Innovative learning approaches to technology transfer using multimedia technologies in developing countries

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ABSTRACT

Agricultural technology transfer has traditionally been conducted through in-person training sessions between agricultural extension agents and farmers. However, this method is restricted in the number of targeted end-users reached. While there are many technologies that are ready for use, effective technology transfer must occur in order for improved practices to be adopted. The current challenges faced in agricultural technology transfer are the issues of scaling-up communication while doing so at a reasonable cost.

The solution proposed in this study is the use of multimedia approaches to technology transfer via information and communication technologies (ICTs) since this delivery mechanism can reach a larger audience than in-person interactions. In addition, the audio and visual elements within a multimedia product can provide various pathways to learning, as described in learning theories, which may improve comprehension and overall technology transfer.

It is proposed that multimedia products, containing multiple media elements, can yield effective technology transfer. Four multimedia products were studied: video, audio narration, song and illustrations. The technology that was transferred was a drying table for parboiled rice paddy. The study was conducted in Benin; thirty-six female parboilers from three villages were exposed to one multimedia product each. A knowledge questionnaire was administered before and after exposure to the respective multimedia products in order to measure knowledge gain. An applied knowledge task was evaluated in order to assess comprehension. A preference survey was also administered.

There were significant effects of village and number of times that participants consulted the multimedia product on knowledge gain. The effect of the multimedia approaches were

significant on knowledge gain in one of the villages (p=0.0396) where the gains were: 17.86% for illustrations, 15.48% for audio narration, 13.10% for song and 12.50% for video. The results from the applied knowledge task were affected by the percentage of the parboiling group that was exposed to the multimedia product (p=<0.0001). Overall, the most preferred multimedia product was the set of illustrations and the least preferred was the audio narration.

Greater numbers of targeted end-users were reached via multimedia approaches to technology transfer than in-person interactions since copies were provided to the study participants who shared and consulted them after training had occurred, thereby illustrating the importance of ensuring that multimedia products are made available and accessible. The design of such multimedia approaches should consider the target audience in order to provide appropriate content. Illustrations can be an effective multimedia, especially in developing countries, in order to overcome illiteracy issues.

Multimedia approaches to technology transfer can effectively reach larger audiences than in-person interactions, and can therefore be used to improve practices and farmers' livelihoods.

RÉSUMÉ

Le transfert de technologie agricole a traditionnellement été réalisé grâce à des séances de formation en personne entre les vulgarisateurs et les agriculteurs. Cependant, cette méthode est limitée dans le nombre d'utilisateurs ciblés atteint. Bien qu'il existe de nombreuses technologies qui sont prêtes à l'emploi, le transfert de technologie doit être fait d'une façon efficace pour que les pratiques améliorées soient adoptées. Les défis actuels dans le transfert de technologie agricole sont liés au besoin de communications à grande échelle à un coût raisonnable.

La solution proposée dans cette étude est l'utilisation d'approches multimédia pour le transfert de technologie par l'intermédiaire de technologies de l'information et de la communication (TIC) puisque ce mécanisme peut atteindre un public plus large que les interactions en personne. De plus, les éléments audio et visuels dans un produit multimédia peuvent fournir différentes voies à l'apprentissage, comme décrit dans les théories de l'apprentissage, ce qui peut améliorer la compréhension et le transfert de technologie de façon globale.

Il est proposé que les produits multimédias, contenant multiple type de médias, puissent encourager un transfert efficace de technologie. Quatre produits multimédias ont été étudiés: la vidéo, la narration audio, la chanson et les illustrations. La technologie qui a été transférée était une table de séchage pour du riz paddy étuvé. L'étude a été menée au Bénin; trente-six femmes étuveuses de trois villages ont été exposées chacune à un produit multimédia. Un questionnaire sur les connaissances a été administré avant et après l'exposition aux produits multimédias respectifs afin de mesurer le gain de connaissances. Une tâche pratique de connaissances a été évaluée afin d'évaluer la compréhension. Une enquête des préférences a également été administrée.

Il y avait des effets significatifs selon le village et le nombre de fois que les participants ont consulté le produit multimédia sur le gain de connaissances. L'effet des approches multimédias a été significatif sur le gain de connaissances dans l'un des villages (p=0,0396) où les gains étaient: 17,86% pour les illustrations, 15,48% pour la narration audio, 13,10% pour la chanson et 12,50% pour la vidéo. Les résultats de la tâche pratique de connaissances ont été affectés par le pourcentage du groupe d'étuvage qui a été exposé au produit multimédia (p=<0,0001). Globalement, le produit multimédia préféré était l'ensemble des illustrations et la moins préférée était la narration audio.

