Tetete and Mepuagiua were selected due to their potential for bean production. Data were gathered through a questionnaire administered during face-to-face interviews.

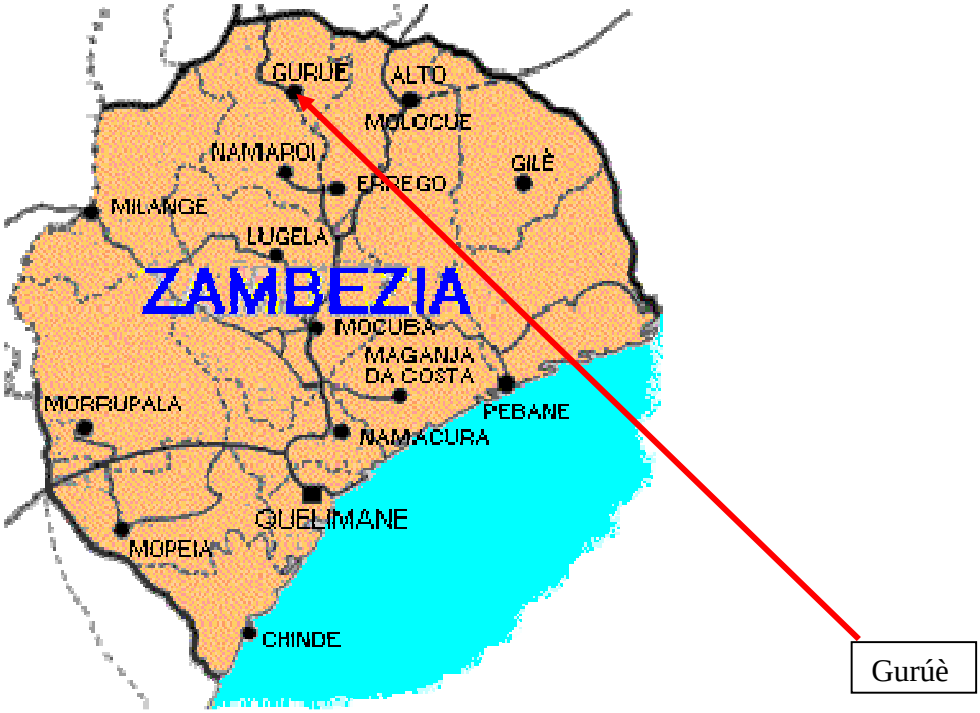


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Figure 2. Location of Gurúè District in Zambézia Province.

In all four experimental groups farmers were trained on how to preserve beans using a sealed jerrycan storage technique. In the effort to improve food security and livelihoods, and raise income, it is important to consider post-harvest losses (Kiaya, 2014). According to results from the Farmer Decision Making Strategies for Improved Soil Fertility Management in Maize-Bean Production Systems (2014) project baseline survey, farmers in both Tetete and Mepuagiua lose a significant amount of beans to weevils. Hermetic storage of beans in airtight containers such as jerrycans has the potential to reduce insect infestation, increasing the amount that farmers can sell at a higher price (Moussa, Lowenberg-DeBoer, Fulton & Boys, 2011).

For the current experiment, before the treatment, farmers provided an enumerator (through a questionnaire) with their previous knowledge about storing beans, especially in sealable containers such as jerrycans (see Figure 3). Information gathered in the pretest also included demographics. After the treatment, farmers were assessed again to see changes in knowledge.

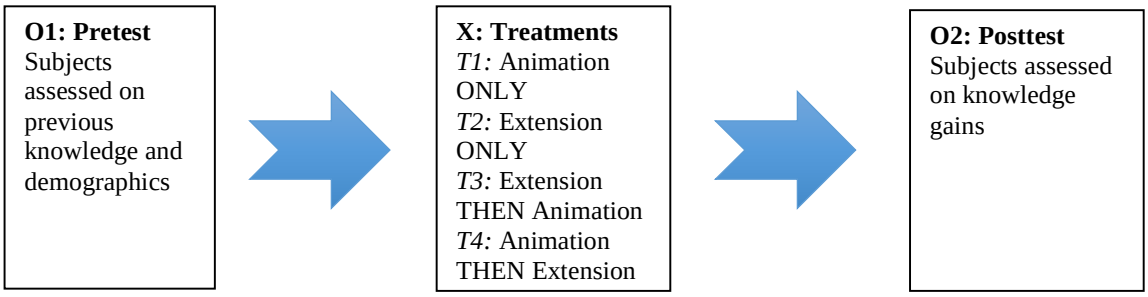

Figure 3: The experiment process design.

The study used a field experiment because treatments were applied in the natural setting of the subjects (Wimmer & Dominick, 2000). Each farmer was assigned to one of the four experimental groups. The experimental groups were the following: (1) traditional extension training ONLY, (2) animation on a mobile phone screen ONLY, (3) traditional extension training THEN animation on a mobile phone screen and, (4) animation on a mobile phone screen THEN traditional extension training. Overall, the field experiment covered 10 communities in 10 days. On each day, all farmers were assigned to the same experimental group. This was done to avoid experimental contamination since those present might have been able to see or hear about any experimental approaches used. Table 1 shows how treatments were assigned. In the Animation ONLY experimental groups farmers were in groups of 3-4 people in which they could talk to one another and watch the animation as many times as they wished. In the Extension ONLY treatment, farmers were in typical extension training groups of 20-25 people. Each of the combined methods followed both procedures. Initially, the research design included only three experimental treatments: stand-alone traditional extension training, stand-alone animated video on a mobile phone screen training and the combination of both. However, in testing prior to training the research team discovered that for the combination approach, which method was used first made a difference. For this reason, the combination treatment was split into two groups.

Table 1. Experimental topics by community

Day	Group 1	N	Group 2	n	Community
Day 1	Extension Only	14	Extension ONLY	13	Tetete Sede
Day 2	Extension then Animation	12	Animation THEN Extension	0	Sede Nova
Day 3	Animation Only	13	Animation ONLY	14	Napuatxi
Day 4	Extension Only	15	Extension ONLY	13	Miranda
Day 5	Extension then Animation	20	Animation THEN Extension	17	Mahara Central
Day 6	Animation Only	20	Animation ONLY	21	Mepuagiua Sede
Day 7	Extension Only	14	Extension ONLY	13	Impira
Day 8	Extension then Animation	19	Animation THEN Extension	20	Invacula
Day 9	Animation Only	20	Animation ONLY	17	Mogeia
Day 10	Extension Only	20	Extension THEN Animation	19	Hulane

Experimental groups

The research compared the effectiveness of animated videos and traditional extension training (independent variables) on farmers' knowledge gains and adoption willingness (dependent variables). Thus, on Day 3 the independent variable exposure to animated video alone was analyzed in relation to knowledge gain and the impact on willingness to adopt. On Day 1, the independent variable traditional extension approach alone was analyzed in relation to knowledge gain and willingness to adopt. On Day 2 farmers received both the extension training and the animated video. The first group received extension first, and the second group received the animation first. The procedure was repeated for the remaining days.

Sampling

For sampling, the study worked with community leaders. Community leaders both from Tetete and Mepuagiua localities provided the study with a list of 600 farmers producing beans (sample frame) selected purposively from 10 communities (5 from Tetete and 5 from

Mepuagiua). Specifically, in Tetete, the community leaders listed at least 60 names of bean farmers from each community, namely: Tetete Sede, Sede Nova, Napuatxi, Miranda and Mahara Central. In Mepuagiua, following the same procedure the research covered the following communities: Mepuagiua Sede, Impira, Invacula, Mogeia and Hulane. From the overall sample frame (600 bean farmers), 314 were randomly selected to be part of the experiment by assigning them numbers and then selecting the sample using a Random Number Generator & Checker system (http://www.psychicscience.org/random.aspx). According to the District of Gurúè Annual Report (2014) Tetete locality has 29,277 inhabitants while Mepuagiua has 42,217 inhabitants, a total of 71,494 inhabitants. A total of 131 out of 314 farmers in Tetete were selected (41.7%). In Mepuagiua the number was 183 out of 314 bean farmers (58.3%).