Un plus grand nombre d'utilisateurs ciblés ont été atteints par l'intermédiaire des approches multimédias de transfert de technologie comparé aux interactions en personne puisque des copies ont été fournies aux participantes de l'étude qui les ont ensuite partagées et les ont consultées après que la formation avait eu lieu, illustrant ainsi l'importance de veiller à ce que les produits multimédias sont mis à leur disposition et qu'ils soient accessible. La conception de ces approches multimédia devrait considérer le public cible afin de fournir un contenu approprié. Les illustrations peuvent être un média efficace, en particulier dans les pays en voie de développement, afin de surmonter les problèmes d'analphabétisme.

Les approches multimédias de transfert de technologie peuvent effectivement atteindre un public plus large que les interactions en personne, et peuvent donc être utilisées pour améliorer les pratiques techniques ainsi que les moyens de subsistance des agriculteurs.

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PREFACE AND CONTRIBUTION OF AUTHORS

This work was completed as a component of the AfricaRice – McGill Project, funded by Foreign Affairs, Trade and Development Canada (DFATD). McGill University and AfricaRice supervisors provided academic support and logistical arrangements for fieldwork; all fieldwork, data collection, statistical analysis and manuscript composition were completed by the candidate, under the supervision of Dr. Michael Ngadi and co-supervision of Dr. Robert Kok.

1. INTRODUCTION

Agriculture is essential to nourish human life, and is especially important in developing countries as it is a primary source of employment and income. In order to continue to feed the global population, improved agricultural practices and technologies are developed to improve parameters such as production, efficiency and quality within food systems. Results from innovation, research and development must be communicated to targeted end-users in order for technology adoption to occur. Agricultural technology transfer, that is, the delivery of agricultural technological information to targeted end-users, namely farmers, has traditionally been conducted through in-person interactions with agricultural extension agents. However, in-person interactions and training sessions between agricultural extension agents and farmers are limited in the number of potential end-users reached. Finite resources are often a limiting factor to reaching large numbers of targeted end-users: financial resources are required to train and dispatch agricultural extension agents to farmers over a limited geographic area and within specific time constraints. The two main challenges in agricultural technology transfer are the issue of scaling-up communication, while doing so at a reasonable cost.

While there are many innovations ready to be put into practice, the rate of technology transfer is low compared to the quantity of available technologies (Shanthy and Thiagarajan 2011, Cruz Castillo et al. 2015). In order to have increased adoption of improved agricultural practices and technologies, greater numbers of targeted end-users must be reached. While monitoring and evaluation of technology adoption are standard practice, the method of technology transfer—a crucial step before technology adoption can ensue—is much less studied. Large-scale methods of disseminating information have only recently started to be used, such as radio and video (Bentley et al. 2014). Given that information and communication

technologies (ICTs), namely mobile phones, are becoming more affordable, accessible and adopted across the globe (Aker 2011), multimedia approaches to technology transfer are proposed as a solution to reach large numbers of targeted end-users (Strong et al. 2014).

Multimedia approaches to technology transfer consist of multiple media elements—audio and visual—that can be used to communicate technical information to targeted end-users. Multimedia approaches can be developed and used as reliable educational resources from which targeted end-users can learn. Few studies involving radio, video or visual images have been conducted in order to compare the effectiveness of these media approaches to in-person training sessions (Moussa et al. 2011). Such multimedia approaches have shown equal or greater effectiveness than in-person training sessions with respect to the number of targeted end-users reached, knowledge gain, information sharing, adoption rates, and overall technology transfer (Zossou et al. 2009, Shanthy and Thiagarajan 2011). Given that each of these media have been tested against the traditional in-person method of technology transfer and shown its effectiveness, it would be expected that a genuine *multi*media product, composed of various audio and visual elements, could yield even greater learning and technology transfer than an individual medium.

1.1 OBJECTIVES

The objectives of this work were to identify effective multimedia approaches to technology transfer using theoretical justification, and testing of such approaches. These multimedia approaches to technology transfer should be able to reach larger numbers of targeted end-users than in-person interactions, yield effective theoretical and practical comprehension,

and be appreciated by targeted end-users in order to combine the media elements to create an overall effective multimedia product for technology transfer.

The specific goals of this study were to:

1) Develop a solid case for the use of multimedia approaches to technology transfer by drawing upon learning theories and the current and future trends related to information and communication technologies to describe the theoretical framework through which effective technology transfer could occur.
2) Develop and test audio and visual media elements that could be incorporated into one multimedia product for effective technology transfer. The sub-goals were:
    a. To evaluate the differences in gain in theoretical knowledge between the multimedia products about a given technology.
    b. To evaluate the differences in gain in practical knowledge between the media products about a given technology.
    c. To determine user-preference of the various multimedia approaches to technology transfer.

2. CONNECTING STATEMENT TO LITERATURE REVIEW

While few studies have been conducted on the comparison of individual media products to traditional in-person training interactions in technology transfer, there is a need to state the case for such multimedia approaches. Learning theories can be drawn upon to describe how humans learn so that multimedia approaches can capitalize on these mechanisms and consequently be appropriately designed. The current and future trends of the accessibility, adoption and coverage of information and communication technologies are also important to consider in proposing the use of multimedia approaches to technology transfer. The following section, 3.0 Literature Review, is a manuscript prepared for publication in which the above-mentioned items are explored in order to fulfill the first goal specified in Section 1.1. References are listed at the end of each manuscript, and differ from the overall reference list (Section 7.0).