Methodological limitations

Mozambique does not have clear and updated data about the population distribution in rural areas, which makes it hard to draw perfect random samples. Farmers move a lot from one place to another and in many cases their house may not be where the farms are located. During the planting and harvesting seasons, farmers move and stay at the farms. Thus, the research encountered a few cases of some of those randomly selected from lists provided not being accessible at the time of the experiment. In many of these cases those selected who could not show up often appointed a relative to represent them. Additionally, due to curiosity other farmers who were not selected through the randomization process showed up. In cases where the selected farmers could not attend the training and did not send a relative, the community leader was asked to nominate additional farmers who were not selected to

participate in the training. In some cases, additional farmers showed up at the training who were not on the lists. In these cases, those extra farmers were permitted to observe the training, but were not interviewed.

Measures

Pretest. To measure knowledge about the jerry can method prior to the training, farmers were asked an open-ended question: "What reasons, if any, do you think there might be for using a jerrycan or other sealed container to store your beans after harvest?" Farmers were awarded one point for each of the four correct answers (A, B, C and D) shown in Table 2. Thus, the score for this variable could range from 0 to 4.

Table 2. Pretest question and answers

What reasons, if any, do you think there might be for using a jerrycan or other sealed container to store your beans after harvest? (Check EACH answer if mentioned, but do NOT read the list).	
A	Jerrycan can be used to save beans from insect attack
B	Use of jerrycan can protect quality of beans
C	Use of a sealed container can prevent moisture from reaching and damaging beans
D	A jerrycan keeps beans safe until bean prices rise and I can sell at a higher price.
E	Other (Please specify)
F	Don't know

Posttest. The same open-ended question used in the pretest was repeated again for farmers following the training, and again the score could range from 0 to 4 correct.

Difference in learning scores. This variable was calculated as the posttest score minus the pretest score.

Total learning. This variable included the same question used in the posttest score plus 5 additional questions that covered specific lessons taught in the training. The questions are shown in Table 3. Question 1 used pretest question with four possible correct answers.

Table 3. Total learning questions and answers

1. What reasons, if any, do you think there might be for using a jerrycan or other sealed container to store your beans after harvest? (Check EACH answer if mentioned, but do NOT read the list).	
A	Jerrycan can be used to save beans from insect attack
B	Use of jerrycan can protect quality of beans
C	Use of a sealed container can prevent moisture from reaching and damaging beans
D	A jerrycan keeps beans safe until bean prices rise and I can sell at a higher price.
E	Other (Please specify)
F	Don't know
2. If you want to use your beans for seed in a future season, is it safe to store them in a sealed jerry can?	
A	Yes (correct)
B	No
C	Don't know
3. How long would it be safe to store beans in a jerry can if you wanted to use them for seed?	
A	It's not safe for any time
B	Six months (correct)
C	Record another time period _____
D	Other (please specify)
4. Could you store your beans safely in a jerry can for a year if you just wanted to eat them later?	
A	Yes (correct)
B	No
C	Don't know
5. What should you do to prepare your beans before putting them into a jerry can for storage? Code each item as correct if mentioned by farmers. Do not read the list.	
A	Beans should be properly dried.
B	Broken or damaged beans should be removed.
C	Dirt and other debris should be removed from the beans.
D	Beans damaged by insects should be removed.
E	Other (Please specify)
6. When filling the jerry can, if you don't have enough beans to fill the container tightly, will the beans still be stored safely?	
A	Yes
B	No (correct)
C	Don't know

Questions 2, 4, and 6 were Yes/No response questions. One point was awarded for each correct answer. Question 3 was a multiple choice item, and one point was awarded for the correct answer (B). Question 5 was an open-ended item, and one point was awarded if participants mentioned each of the correct answers (A, B, C and D). Thus, a total of 4 points could be earned for this question. In total, 12 points could be earned if all questions were answered correctly.

For the measurement of each variable, trained enumerators asked subjects to answer each of the six questions in their own language. Subjects received one point for each correct answer. For instance, subjects who mention, “beans should be properly dried” and “beans damaged by insects should be removed” in answer to the question, “What should you do to prepare your beans before putting them into a jerrycan for storage?” received two points. The knowledge score was determined by counting the number of correct points about storing beans in a jerrycan. The highest possible score was 12; the lowest was 0. The score a subject received before training was the pretest Score. After training, the score was the posttest score.

Stimuli: training topic and animated video

Post-harvest loss is one of the major constraints among farmers in rural areas of developing countries. Bean farmers may lose up to 75% of their production to bruchids (weevils). Bruchids usually bore holes the beans, reducing both the quality and the quantity. Farmers from both Tetete and Mepuagiua interviewed during the baseline household survey reported significant losses when storing beans (Farmer Decision Making Strategies for Improved Soil Fertility Management in Maize-Bean Production Systems, 2014).

The use of non-chemical bean grain storage techniques such as jerrycans have been successfully tested in rural areas of developing countries (Moussa, Lowenberg-DeBoer, Fulton & Boys, 2011). The jerrycan should be completely packed with dried cleaned beans and sealed tightly so that existing bruchids die or become inactive due to a lack of oxygen inside. With this method, farmers can save beans for six months and still use them as seed for planting. Longer storage is possible for beans that will be eaten.

The animated video portrays how to use the jerrycan for storing beans and avoid post-harvest losses. The animation depicted visually steps on how to store beans and also emphasized some advantages for using this method following exactly what the extension training was supposed to deliver. This animation was produced in partnership with Scientific Animations Without Borders (SAWBO) of the University of Illinois and can be viewed and downloaded on https://www.youtube.com/watch?v=ACIyKKEkpgc. Additional animations are available from the SAWBO website (http://sawbo-illinois4.org/) and can be downloaded and re-used for educational purposes for free. The animation used in the experiment was created in Lomué (local language) and for the sake of consistency with all treatments, the extension worker who led the traditional training approach did the voice-over as well.

The video animation produced by SAWBO utilized technical recommendations by scientists that were ratified by farmers in the area. Each step of the process was visually emphasized. For example, a calendar was used several times to emphasize how long one might safely store beans that were to be used either for planting or home consumption. The point that the jerrycan needed to be completely full of clean dry beans was made by showing visually each step of the cleaning and drying process followed by a cut-away view of the interior of the jerrycan showing it completely full. Visuals of the container being shaken a

number of times to eliminate air pockets in the container were included. The combination of use of the local language (Lomué) plus the visual examples were carefully designed to reinforce each other, and also to provide multiple ways farmers might learn the key facts about the process. A summary at the end of the animation repeated and reinforced the key points both orally and by visuals.

Experimental Procedure

Each training session of the experiment hosted 20 to 40 subjects. Given that this experiment involved human subjects, all sessions started with the explanation of the process and obtained consent. Additionally, the sessions were predominantly in Lomué (local language) and Portuguese (official language). Each participant completed the knowledge pretest and demographic items. Farmers as a group were assigned to one of the four experimental treatments. For the treatment of stand-alone extension, farmers received training on the use of a jerrycan for storing beans by an extension officer who lectured about each step and then demonstrated the technique with a jerrycan and beans. In the stand-alone animation through mobile phone screen treatment, participants were exposed to the jerrycan animated video with three to five farmers watching each mobile phone device (a total of 10 groups of three to five people). In all treatments, following the presentation several farmers were asked to come forward and demonstrate what they had learned while others provided comments and suggestions. This served a dual purpose – to reinforce the lesson, but also to provide an immediate assessment of what had been learned. Results indicated that participants learned the basic steps from the extension presentation and animation without their own demonstration, although it might have reinforced the lesson.