3. LITERATURE REVIEW: MANUSCRIPT 1 - INNOVATIVE LEARNING APPROACHES TO TECHNOLOGY TRANSFER USING MULTIMEDIA AND INFORMATION AND COMMUNICATION TECHNOLOGIES

Title: Innovative Learning Approaches to Technology Transfer Using Multimedia and Information and Communication Technologies (Formatted according to the *Journal of Agricultural Education and Extension*)

Authors: Rebecca Chin, Robert Kok, and Michael Ngadi

3.1 ABSTRACT

Purpose: *Traditionally, agricultural technology transfer consists of in-person training given by agricultural extension agents to farmers. However, two of the primary obstacles currently faced in technology transfer is the scaling-up of communication at a reasonable cost. Innovative learning approaches are presented as potential solutions to overcome these barriers.*

Design/methodology/approach: *Information and communication technologies (ICTs) may provide a wide-reaching approach through which technology transfer may be affected at a lower cost than in-person interactions. Information and communication technologies are used worldwide, thereby making them an ideal tool for technology transfer. These ICTs have the capacity to carry innovative educational material designed based on learning theories—such as cognitive, dual coding, social constructivist and emotional interest—that support the use of visual and audio elements, that is, multimedia. The proposed multimedia approaches include the use of audio narration, song, illustrations and audiovisual videos that can be packaged as multimedia products for dissemination through ICTs.*

Findings: *Such innovatively designed multimedia approaches to technology transfer may be more likely to cater to one's learning style, potentially yielding more effective technology transfer.*

Practical implications: *Designing innovative approaches to technology transfer using multimedia and ICTs would require: the creation of innovative learning multimedia products about a given technology, packaging of multimedia products and disseminating the multimedia products via ICTs.*

Originality/value: *The global use of ICTs can be leveraged to transfer technology more widely and at a lower cost. Multimedia approaches to learning can be effective ways to transfer technology and ICTs are able to serve as the means through which multimedia technology transfer can occur.*

KEY WORDS: Agricultural Extension, Technology Transfer, Multimedia Learning, ICT, Education, Video, Illustrations, Song, Audio

3.2 INTRODUCTION

Agriculture is a dominant field in many developing countries that can help fulfil populations' subsistence needs, as well as contribute to countries' economic growth. In order to increase agricultural productivity, improved practices and technologies can be employed. Research and development of such practices and technologies often occurs in research centres and universities. However, in order to reach the targeted beneficiaries, namely farmers, technology transfer must occur. Technology transfer can be defined as the movement of knowledge from one area to another, such as from the research centre to farmers for application.

Agricultural extension agents are people employed by various bodies, such as governmental extension services or non-governmental organizations, with the mandate of transferring technology to farmers. Traditionally, extension agents would train and visit farmers

in-person to provide information, which may have included demonstrations, about methods and technologies. Deploying extension agents for in-person technology transfer entails logistical constraints: extension agents must be trained in the new technology; they must travel to beneficiaries whose location—including remote villages—may not be easily accessible; the number of beneficiaries reached through meetings with extension agents is limited by physical and temporal parameters; and hence, the overall costs involved in this process of in-person technology transfer can be significant.

There are numerous technologies available to be transferred to farmers, however, it is the rate of technology transfer from research centres to farmers that is typically limited (Shanthy and Thiagarajan 2011). The ratio of extension agents to farmers is generally very low: for example, in China, there is 1 extension agent for every 1200 farmer households (Feng et al. 2005). In order for technological developments to be disseminated, adopted by users and improve practices, technology transfer must occur on a much wider and faster basis than in-person interactions; ICTs may be a potentially successful mechanism through which to reach a wider audience. Examples of ICTs include radio, television and computers, however the main focus of ICTs in this paper is on mobile technology, such as mobile phones and tablets, since their use is growing worldwide.

In addition, technology transfer methods should account for the ways in which humans learn so as to increase the likelihood of successful technology transfer. Learning theories should be considered in order to design innovative and effective approaches to technology transfer; the use of multimedia will be discussed in this article. Information and communication technologies can be an ideal tool for technology transfer due to their capacity to convey visual and audio elements, that is multimedia. The widespread use of ICTs also make them an ideal tool to reach a large audience. The objective of this paper is to illustrate the linkages between learning theories,

multimedia products to convey learning material, and ICT use and potential as a delivery vehicle; these elements converge towards effective technology transfer.

3.3 HOW DO HUMANS LEARN?

In order for effective technology transfer to occur, the content delivered through ICTs should be designed in accordance with how human beings learn. Relevant learning theories to consider in innovative technology transfer include cognitive, dual coding, social constructivist and emotional interest theories.