Following the experimental treatment and demonstration, the posttest questions were administered to all farmers. Farmers also were asked questions about behavioral intent to adopt the practice. Nearly all (98%) farmers said that they intend to use this technique in the future; thus, no further analysis was undertaken regarding this variable due to lack of variation.

Data Analysis

The current study has four research questions. For data analysis the study used the Statistical Package for Social Sciences (SPSS), version 14. Descriptive statistics were used to list frequencies for each variable and inferential statistics tested causal relationships.

Research question 1 asked whether each of the experimental treatments increased farmers' knowledge. Thus, a comparison of pretest knowledge scores with posttest knowledge scores of the same subjects was performed. A paired samples *t*-test was used to test the statistical difference between time 1 and time 2 scores for the same subjects.

Research question 2 assessed the effectiveness of using combined training methods over single approaches. This research question asked whether those exposed to stand-alone animation and stand-alone extension training will have lower knowledge scores than those exposed to a combination of both methods. For data analysis, Analysis of Variance (ANOVA) was performed in which single experimental treatment groups (Extension ONLY and Animation ONLY) were compared to combined approaches (Extension THEN Animation and Animation THEN Extension) for the difference in learning score (dependent variable).

Research question 3 examined whether men have higher knowledge scores at the pretest. An Independent Samples *t*-test was performed in which gender was treated as independent variable and pretest score was the dependent variable.

Research question 4 builds on research question 3. If, as expected, men are more likely to have higher knowledge scores at the time of the pretest, research question 4 asks whether women will learn as much or more than men at the posttest. For data analysis, an Independent Samples *t*-test was performed in which gender was treated as the independent variable and the difference in learning score was the dependent variable.

CHAPTER 4: RESULTS

The current study is a field experiment concerning the use of animated videos delivered through mobile phones to enhance knowledge gain among bean farmers in Gurúè, Mozambique. The study was guided by four research questions.

Research question 1: The Contribution of Visual Training Approaches on Significant Learning.

For Research Question 1, the study assessed whether farmers in each treatment group increased their knowledge significantly about the jerrycan storage method following the training. See the diagram below.

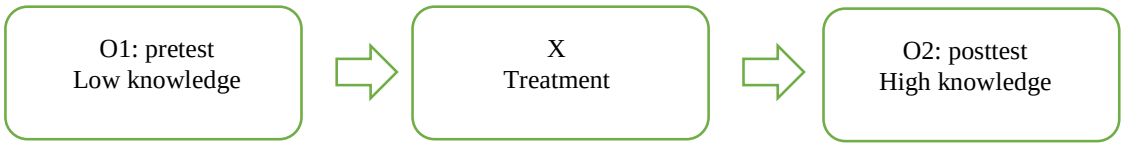

Figure 4. Diagram of knowledge gain assessment process

In data analysis for this research question, the group or treatment farmers were exposed to was used as the independent variable and dependent variables were both pretest and posttest scores. A paired samples *t*-test was performed to compare the mean scores of the pretest and posttest. Results are shown in Table 4.

Table 4. Paired Samples *t*-Test for differences in farmers' knowledge scores between.

	Time scores				
	Pretest	Posttest			
	M	M	*df*	*t*-value	*p*-value
All treatments	.48	2.29	313	24.85	.000
Individual groups					
Extension ONLY	.40	2.02	120	15.03	.000
Extension THEN Animation	.76	2.44	46	7.18	.000
Animation THEN Extension	.51	2.67	46	14.85	.000
Animation ONLY	.43	2.34	87	13.58	.000

Results show all treatments scored a pretest mean of .48, increasing to 2.29 after the training. The paired samples *t*-test was statistically significant with a *t*-value of 24.85. Further analysis for each training method showed all methods resulted in significant learning when comparing the pretest to posttest. Thus, results report a statistically significant effect of stimuli on participants.

Research Question 2: Combined versus Single Methods Knowledge Scores.

To address this research question, an ANOVA with *Scheffé* tests was conducted so that differences among groups could be measured.

Comparisons of mean scores (Table 5) for total learning show that the training method with the highest mean score was Animation then Extension (M=8.81, SD=1.17) followed by

Animation ONLY (M=8.75, SD=1.24). The lowest was Extension ONLY (M=8.14, SD=1.56).

The ANOVA found the groups to be significantly different (F=5.12, p<.002) overall. The post hoc *Scheffé* test found mean scores of Extension ONLY (single method) to be significantly different from the mean score of Animation THEN Extension (combined method) but not significantly different from the mean score of Extension THEN Animation (combined method). *Scheffé* also reported mean scores of Animation ONLY (single method) were not statistically different from any of the combined methods. However, when comparing both single methods, the *Scheffé* test showed Animation ONLY and Extension ONLY were significantly different. Post hoc *Scheffé* tests show no significant differences in total learning scores between those in Extension ONLY experimental group and those in Extension THEN Animation experimental group as well as no significant differences between Animation ONLY and either Extension THEN Animation and Animation THEN Extension. Given that this was a directional research question, a one-tail test of significance was used (see the results of One-way ANOVA in Table 5).

Table 5. One-way ANOVA of farmers' extended posttest scores.

		F	Sig.
One-way ANOVA		5.12	.002
Overall mean scores			
Treatment groups		M	N
Extension ONLY		8.14	121
Extension THEN Animation		8.72	47
Animation THEN Extension		8.81	58
Animation ONLY		8.75	88
Total		8.52	314
Scheffe test results			
Treatment groups	Multiple comparisons	M	Sig.
Extension ONLY	Extension THEN Animation	-.58	.054
	Animation THEN Extension	-.66*	.01
	Animation ONLY	-.60*	.01
Extension THEN Animation	Extension ONLY	.58	.054
	Animation THEN Extension	-.08	.49
	Animation ONLY	-.02	.50
Animation THEN Extension	Extension ONLY	.66*	.01
	Extension THEN Animation	.08	.49
	Animation ONLY	.06	.49
Animation ONLY	Extension ONLY	.60*	.01
	Extension THEN Animation	.02	.50
	Animation THEN Extension	-.06	.49

*$p<.05$, 1 - *tail* test

Although participants in the Extension ONLY approach had lower total learning scores than other approaches, overall analysis suggests mixed results. Participants in

combined approaches (Extension THEN Animation and Animation THEN Extension) and those in Animation ONLY had about the same total learning scores. In fact, in all approaches involving animation participants scored higher.

Research Question 3: Gender Comparison on Pretest Knowledge Scores.

An independent samples *t*-test was performed to assess whether there was a significant difference in mean scores before the treatment between men and women in all experimental groups. In this case, gender was treated as an independent variable and pretest score was the dependent variable. Analysis shows that for all groups combined, male participants scored significantly higher than female participants during the pretest (Table 6).

Table 6. Gender differences in pretest mean scores

Pretest scores					
Gender	N	M	*Df*	*t*-value	*p*-value
Male	174	.61	313	2.53*	.006
Female	140	.32			

*$p<.05$ 1-Tail test

However, when each individual experimental group was tested, men and women were significantly different only in Extension THEN Animation group (Table 8). Examination of results suggest that men had somewhat higher scores in all four groups, but due to small sample sizes, the differences in the other groups were not statistically significant.

Research Question 4: Gender Comparison on Posttest Learning Scores

A cross tabulation between gender and education to help understand the size of gap shows that both men and women average fifth grade or below. Thus, the study did not consider education as an instrumental variable for analysis given that they all had about the same level of formal education. Given that about 70% of farmers reported storage losses to weevils, the study had the premise that the use of sealed containers to safely store beans would elicit high levels of motivation.