3.3.1 COGNITIVE LEARNING THEORY

The dominant educational psychological perspective is currently cognitive theory through which it is stipulated that learners use one's prior knowledge in order to make sense of new information (Bruner 1957). Therefore, technology transfer through a cognitive learning theory lens would lead learners, that is, farmers, to establish their understandings of new technologies based upon their existing mental references.

Bruner (1957) describes coding as a process of cognitive learning through which people use acquired knowledge—for example, about new technologies—to generalize and extrapolate to new learning situations such as the assimilation and adoption of such technologies. Three issues with respect to coding can be identified: 1) the *condition of code acquisition* which refers to the learning context and environment that affect how information is coded; 2) the *problem of creativity* is the challenge in creatively coding a generalization that can be efficiently used in subsequent situations; and, 3) the *problem of instruction* is the issue regarding which type of information can facilitate coding. It is proposed that these coding issues be considered in the design of learning approaches for technology transfer so as to create innovative methods that may lead to more effective knowledge-building and ultimately successful technology transfer.

3.3.2 SOCIAL CONSTRUCTIVIST THEORY

Constructivism is the theory that one constructs knowledge based on prior knowledge (McHaney 2012). Social constructivist theory is an extension of constructivism whereby it is stipulated that knowledge is built socially; communities consensually attribute value to certain information, upon which more knowledge is built. An understanding of the social characteristics of the target audience can be beneficial in creating relevant learning material in order to facilitate technology transfer.

Scaffolding is a constructivist learning method whereby learners are gradually exposed to more information received through a structured and guided approach that builds upon prior knowledge. Building blocks of information can be delivered by a teacher, such as an agricultural extension agent, or a technical delivery system. Technical delivery systems can include the use of ICTs through which technology transfer learning modules can be made available. Scaffolding is expected to enable learners to take ownership and responsibility of their learning, leading to increased levels of engagement (McHaney 2012).

3.3.3 DUAL CODING THEORY

Dual coding theory is composed of two main cognitive sub-systems that process inputs: a verbal sub-system and an imagery sub-system. Multimedia can be an effective tool to transfer information since both sensory components can be incorporated into the delivery and processed by the brain's separate channels: verbal information can be interpreted in parallel with a pictorial representation, which can lead to a better overall understanding (Mayer, Heiser, and Lonn 2001).

Findings from formal educational contexts have shown that there are limitations in the effectiveness in understanding and information recall when overloading one sub-system, such as

overloading the visual system with both images and written text (Mayer, Heiser, and Lonn 2001). Therefore, it would be expected that the creation of multimedia learning products for technology transfer should include a balanced array of various information delivery methods. Information and communication technologies have the ability to convey visual and audio methods of communication which may make them a potentially effective device through which to transfer multimedia information.

3.3.4 EMOTIONAL INTEREST THEORY

The emotional interest theory has been described as a cause-and-effect type of learning situation: when interesting material is included in the presentation of new information, the learner is more likely to enjoy learning and be more attentive. The learner is expected to be more emotionally involved in the process which in turn increases one's cognitive processing (Harp and Mayer 1997). However, interesting material should not be irrelevant nor contextually inappropriate since these seductive details do not lead to improved learning (Harp and Mayer 1998). Multimedia learning products for technology transfer have the potential to incorporate interesting and relevant material that may lead to better learning, as expected through emotional interest theory.

3.3.5 LEARNING: WHERE TO GO FROM HERE?

Theories about human learning can be consulted for guidance in the design of learning material for effective technology transfer. Cognitive theory and coding issues should be considered in the design of technology transfer material in order to facilitate learning to build upon existing knowledge. Capsules of information can be produced, which can be considered a scaffolding technique in social constructivist theory, to stimulate community discussion and knowledge acceptance. The visual and audio cognitive sub-processing systems that characterize dual coding

theory can both be exploited for better overall information processing. Material can be created to arouse learners' interest, increasing their attention and hence cognitive processing as described in emotional interest theory.

The case for multimedia learning approaches as a method for innovative technology transfer can be justified by these learning theories. Such multimedia learning approaches can then be disseminated via ICTs.

3.4 INNOVATIVE LEARNING APPROACHES: MULTIMEDIA

3.4.1 TARGET AUDIENCE CONSIDERATIONS

In order to effectively train farmers in developing countries, the design of technology transfer material should be done in accordance with the characteristics of the target audience in mind. Illiteracy may be an issue that must be considered in the design of educational material in order to properly convey messages in developing countries where literacy rates may be low. Traditionally in developing countries, oral exchange is used more often than other methods of knowledge sharing such as written records (Abdul Kargbo 2008). Therefore, methods of communication used in technology transfer should be selected with the aim of facilitating learning; such methods can include various visual and audio media, delivered either independently or in combination with each other.