An independent samples *t*-test was performed to assess whether there were significant differences in "difference in learning" scores between men and women after the treatment. Gender was treated as an independent variable and the "difference in learning" score as the dependent variable. Results (Table 7) show that although the women's "difference in learning" score was slightly higher, it was not a statistically significant difference.

Results show that men and women were significantly different before treatment. After treatment, their scores were no longer significantly different. The independent samples *t*-test for the post-test yielded t=.934, p<.325. Results suggest that women learned just as much as men did, so the knowledge gap did not widen (Figure 5). Given that men had slightly higher scores before treatment, it is possible that one reason they didn't continue to learn more than women is due to a ceiling effect. However, the true ceiling was a score of '4', and men reached only 2.34, so they could have learned more.

Table 7. Gender pretest, posttest and change in mean scores

	Time scores

		Pretest	Posttest	Difference in Learning Scores
Gender	N	M	M	M
Male	174	.61	2.34	1.72
Female	140	.32	2.23	1.90
Sig.	314	$p<.006$	$p<.325$	$p<.113$

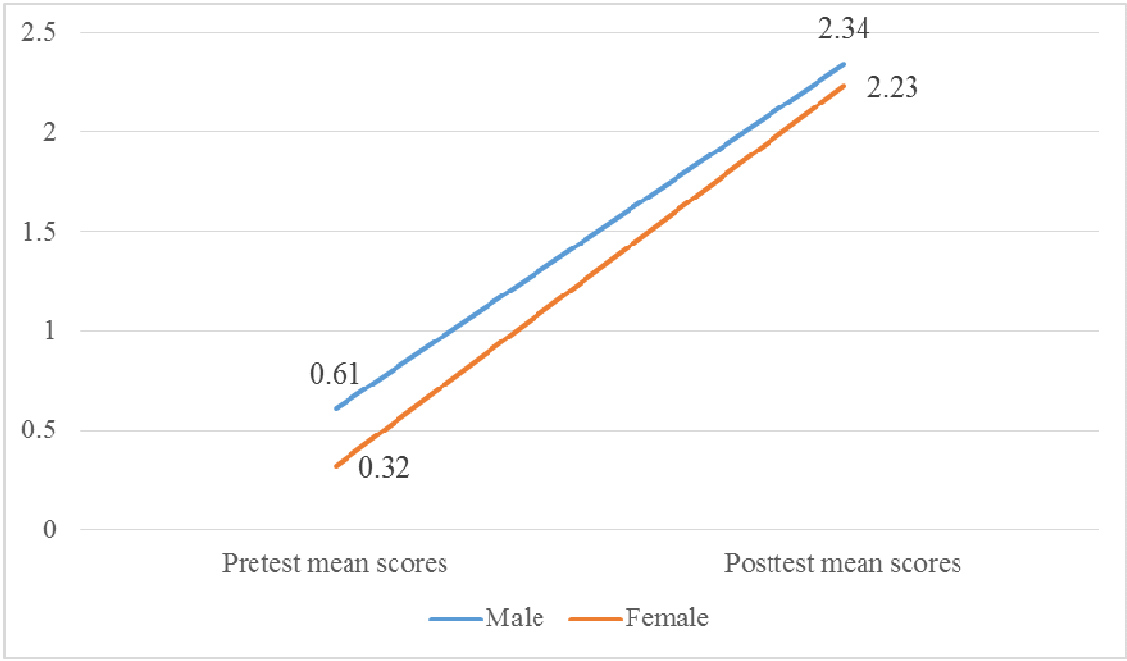

Figure 5: Chart of gender knowledge gap

Analysis by Sex and by Experimental Treatment Group

Thus far, analysis has focused on results by gender for all groups combined. It is possible that this might mask differences that occurred within treatment groups. For this reason, analysis also was done by gender and by group, and the results are shown in Table 8.

Results do show several interesting things. Differences between men and women for the pretest were greatest in the Extension THEN Animation group. They were significantly different in this subgroup, while they were not significantly different for any of the other

Table 8: Test Scores by Gender and by Treatment Group

N	Gender	Pre-test	Post-Test	Total Learning	Difference in Learning
ALL Groups Combined					
174	Men	.61	2.34	8.64	1.73
140	Women	.33	2.24	8.38	1.91
		P=.005 (1-tail)	P=.344 (2-tail)	P=.103 (2-tail)	P=.216 (2-tail)
Extension Only					
62	Men	.52	2.08	8.27	1.56
59	Women	.29	1.97	8.00	1.68
		P=.07 (1-tail)	P=.556 (2-tail)	P=.336 (2-tail)	P=.601 (2-tail)
Extension then Animation					
29	Men	1.00	2.51	8.82	1.52
18	Women	.39	2.33	8.56	1.94
		P=.04 (1-tail)	P=.525 (2-tail)	P=.491 (2-tail)	P=.311 (2-tail)
Animation then Extension					
32	Men	.69	2.81	9.09	2.13
26	Women	.31	2.50	8.46	2.19
		P=.09 (1-tail)	P=.203 (2-tail)	**P=.041** (2-tail)	.820 (2-tail)
Animation Only					
51	Men	.47	2.27	8.68	1.80
37	Women	.38	2.43	8.84	2.05
		P=.322 (1-tail)	P=.459 (2-tail)	P=.575 (2-tail)	P=.383 (2-tail)

three subgroups. At the posttest, none of the subgroups had significantly different scores. However, for the total learning score, in the Animation THEN Extension group, men had significantly higher scores than women even though they were not different for the pretest. Also, in the Extension ONLY, Extension THEN Animation, and Animation THEN Extension

groups, men had slightly higher total learning scores than women, but for the Animation ONLY group, women's total learning scores were slightly higher than men's (although not significantly so). Overall, however, differences across groups were not great, reinforcing the idea that learning occurred about equally across all groups.

CHAPTER 5: DISCUSSION

Knowledge scores increasing after treatment

Information processing theory states that when people are exposed to stimuli they can either store the information or displace it (Miller, Galanter & Pribram, 1960; Atkinson & Shiffrin, 1968). For Kandarakis and Poulos (2008) the extent to which people decide to store the information is an indicator of the relevance of the stimuli or the effectiveness of the means through which it is delivered. In this study, each of the 314 farmers was exposed to one of the four experimental treatments (Extension ONLY, Extension THEN Animation, Animation THEN Extension and Animation ONLY).

Results show significant gains in knowledge scores after treatment as compared to before. From the point of view of information processing theory, results suggest that farmers in all experimental groups managed to store stimuli.

Information processing theory also argues that people who find a certain topic important are more likely to store it than those who do not. About 61% of participants in the experiment reported losses of beans to storage pests and all of them (100%) found the topic covered in experimental groups very important. Thus, the relevance of the topic might be one of the factors explaining increasing knowledge scores. Extension is one of the most reliable sources of agricultural information in rural areas of developing countries. The problem is access -- 78% of participants reported that they never had an opportunity to attend a training presentation by an extension agent (worker) and none of them (100%) had seen an animated video on a smartphone screen before.

Mixed results in the comparison between combined and single training methods

Information processing theory suggests that the use of multiple approaches of delivering the stimuli would likely increase the storing of information (Maddox, Ing & Lauritzen, 2006). Previous studies comparing different training approaches found that participants receiving combined methods had better knowledge scores compared to those receiving single methods (Cai & Abbott, 2013). In this study, although all groups scored high after the treatment, data analysis showed mixed results.

Knowledge scores of participants exposed to Animation THEN Extension were significantly higher than those exposed to Extension ONLY. However, knowledge scores of participants in Extension ONLY treatment compared to those in Extension THEN Animation were not significantly different. Additionally, when comparing both combined methods to Animation ONLY, knowledge scores were not significantly different as well. The Animation ONLY participants scored as well as those receiving the combined methods. Extension ONLY participants scored significantly less than those in Animation ONLY.