3.4.2 THE CASE FOR MULTIMEDIA USE IN TECHNOLOGY TRANSFER

As supported by the dual coding theory, multisensory materials can be more effective for learning than similar programs that use only one sense (Shams and Seitz 2008). Cognitive learning can occur more easily through the use of multi-modal methods since there is a more evenly distributed

cognitive load; information can be packaged more efficiently for short-term memory which then helps to build long-term understandings (Bagui 1998).

Making use of different senses may be a logical approach in order to transfer information to the widest audience possible, as learners can then benefit from the various modalities presented. Better learning can ensue due to the various modes of communication by more effectively tapping into one's dominant senses (Katai and Toth 2010).

It is envisioned that an audiovisual video product containing various methods of communication—including audio narration, song, illustrations and audiovisual video—can be produced to be optimally received, comprehended and appreciated by the end-user. These individual media elements that can be used in technology transfer are described below.

3.4.3 AUDIO MEDIA

3.4.3.1 SPOKEN COMMUNICATION Given that literacy rates are generally low in many developing countries, it would be appropriate to provide oral methods of communication for transferring technology. Oral communication permeates human history and has existed before recorded history. Oral traditions are generally passed on from one generation to the next, which helps to preserve memories and culture through oral 'walking encyclopedias' (Abdul Kargbo 2008). Some cultures, such as many African ones, highly regard the art of conversation, where hearing is prioritized over seeing. Invaluable information can be transmitted through oral traditions including tribal customs, religious beliefs and agricultural practices.

Spoken communication has been used in agricultural technology transfer, including through the use of radio, speech recognition systems and voice annotations in conjunction with visual images. Through an information system accessible through mobile phones, speech was used as a search mechanism and requested information was provided orally. Users of the system

had positive feedback since they considered the use of speech to be 'natural' (Cuendet et al. 2013). Spoken communication is a medium with which it would be expected that the majority of people be familiar, as oral communication is a part of daily life. Therefore, the use of spoken communication can be a method to use in the transfer of technology.

3.4.3.2 SONG Songs can be used as mnemonic devices, aiding in learning and recalling of concepts. Songs can be used to build meaning for learners which is a component of constructivist theory. Connections can be made through cognitive theory when learners break down the meaning and messages behind comprehensible and accessible lyrics (Governor, Hall, and Jackson 2013).

It has been shown by neuroscience research that lyrics and melodies create multiple pathways which enable memory storage, access and retrieval. In addition, memories can be recalled through more than one type of stimulus. Instruction through emotions, and consequently through song since it is able to elicit emotions, 'binds and improves learning' (Governor, Hall, and Jackson 2013).

Cultural traditions, which includes song, can be used to communicate with target populations since they can be a source of entertainment and sustain one's interest. Song, dance and painting were innovatively used to deliver agricultural messages by the non-governmental organization (NGO) Shushilan in Bangladesh which resulted in rice yields more than doubling for some participants while lowering their costs (Bentley et al. 2005).

3.4.4 VISUAL MEDIA

3.4.4.1 VISUAL IMAGES: REAL-LIFE PHOTOS The use of images and photos to communicate ideas is supported by the adage 'a picture is worth a thousand words'. This visual method of information dissemination uses the visual channel within the dual coding theory. Images can

provide clarifications and details of an idea, which can facilitate understanding (Ramkumar et al. 2007).

Many existing technology transfer materials include the use of photos or images in order to account for illiteracy levels in many of the target populations. Visual literacy is another criterion to consider in the design of learning material for technology transfer; it is the ability to correctly recognise and interpret images (Stringer et al. 2011). In order to increase the likelihood of comprehension of images, they can be presented in different forms which may vary among levels of visual literacy. Stringer et al. (2011) found that real-life photos with the backgrounds whitened out were easily interpreted by the study's experimental groups, compared with black and white, colour and cartoon style images.

3.4.4.2 ILLUSTRATIONS Another visual representation of information are hand-drawn illustrations. With respect to visual literacy, hand-drawn images may be more easily interpreted than photographs. This may be due to the fact that hand-drawn images can be simplified and present only the necessary information, whereas real-life photographs may include irrelevant visual information which may make them more difficult to interpret (Medhi, Prasad, and Toyama 2007).

Illustrations have been used in printed materials in the health education field with the aim of improving information transfer and subsequent appropriate health behaviours. Delp and Jones (1996) reported that educational material with illustrations were referred to more often, yielded better comprehension and promoted appropriate health behaviour compared to printed material without illustrations. Educational material with illustrations can be helpful for users that have had little formal schooling, low literacy skills, and cognitive limitations (Kripalani et al. 2007); illustrations can facilitate understanding and be helpful in remembering information.