Results suggest that it is not a matter of combining methods, but rather the effectiveness of the animated video. Since most farmers had never seen an educational animated video delivered via a smartphone, there may have been a 'novelty effect' operating that caused additional learning.

Gender knowledge gap before the treatment

The lack of opportunities for women and gender inequalities in knowledge especially in rural areas of developing countries have been widely discussed (Walby, 2003; Bauer & Shah, 2006; Grigorian, 2007; Bryan & Varat, 2008). According to Tichenor, Donohue and

Olien (1970) in their knowledge gap hypothesis in most cases people with low education, income and low networking have low access to information and/or knowledge. Female farmers in Gurúè (research setting of this study) are no exception.

Results show that women had significantly lower knowledge scores than men at the pretest. Most probably men knew more than women about agricultural topics due to their ability to attend meetings and talk with experts, but they did not differ from women in terms of formal education attainment.

Men and women with about the same posttest knowledge scores

Knowledge gap theory also discusses the likelihood of reducing or minimizing differences between people (Corley & Scheufele, 2010). The current study examined whether due to experimental treatment women were able to learn as much or more than men. Results show that in all experimental groups both men and women scored about the same. Although women were not necessarily able to close the knowledge gap in scores with men, they did learn at least as much as men and the gap did not widen. These were the same results that Cai, Abbott and Bwambale (2013) found, suggesting that visuals can potentially prevent the increasing of the gap but not necessarily close it.

CHAPTER 6: CONCLUSIONS

This study showed that animated videos performed at least as well as the traditional face-to-face extension approach in enhancing agricultural knowledge among bean growing farmers of Gurúè. Results suggest that animated videos could either complement or replace extension in delivering agricultural messages. Additionally, this training approach seems to be equally effective for both genders, suggesting that women, who often lag in agricultural knowledge, might learn at least as much as men. New methods are timely, given that the current extension system is under-resourced and covers only a small portion of the entire population of farmers. The ability to use animations delivered via smartphones adds to previous studies showing that live videos also could be used to supplement extension presentations or serve as stand-alone educational tools (Cai & Abbott, 2013). The use of smartphones as the delivery channel also adds to previous studies that used small portable battery-powered projectors. Both of these methods seem to be effective. One constraint noted in previous studies using video was that characters used needed to be local in most cases so that cultural and language barriers could be overcome. To do this on a large scale would be expensive, requiring production of many videos. The current study addresses the cultural and technical concerns by using animations instead. A single animation can serve many different areas by adding a local language sound track to an existing animation. However, animations often cost more than videos to produce. So whether or not they are a better choice depends on the size of the audience and number of difference audiences that might be served by a single animation message. A future study could look at the costs and sustainability of using animated videos via mobile phones as training approach. What is the overall cost of

producing an animation? What are the technical requirements? Could local extension build expertise to produce them and distribute with farmers they cannot reach?

This study also took advantage of the fact that many farmers in Mozambique now have access to a smartphone. Results show that animations delivered via mobile phones can potentially train farmers as well or better than face-to-face extension presentations. Given that 91.7% of farmers currently lack any personal contact with extension agents, and given the increasing adoption and use of smartphones and upgrading of bandwidth, smartphones would seem to be a logical choice as an additional effective way to reach farmers. Additional research could focus on testing extension content distribution strategies and to what extent farmers could share content with one another. How can farmers receive animated videos via their phones? What are the possible effective strategies for sending the materials to farmers? Once they have them, how likely is it that they will share them with others?

Results show that all treatments, including Animation ONLY, can reach both women and men effectively. This finding is especially important for reaching women, who are less likely to attend extension meetings and presentations than men. Whether or not women with smartphones would want to use them to view extension messages on their own is something that would have to be examined later. The current study only showed that women who were invited to a special demonstration that involved viewing messages in small groups on smartphones were able to learn effectively. Whether they would seek these messages out on their own, or learn effectively without group support or other training, remains to be seen.

This study also examined whether or not there is a benefit to providing a combination of different communication methods in a training session. Is it better to use both animation and a personal extension demonstration? Results indicate that single methods all resulted in

significant learning. Combinations of methods did not seem to boost scores significantly. The conclusion would be that any of the methods would work. The question comes down to cost and topic. Some topics might lend themselves well to animation, while others might require a more personal approach.

Limitations and Implications

There are several limitations of the research in this study that should be noted.

- Novelty effect: Since the farmers viewing the animations on the smartphone had never seen something like this before, they were excited by it, took a great interest in it, and learned. While this is impressive, one must consider that the "newness" of the innovation would likely wear off if used frequently, and this could mean that future animations delivered in the same way might be less effective. Another limitation to be considered is that farmers in Animation ONLY were in small groups of 3-4 people. That is, they were not viewing the animation as individuals. It was noted during the experiment that they often talked about what they were seeing with each other. This interaction probably had some effect on the interest they paid to the program, and the learning that resulted from it. Had they seen the program as individuals, it might have had less (or more) effect. Future studies of the use of smartphones to deliver these messages should test this by letting individuals view them. It may be that something about being in a group contributed to learning more. In all four treatments (Extension ONLY, Animation ONLY, Extension THEN Animation and Animation THEN Extension) following the treatment, farmers were asked to repeat the behavior. Usually a couple of farmers would step in front of the entire group and explain the

topic while others helped, reminding with correct answers. This could have been a source of initial learning, or reinforcement of the extension presentation or animation. Demonstrations were included to enable the research team to get immediate feedback on whether the treatments were effective. Farmers demonstrated that they knew most of the basic steps of the process when asked to repeat the behavior right after the treatments. This suggests that it was the treatments, and not the demonstration that occurred later, that was responsible for teaching them. However, the demonstration certainly could have reinforced the messages. Future studies should control for this.

- Experimental effect could be another limitation of the study. Farmers were invited in advance to attend the training and given that such initiatives do not occur regularly, it was treated as a big event. Farmers were curious about the training, and the topic was of the high relevance for them. Additionally, non-governmental organizations (NGOs) that every once in a while work in those communities often bring gifts or provide farmers with free seeds, which probably caused them to show up in mass to the training and perform well throughout.

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APPENDIX A: INFORMED CONSENT

INFORMED CONSENT DOCUMENT

Title of Study: Use of Animated Videos to Enhance Agricultural Knowledge and Adoption Among Bean Farmers in Gúruè District, Mozambique

Investigators: Sostino Mocumbe, Eric A. Abbott

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION
Sostino Mocumbe, a graduate student at Iowa State University, is conducting a study of effective communication methods to disseminate relevant information among bean farmers in Gúruè District, Mozambique. As a bean farmer of Gúruè District, you have been invited to participate in this study.

DESCRIPTION OF PROCEDURES
If you agree to participate, you will be asked to:
(1) Respond to questions about your knowledge and adoption of the agricultural techniques before and after the training section.
(2) Participate in a training on post-harvest losses and storage techniques to solve the problem.
(3) Possibly participate in a post-test to assess knowledge and skills gained from the training.

The pre-test will take approximately 20 minutes. The agricultural training will take about an hour. If you are selected to participate in the post-test, it will take approximately 30 minutes.

RISK
There are no foreseeable risks from participating in this study.

COST AND BENEFITS
If you choose to take part in this study, there will be no cost or direct benefit to you. However, the information from this study is important in helping local extension staff and researchers in the Farmers Decision Making Project to develop effective approaches to share relevant agricultural knowledge with local farmers.

PARTICIPANTS' RIGHTS

Your participation in this study is completely voluntary, and you may refuse to participate or withdraw from the study at any time without penalty or negative consequences.