3.5 OPTIMIZING LEARNING: MULTIMEDIA

Audio and visual media elements can be used in order to facilitate learning as described through the aforementioned learning theories which included cognitive, social constructivist, dual coding and emotional interest theories. Although each medium of communication can be used independently for learning, it is proposed in this article that combinations of these media elements be used, so as to provide multimedia learning approaches for technology transfer. Media designed around human learning can provide impactful tools in human cognition and lead to better learning (Mayer 2003).

Multimedia products can be an effective method of communication to transfer information and lead to behaviour change. One watching the multimedia product is more likely to be receptive to learning the information if he is interested and willing to listen and watch; this receptivity to learning depends more on the medium of communication rather than the message itself (Amuseghan 2009). It is envisioned that by providing multimedia approaches to learning for technology transfer, learners, which include farmers, will be more interested in the learning material and therefore motivated to pay attention. As a consequence, it would be expected that farmers be engaged in more cognitive processing through the multiple channels and be able to build meanings from such presented information, which should lead to more effective learning.

Video has been used extensively as a means of agricultural training (Van Mele et al. 2005). Television, radio and video have shown effectiveness in knowledge transfer and correct recall of information years after viewing (Bentley et al. 2014). Although such data is promising for effective learning and technology transfer, the authors believe that there is a need to examine how several different types of audio and visual media, including arts-based techniques, can be

combined to facilitate learning; multimedia products can allow learners to process information through audio and visual channels, enabling cognitive analysis of the content.

Only a few agricultural technology transfer programs have tried arts-based methods to convey messages, which have included the use of song, drama and visual art such as illustrations. These creative visual and auditory methods yielded favourable results in terms of user preferences and information acquisition, given that the arts are able to educate. Similarly to how communication can be optimized through dual coding, the use of arts can also accommodate various learning styles, especially of men and women farmers (Curtis 2011). Such arts-based approaches to technology transfer were done through in-person interactions. In order to reach a wider audience, large-scale methods of communication, primarily the aforementioned video, can be used. Within the health domain, educational material has previously been disseminated through such arts-based educational methods through the use of serial dramas and soap operas which provide entertainment and education and has been referred to as an 'enter-educate' approach (Amuseghan 2009). Therefore, the authors propose the use of entertaining and educational material in the dissemination of information for technology transfer; it can be envisioned that these various multimedia approaches of communication can be utilised together and cohesively packaged into a media product that can cater to several different learning styles. It would be expected that by providing learning opportunities through multimedia, learners would have better comprehension and retention of technology transfer messages and concepts which may then encourage technology adoption. With repeated messages delivered via various media, better information acquisition can result and increase adoption (Shanthy and Thiagarajan 2011). Such multimedia products can be developed as stand-alone products, or as mutually supporting resources with the aim as serving as scaffolds to learning and knowledge-building.

3.6 DELIVERY MECHANISMS: INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS)

3.6.1 COVERAGE AND ADOPTION OF ICTS

Information and communication technologies may be a potentially successful mechanism through which to reach a wider audience. Information and communication technologies can be defined as technologies, including hardware and software, that enable the transfer of information and communication between providers and users. Throughout the world, adoption rates of mobile ICTs are increasing given the increased coverage, including in rural populations in poor countries; in sub-Saharan Africa, for example, there was only 10% coverage in 1999 while in 2008 it had increased to more than 60% (Aker 2011).

3.6.2 USING ICTS FOR MULTIMEDIA TECHNOLOGY TRANSFER

It is proposed that these innovative multimedia learning approaches—namely narration, song, images, illustrations and video footage—be documented through media in order to be packaged together and delivered through ICTs. A video about a technology for transfer comprised of various visual and audio elements would be expected to provide useful ways of acquiring and processing information based on how humans learn. The delivery of information should remain designed around learner-centered principles to encourage cognitive processing, while the use of ICTs to transmit informative messages are utilised as a communication tool to encourage such learning.

Information and communication technologies can be regarded as the means through which information transfer can be facilitated, while comprehension occurs when the learner decodes the transmitted information into knowledge (Feng et al. 2005). Technologies can be viewed as socio-cultural tools, as 'mediators of accumulated knowledge and as cultural tools' (Ludvigsen and Mørch 2010). Beyond multimedia technology transfer through ICTs, within a social constructivist

framework such knowledge can become agreed upon and ICTs can be used to transmit such accumulated knowledge and reflect cultural perspectives.

The authors propose that the multimedia learning approaches be combined into a multimedia package in order to facilitate learning of various styles. The overarching multimedia product that is envisioned is a multimedia video product that would consist of the various audio and visual elements described above. Such a multimedia video product should be made available in various formats to be accessed by the public through ICTs. Current methods of media-sharing in developing countries where internet coverage is not reliable or widespread include through the use of CDs, DVDs and village viewings whereby communal resources are pooled in order to provide video screenings for the entire village. Sharing of information is facilitated by physical copies and practices.

3.6.3 DELIVERY OF MULTIMEDIA PRODUCTS

An intermediate environment between no internet resources and constant online coverage can be a specific physical location that has limited internet coverage. This can include fixed connections to landline communications, or Wi-Fi-enabled zones that have wireless connections. In such online environments, information can be shared and accessed when using such connected resources in the case of fixed telecommunications, or within range of such coverage areas in the case of Wi-Fi hotspots. Although Wi-Fi hotspots may be thought of as a physical location to which a user would need to travel in order to access information, wireless communication services can be brought to users instead. DakNet is an example of one such technology: it is comprised of an information system that has a remote Wi-Fi transceiver that can be transported to and from different physical locations, uploading information to local village Wi-Fi-enabled kiosks (Pentland, Fletcher, and Hasson 2004). This method of information transfer is asynchronous,

meaning that the information that is physically transported between Wi-Fi-enabled village kiosks is limited to what information is initially placed on the remote Wi-Fi transceiver. Although this method of transferring data is not done in real time, it can still be an effective way of providing new information. Offline portals are another asynchronous type of infrastructure that can make information available: information can be pooled to create a portal and can be accessed without an online connection. Multimedia products do not need to be accessed synchronously since they should be packaged for retrieval and should not be affected by temporal parameters. Therefore, technology transfer can be done through uploading of multimedia products to Wi-Fi-enabled village kiosks, landline linked service points or offline portals, whereby users can then access such instructional material.

It is anticipated that internet coverage and mobile data networks will become more widespread and accessible, such as the 3G and 4G networks that continue to evolve and provide mobile broadband internet access. Therefore, these multimedia products should be made accessible online for download or streaming. The choice of file formats should be considered in order to enable the widest access and utility based on the compatibility of ICTs, such as cell phones and tablets, which may have various software constraints such as different file readers or viewers. The size of files should also be considered since the transfer of data requires certain conditions like adequate available bandwidth to be able to access and retrieve information. The size of a file is related to its quality; in the case of video files, higher definition videos are typically larger files, so this size-quality relationship should be considered in the packaging of multimedia products. By providing the multimedia products in various file formats and sizes, users can be presented options containing the same information and content, while remaining within their technological restrictions.

Multimedia video products are proposed as a means through which to transfer technology and has been shown to be appropriate for farmers' learning and acceptance; they are able see and hear about technologies, and when such testimonials are given by fellow farmers, this can increase their likelihood of adopting such technologies for themselves. The use of multimedia video products may be a promising means of widely disseminating information since it has been shown that informational videos do not absolutely require facilitation from a subject matter specialist; the video itself can provide necessary information (Bentley et al. 2014).

Although multimedia video products are proposed as a holistic package of audio and visual elements, in order to provide more options for accessing information, the individual media components could be made available. This would allow for smaller files to be transmitted, which may enable learners to access information within any present connectivity or technological constraints. It is anticipated though that connectivity coverage will continue to grow, so such media elements can be presented as individual components, or as a complete multimedia package. This forecast greater coverage of connectivity may allow learners to become more active in their knowledge-building, as they can then search for topics based on their own interest, or ones that build upon and complement previous learning. Individual multimedia video products, which learners may consider interesting as observed through emotional interest theory, are composed of visual and audio channels as described in dual coding theory and can be considered scaffolds in the constructivist learning approach leading to better overall cognitive processing and learning.

3.6.4 REDUCED COST

Since ICT adoption and mobile coverage are increasing, more people continue to gain access to information available through such technologies. This use of ICTs enables knowledge to reach a wider audience at a low cost (Ramkumar et al. 2007). In the creation of the multimedia products

that are then transferred through ICTs, production costs are incurred only once before the information is disseminated. Another advantage of using multimedia products is that there is a certain reliability in transferring the technology since the information is conveyed consistently every time, whereas human exchanges leave room for inconsistencies which may require additional resources to rectify the exchange. In addition, the cost to farmers for accessing information, which can be referred to as the 'search cost', can be also be decreased through the use of ICTs since the presumed owned or locally accessible ICT is expected to be within closer proximity than having to travel to an extension agent, a process through which one would incur travel and time costs (Aker 2011).

3.6.5 COLLECTIVE LEARNING

In some cultures, collectivity is more valued than individualism. With the adoption of ICTs, this may enable multiple people to access the same ICT equipment without having to own it themselves. This sharing of resources can increase the scope of technology transfer since more people can access and learn from multimedia products.

By learning through a common ICT resource alongside fellow members of the community, there is the possibility of engaging in social constructivist learning. Farmers can engage in discussion with each other about new technologies and learn from early adopters of technology, which may lead to their increased rate of adoption of the technology as well (Aker 2011).

3.6.6 INCIDENTAL LEARNING

The availability of ICTs is an essential element in the proposed multimedia technology transfer. The authors believe that the present and near future are opportune times to capitalize on the use of mobile ICTs in technology transfer. If the use of computers for training is a 'milestone' (Shanthy

and Thiagarajan 2011), then the use of mobile ICTs should be an equally important and significant method of transferring technology.