CONFIDENTIALITY

Your responses will be kept confidential and no comments will be attributed to any individual in any reports produced by the study. Your name will be taken only for the purpose of locating you in the event you are invited for a post-test. Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies, auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality and data assurance. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: Your name will be taken only for the purpose of locating you in the event you are invited for a post-test. Following the post-test, your name and any other identifiers will be removed from the data and destroyed. Summaries of the results will never provide information that would enable anyone to identify you. Your identity will be kept confidential in any publication or dissemination of the study results.

CONTACT INFORMATION

You are encouraged to ask questions at any time during this study.

• For further information about the study, contact: Sostino Mocumbe, Greenlee School of Journalism and Communication, Iowa State University, Ames IA 50011, USA. Phone: 515-708-1141. Supervising Professor: Eric Abbott, Professor, Greenlee School of Journalism and Communication, Iowa State University, Ames, Iowa 50011, USA. Phone: 515-294-0492; email:eabbott@iastate.edu.

• If you have any questions about the rights of research subjects or research-related injury,

please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515)

294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011, USA.

APPENDIX B: IRB APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 4/21/2015

To: Sostino Mocumbe
101 Hamilton Hall

CC: Dr. Eric Abbott
204C Hamilton Hall

From: Office for Responsible Research

Title: Use of Animated Videos to Enhance Agricultural Knowledge and Adoption Among Bean Farmers in Gurue District, Mozambique

IRB ID: 15-232

Study Review Date: 4/21/2015

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (1) Research conducted in established or commonly accepted education settings involving normal education practices, such as:
  - Research on regular and special education instructional strategies; or
  - Research on the effectiveness of, or the comparison among, instructional techniques, curricula, or classroom management methods.

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

You do not need to submit an application for annual continuing review.

You must carry out the research as described in the IRB application. Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX C: QUESTIONNAIRE

Interview Questionnaire

Use of Animated Videos to Enhance Agricultural Knowledge and Adoption Among Bean Farmers in Gúruè District, Mozambique

Section A: Filter Questions and Identification Information

Are you currently farming land in this region?

1	Yes
2	No

Are you growing common beans on your land?

1	Yes
2	No

(If respondents answers NO to either Questions 1 or 2, STOP the interview. This respondent is not eligible to participate). If YES to BOTH, continue the interview.

NOTE: ID NUMBER _____ (ENTER HERE, BUT ALSO ENTER AT THE TOP OF THE NEXT PAGE. MAKE SURE THE NUMBERS ARE THE SAME!]

Name: _____

Contact information: Mobile phone or location details_____

Interview Questionnaire

Use of Animated Videos to Enhance Agricultural Knowledge and Adoption Among Bean Farmers in Gúruè District, Mozambique

1. [ID] Questionnaire ID #: _____

2. [DATE] Date: Year/month/day (e.g. 15/06/24)_____
3. [START] Start time: (e.g. 10:23] _____
4. [EN
5. D] End time (e.g. 10:45] _____
6. [INTERVW] Interviewer: Note: Circle and Code ONLY the number of the person.
   [1] Eufrates João
   [2] Sérgio Caetano
   [3] Sostino Mocumbe
   [4] Unasse Uaite
   [5] _____
   [6] _____
   [7] _____

Location Information

7. [POSTA] Administrative Post: Note: Each district will be given a number. Circle and Code only the number.
   [1] Lioma
   [2] Mepuagiua

8. [COMMUNID] Community: Note: Each village will be given a number. Circle and Code only the number.
   [1] Sede Nova
   [2] Miranda
   [3] Tetete Sede
   [4] Mahara Central
   [5] Hulane
   [6] Impira
   [7] Mogeia
   [8] Mepuagiua Sede
   [9] Invacula
   [10] Napuatxi

Section B: Bean and Crop Production Data

9. What crops are you growing on your farm? Which are your main crops? By main crop, we mean those contributing the MOST in your family income.

	Crop	Grow this crop 1=yes 2=no		Main Crop 1=yes 2=no
[MAIZE]	Maize		[MAIZMAIN]	
[CASSAVA]	Cassava		[CASSMAIN]	
[BEANS]	Beans		[BEANMAIN]	
[PPEA]	Pigeon Pea		[PPEAMAIN]	
[SOYBEAN]	Soybean		[SOYMAIN]	
[RICE]	Rice		[RICE]	
[COFFEE]	Coffee		[COFFMAIN]	
[BANANAS]	Bananas		[BANAMAIN]	
[IRISHPOT]	Irish Potato		[IRPOTMAIN]	
[SWEETPOT]	Sweet Potato		[SPOTMAIN]	
[GROUNDNT]	Ground Nuts		[GNUTMAIN]	
[CABBAGE]	Cabbage		[CABBMAIN]	
[TOMATO]	Tomato		[TOMAMAIN]	
[ONION]	Onion		[ONIOMAIN]	
[MILLET]	Millet		[MILLMAIN]	
[PINEAPLE]	Pineapple		[PINEMAIN]	
[PASFRUIT]	Passion Fruit		[PASHMAIN]	
[SUNFLOWR]	Sunflower		[SUNMAIN]	
[GRPEPPER]	Green Pepper		[GPEPMAIN]	
[OTHER]	Other crop		[OCRPMAIN]	

Now, I want to ask a few questions specifically about your common bean production.

10. How many hectares of common beans did you grow in the last two seasons? (code 9999 if they don't know)
    10A [DHECTARE] Dry season _____ ha.
    10B [RHECTARE] Rainy season _____ ha.
    10C [THECTARE] Total _____ ha.

11. How many kilograms (kg) of common beans did you harvest? (code 9999 if they don't know)
    (Tins, or *canecas*, are also used. How much does one weigh? May need to convert to kg.)
    11A [DHARVEST] Dry season _____ kg
    11B [RHARVEST] Rainy season _____ kg
    11C [THARVEST] Total _____ kg

12. Of the common beans you harvested, how much was for consumption by your own household? How much was saved for seed? How much did you sell? Circle and Code only the number.

	None	Small part	Almost half	More than half	All
	1	2	3	4	5
12A [HOMECON12A] Amount saved for home consumption					
12B [SAVESEED12B] Amount saved for seed					
12C [SOLD12C] Amount sold					

13. In the past year, did you store any of your beans for more than 30 days after harvest? Circle and Code only the number. VAR = [STORBEAN13]

1	Yes: Go to Question 13
2	No: Go to Question **21**

14. What method or methods did you use to store your beans? (Check ALL of the following that were used)

Methods Used	Beans for Consumption 1= yes 2=no	Beans Saved for Seed 1=yes 2=no	Beans to Sell 1=yes 2=no
14A Store in open container	[Q14A1CONS]	[Q14A2SEED]	[Q14A3SELL]
14B Store in sealed bag (jute or other material)	[Q14B1CONS]	[Q14B2SEED]	[Q14B3SELL]
14C Store in sealed container	[Q14C1CONS]	[Q14C2SEED]	[Q14C3SELL]
14D Other (Please specify)	[Q14D1CONS]	[Q14D2SEED]	[Q14D3SELL]

15. Prior to storing your beans, do you test them to see if they are dry enough? Circle and Code only the number. VAR= [TESTDRY]

1	Yes: Go to Question 15
2	No: Go to Question 16

16. What methods do you use to decide if your beans are dry enough to store safely?

Method	1=Yes; 2=No
16A [SUNDRY] Dry them in the sun until they are ready (no other test)	
16B. [BITEDRY] Bite them or pinch them	
16C. [WTDRY] They are light in weight when ready	
16D. [SHINYDRY] Seeds are hard and shiny when ready	
16E. [SOUNDDRY] Listen for sound when they are poured	

16F. [PRESSDRY] Assess if it falls or not after pressing in the palm of hand	
16F. [OTHERDRY] Other (Please specify)	

17. When storing your beans, do you add anything to the container to protect them? Circle and Code only the number. VAR= [ADDDRY]

1	Yes: Go to question 17
2	No: Go to question 18

18. If yes, what do you add to your beans to protect them and how effective is it for you?

Things You Add	1=I do this	2=I don't do this	How effective is this for you? 1=not very effective; 2=somewhat effective; 3=very effective
18A. [Q18A1ADDASH] Ash			[Q18A2ASHEFF]
18B. [Q18B1ADDHPEP] Hot pepper			[Q18B2HPEPEFF]
18C. [Q18C1ADDHERB] Other Plant/Herb (Please Specify)			[Q18C2HERBEFF]
18D. [Q18D1ADDMALA] Malathion			[Q18D2MALAEFF]
18E. [Q18E1ADDFURAD] Furadan			[Q18E2FURAEFF]
1F. [Q18F1ADDCHEMO] Other Chemical (Please specify)			[Q18F2OTHCHEMEFF]

19. Do you store your beans on a raised platform above the ground? Circle and Code only the number. VAR= [STORAISE]

1	Yes
2	No

20. Do you keep your stored beans away from side walls? Circle and Code only the number. VAR=[AWAYWALL]

1	Yes
2	No

21. How much of beans that you store do you lose to storage pests? Circle and Code only the number. VAR= [LOSSPEST]

None	Small part but not an important loss	Loss is more than 20%	Loss is more than 30%	Loss is more than 40%	Loss is More than half	Don't know
1	2	3	4	5	6	9

22. Have you ever heard about using a jerrycan to store beans after harvest? [JERRYCAN]

[Q22AHEARJERRY]	Circle one
No	1
Yes, I have heard about using a jerrycan, but I don't do it now	2

Yes, I have heard about using a jerrycan and I use this method now	3
[Q22BHEARSEAL]	
Have you ever heard of storing beans in another type of sealed container other than a jerrycan?	1=yes 2=no

23. What reasons, if any, do you think there might be for using a jerrycan or other sealed container to store your beans after harvest? (Check EACH answer if mentioned, but do NOT read the list).

Possible reasons for using a jerrycan to store beans	Code 1 for each one they mention
23A [SVINSECT] Jerrycan can be used to save beans from insect attack	
23B [PQUALITY] Use of jerrycan can protect quality of beans	
23C Use of a sealed container can prevent moisture from reaching and damaging beans	
23D [PRICEUP] A jerrycan keeps beans safe until bean prices rise and I can sell at a higher price.	
23E [OTHRSAVE] Other (Please specify)	
23F	
23G [DKSAVE] Don't know	

24. Are there any possible reasons you can think of that might make using a jerrycan a bad idea for bean storage? DO NOT READ THE LIST. CHECK ONLY IF THEY MENTION IT.

Possible reasons for not using a jerrycan	Code 1 for each concern expressed
24A.[NOCAN] I don't have a jerrycan	
24B [EXPENSIVE] Too expensive	
24C [MOISTURE] Sealing beans would trap moisture and ruin the beans	
24D [INSECTEAT] Insects would eat all the beans inside	
24E [NOTAKE] If beans are sealed we can't take some when we want to eat or sell	
24F [NOPROBI] I don't have any insect problems with my beans	
24G [NOSAVE] I don't save my beans	
24H [OTHERNOT] Other (Please specify)	
24I [DKNOTUSE] Don't know	

Section C: Sources of Information

25. What are sources of information you use to learn about ways to improve your bean production? How would you rate the quality of each source?

Source	Code 1 if used; code 2	Quality of information received:

	if not used	1=not very useful 2=somewhat useful 3=very useful
25A. [Q25AINFOFARMER] Other farmers living near you	25A1	25A2 [Q25A2FUSEFUL]
25B. [Q25BINFOEXT] Extension	25B1	25B2 [Q25B2EUSEFUL]
25C. [Q25CINFORADIO] Radio	25C1	25C2 [Q25C2RUSEFUL]
25D.[Q25DINFOSELLER] Input or seed sellers	25D1	25D2 [Q25D2SUSEFUL]
25E. [Q25EINFOOTHER] Other (Please Specify)	25E1	25E2 [Q25E2OUSEFUL]

26. Please indicate to me which of the following communication devices you have. If you have any of them, do you use them at all for agricultural purposes? If yes, what purpose?

Device	Code 1 if they have it; code 2 if they don't have it	Code 1 if they use it for agricultural purpose, 2 if they don't. Code ONLY if they say they use the device.	If they use it for an agricultural purpose, what is the purpose?
Mobile Phone	[Q26A1].	[Q26A2].	[Q26A3]
Smartphone	[Q26B1].	[Q26B2]	[Q26B3]
Computer	[Q26C1].	[Q26C2]	[Q26C3]
Tablet (iPad, etc.)	[Q26D1]	[Q26D2]	[Q26D3]
Radio	[Q26E1]	[Q26E2]	[Q26E3]

27. Do you or any other members of your household have access to the Internet? Circle and Code only the number. VAR=[INTERNET]

1	Yes
2	No
3	Don't know

28. Are you, or is anyone in your household, a member of a group that provides your household with any information or inputs for your farming activities? VAR= [GROUP]

1	Yes: Go to Question 29
2	No: Go to Question 30

29. If yes, please check any of the types of assistance you have received from being a member of this group. (READ EACH ITEM FROM THE LIST and CODE 1 for Yes, 2 for NO)

29A. Information [Q29AINFO]	1	2
29B. Seeds [Q29BSEEDS]	1	2

29C. Access to Technology [Q29CTECH]	1	2
29D. Fertilizer [Q29DFERT]	1	2
29E. Chemicals [Q29ECHEM]	1	2
29F Loans [Q29FLOAN]	1	2
29G. Other (Please specify) [Q29GOTHER]	1	2

Section D: **Demographic characteristics**

Now, to conclude this part of the interview, I would like to get some information about you and your household.

30. Gender (DO NOT ASK. JUST CHECK THE CORRECT BOX). VAR= [SEX]

1	Male
2	Female

31. Age in years _____ VAR= [AGE]

32. Marital status. VAR= [MARRIED]

1	2	3	4	5
Married	Single	Divorced	Widow(er)	Separated

33. Education. VAR= [EDUC]

1	2	3	4	5
Grade 1 to 5	Grade 6 to 7	Basic level[1]	Medium level[2]	University level

34. How many people are living in your household currently?
Adults (33A)_[Q33AADULTS] _____. Children(33B) [Q34BKIDS]_____

35. How many years have you lived at your current location? _____ (years). VAR= [YEARLOC34]

36. How many years have you been engaged in farming? _____ (years). VAR=[YEARSFARM]

Section E: Post-Experiment Questions

37. [START] Start time: (e.g. 10:23) _____
38. [END] End time (e.g. 10:45] _____
39. [INTERVW] Interviewer: Note: Circle and Code ONLY the number of the person.
[1] Eufrates João

[1] Include both Grade 8-10 and Technical Education
[2] Include both Grade 11-12 and Technical Education

[2] Sérgio Caetano
[3] Sostino Mocumbe
[4] Unasse Uaite
[5] _____
[6] _____
[7] _____

40. Indicate here which experimental treatment group the respondent was assigned to. VAR= [EXPGROUP]

Extension ONLY	1
Extension THEN Animation	2
Animation THEN Extension	3
Animation ONLY	4

40B. Was this the group that had to fill the jerry can?

1	Sim
2	Não

Now that you have attended the training session, I would like to ask you some questions about the Jerrycan storage method for beans.

41. Based upon the training, what would you say are some advantages of using the jerrycan or other sealed containers to store beans? DO NOT READ THE LIST. CODE IT ONLY IF THEY MENTION IT. PROMPT ONCE: Are there any other advantages you can think of?

Possible advantages for using a jerrycan to store beans	Code 1 for each one they mention
41A [Q40AINSECT] Jerrycan can be used to save beans from insect attack	
41B [Q40BQUALITY] Use of jerrycan can protect quality of beans	
41C [Q40CMOIST] Use of a sealed container can prevent moisture from reaching and damaging beans	
41D [Q40DPRICE] A jerrycan keeps beans safe until bean prices rise and I can sell at a higher price.	
41E [Q40EOTHER] Other (Please specify)	
41F [Q40FDK] Don't know	

42. If you want to use your beans for seed in a future season, is it safe to store them in a sealed jerrycan? Circle and Code ONLY the number of the person. VAR= [Q40SAFESTORE]

1	Yes
2	No
3	Don't know

43. How long would it be safe to store beans in a jerrycan if you wanted to use them for seed? Circle and Code ONLY the number of the person. VAR= [Q41TIMESTR]

1	It's not safe for any time
2	Six months (correct)
3	Record another time period _____
4	Other (please specify)

44. Could you store your beans safely in a jerrycan for a year if you just wanted to eat them later? Circle and Code ONLY the number of the person. VAR= [Q42EATLATER]

1	Yes (correct)
2	No (incorrect)
3	Don't know (incorrect)

45. What should you do to prepare your beans before putting them into a jerrycan for storage? DO NOT READ THE LIST. CODE ONLY IF THEY MENTION IT. PROMPT ONCE: Are there any other things you should do to prepare the beans for the jerrycan?

	Code 1 if this was mentioned
45A. [Q43ADRY] Beans should be properly dried.	1
45B. [Q43BBROKEN] Broken or damaged beans should be removed.	1
45C. [Q43CDIRT] Dirt and other debris should be removed from the beans.	1
45D. [Q43DDAMAGE] Beans damaged by insects should be removed.	1
45E. [Q43EOTHER] Other (Please specify)	1

46. When filling the jerrycan, if you don't have enough beans to fill the container tightly, will the beans still be stored safely? Circle and Code ONLY the number of the person. VAR = [Q44DONTFILL]

1	Yes (Incorrect answer)
2	No (correct answer)
3	Don't know (Incorrect answer)

47. Why is it important to seal the container tightly using an extra piece of plastic? Circle and Code ONLY the number. VAR= [Q45PLASTIC]

Reason	
47A. Must prevent oxygen (air) from getting in, or the bruchids (insects) will not die	1 (correct answer)
47B. To keep moisture out	2 (incorrect answer)
47C. You don't need to use the extra piece of plastic.	3 (incorrect answer)
47D. Other (Please specify)	4
47E. Don't know	9

48. After a few weeks, suppose you need to remove a few beans from the sealed container to eat for dinner. You remove them quickly, and then reseal the container again. Will your beans still be protected? Circle and Code ONLY the number of the person. VAR= [Q46PROTECTED]

48A. No, when the seal is broken, the insects can multiply and eat the beans, damaging them. It is important to keep the container sealed	1 correct answer
48B. Yes. It should be okay to do this, but the container must be sealed again.	2 incorrect answer
48C. Don't know	3 incorrect answer

Now, I would like to ask you a few questions about the training you received today.

49. Did the training topic today focus on an important problem you have? Would you say that the problem of how to store your beans is a "very important" problem for you, a "somewhat important" problem, a "not very important problem," or a problem that is "not important at all" for you? Circle and Code ONLY the number. VAR= [Q47TOPICIMP]

1		2	3	4	99
Not important at all		Not very important	Somewhat important	Very important	Not sure

50. Did your training cover the topic clearly and completely, answering any questions you might have about the process? Circle and Code ONLY the number. VAR= [Q48CLEAR]

1	Yes
2	No

51. What specific comments do you have about the training you received?

51A. Comments for those who received training by the Extension Agent. Circle and Code ONLY the number. VAR= [Q50EXT]

51A1. Had they ever attended a training presentation by an Extension Agent before?

1	Yes
2	No

51A2. Could they see and hear the message clearly?

1	Yes
2	No

51A3. How did they like receiving training messages this way?

1	Yes
2	No

51B. Comments for those who received the Jerrycan Animation via smartphone. Circle and Code ONLY the number. [Q50BANIMATE]

51B1. Had they ever seen a training video via smartphone before?

1	Yes
2	No

51B2. Could they see and hear the message?

1	Yes
2	No

51B3. Did they need to see it multiple times?

1	Yes
2	No

51B4. How did they like receiving training messages this way?

1	Yes
2	No

Section F: Intent to Adopt Questions

52. Based upon what you have seen during the training, what is your opinion about how effective the jerrycan method would be to protect beans after harvest? Would you say it would be "very effective," "somewhat effective," "not very effective," or "not effective at all"? Circle and Code ONLY the number. VAR = [Q51CONFIDENT]

1	2	3	4	9
Not confident at all	Not very confident	Somewhat confident	Very confident	Not sure

53. Now, let's consider your own personal situation. After participating in this training, do you intend to use the jerrycan (or another sealed container) method to store your own beans during the next year? Do you already use this method or something like it? How certain would you say you are that you will be using this method in the next year? Circle and Code ONLY the number. VAR= [Q51PLANUSE]

1	2	3	4	5	6
I am certain I will NOT be using it	I probably will NOT be using it.	I'm not sure whether I will use it or not.	I probably will be using it.	I am certain that I will be using it	I already use it and will continue.

54. If you selected choices 4, 5, or 6 as your answer, what are the main reasons that you think the jerrycan method would be a good one for you to adopt? DO NOT READ THE LIST. CHECK ONLY IF THEY MENTION EACH ITEM.

	Reasons. CHECK ALL THAT APPLY.	Code 1 if they mention it.
54A	[Q52AHAVECAN] I already have a jerrycan or sealed container I can use	
54B	[Q52BGETCAN] I can get a jerrycan or sealed container easily/cheaply	
54C	[Q52CPEST] I want to reduce pest damage to my stored beans	
54D	[Q52DPRICE] I want to preserve beans to sell at a higher price	

	later	
54E	[Q52EJUSTRY] I just want to try this to see if it works.	
54F	[Q52FOTHERSDO] I want to try this because other are doing (or will).	
54G	[Q52GOTHER] Other (Please specify)	

55. If you selected choices 1, 2 or 3, what are the main reasons why you might not use the jerrycan method? DO NOT READ THE LIST. CHECK ONLY IF THEY MENTION EACH ITEM.

	Reasons: CHECK ALL THAT APPLY	Code 1 if they mention it.
55A	[Q53ANOCAN] I don't have a jerrycan or other sealed container	
55B	[Q53BCOSTHIGH] A jerrycan or sealed container would cost too much. I don't have the money now.	
55C	[Q53CNOPROTECT] I don't think this would really protect my beans against insect damage	
55D	[Q53DNOBEANS] I don't have enough beans to justify use of such a container.	
55E	[Q53ENOSAVE] I don't save my beans after harvest.	
55F	[Q53FNOPRICE] I don't think saving them would result in a higher price for beans later.	
55G	[Q53GNOWORK] I tried this method before and it didn't work, or I saw someone else try it and it didn't work.	
55H	[Q53HNEEDTIME] I need time to think about this before making a decision. I may need to talk with others first.	
55I	[Q53INODAMAGE] My beans are not damaged by insects. I don't need this method.	
55J	[Q53JNOPLACE] I have no place where I could put the stored containers.	
55K	[Q53KNOGROW] I fear that beans stored this way would not germinate if I save them for seed.	
55L	[Q53LOTHER] Other (Please specify)	