Accessing and building understandings from multimedia products through ICTs can lead to incidental learning, which is peripheral knowledge that learners gain through the main learning process. Incidental learning can be viewed as a natural and powerful by-product of the primary learning process (McHaney 2012). Such incidental learning through the use of ICTs can include skills in navigating interfaces and using the hardware. This can be an important skill as ICTs become more widely used; more information can be accessed, covering a range of different fields, from both formal and informal sources of information. Overall, learning via ICTs can provide additional skills and knowledge beyond the intended technology transfer.

3.7 CONCLUSION

Innovative learning approaches through the use of audiovisual multimedia products that are designed to address how people learn can be used for technology transfer, which may lead to better comprehension and hence technology adoption. Multimedia products can be created using principles from cognitive, social constructivist, dual coding and emotional interest theories. Multimedia learning approaches can be delivered through ICTs which are widely used, thereby reaching a large audience. These innovative learning approaches can lead to changes in technology transfer by engaging the audience and informing a greater number of people, which is hoped to yield better agricultural practices, outcomes and livelihoods.

3.8 ACKNOWLEDGEMENTS

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4.0 CONNECTING STATEMENT TO SECTION 5.0

Via the review of the literature, the first goal of the study, outlined in Section 1.1 was achieved. Using the theoretical framework whereby linkages between learning theories and information and communication technologies were illustrated to state the case for multimedia approaches to technology transfer, four multimedia approaches were created and tested; the following section is a manuscript prepared for publication reporting this study. The audio and visual media elements identified and supported by learning theories in Manuscript 1 were evaluated against each other in order to determine the differences in transferring theoretical and practical technological knowledge, as well as user preference, as per the second goal outlined in Section 1.1. The multimedia products are available from Dr. Michael Ngadi for review upon request.

5.0 MANUSCRIPT 2 - EVALUATION OF FOUR MULTIMEDIA APPROACHES TO TECHNOLOGY TRANSFER: ANALYSIS OF THEIR EFFECTS ON KNOWLEDGE GAIN AND USER-PREFERENCE

Title: Evaluation of Four Multimedia Approaches to Technology Transfer: Analysis of Their Effects on Knowledge Gain and User-Preference (Formatted according to the *Journal of Agricultural Education and Extension*)

Authors: Rebecca Chin, Robert Kok, and Michael Ngadi

5.1 ABSTRACT

Purpose: *Traditional in-person agricultural technology transfer is limited in the number of beneficiaries that can be reached; therefore, multimedia approaches can be developed to transfer technology widely via information and communication technologies.*

Design/methodology/approach: *Four multimedia approaches, namely video, audio narration, song and illustrations, were created for communicating construction of a drying table for parboiled rice paddy. Thirty-six women from three villages in Benin, exposed to one multimedia approach each, were administered a knowledge questionnaire to compare knowledge score gains between the multimedia approaches. An applied knowledge task was performed to evaluate comprehension. A preference survey was also conducted.*

Findings: *Knowledge gain was influenced by village and number of times that participants consulted the multimedia product. Within a village, multimedia approaches were statistically significant on knowledge score gain ($p=0.0396$); gains were 17.86% for illustrations, 15.48% for audio narration, 13.10% for song and 12.50% for video. The percentage of the parboiling group exposed to the multimedia approach had an effect on the applied knowledge task ($p=<0.0001$).*

The most preferred multimedia approach were illustrations, while the least preferred was audio narration.

Practical implications: *Multimedia approaches to technology transfer can effectively reach large audiences and should be designed for the target audience. They should be made available and accessible to enable learning and technology transfer. Illustrations can be effectively used to transfer technology since the information can be delivered visually, overcoming issues of illiteracy.*

Originality/value: *Of the few studies conducted in this field, this study aimed to evaluate the differences in effectiveness between various multimedia approaches, rather than simply against traditional in-person interactions.*

KEY WORDS: Agricultural Extension, Technology Transfer, Multimedia Learning, ICT, Education, Video, Illustrations, Song, Audio

5.2 INTRODUCTION

Development of new technologies are typically designed to improve specific aspects of a process for target applications and users. The technological information must be effectively communicated to the target audience in order for technology adoption to occur. Within the agricultural context in developing countries, traditional technology transfer consists of in-person training and visits between agricultural extension agents and farmers. However, the rate of technology transfer from research centres to farmers is limited; low ratios of extension agents to farmers can explain this restricted reach of beneficiaries (Shanthy and Thiagarajan 2011). Currently, the two major challenges in agricultural technology transfer are the issue of scaling-up communication, while doing so at a reasonable cost (Aker 2011).

Multimedia approaches can be used to overcome these challenges since such educational products can be created, incurring costs only once, yet remaining available for countless consultations through information and communication technologies (ICTs). Given that ICTs are used globally by a large portion of the population, multimedia approaches can increase efficiency of technology transfer (Feng et al. 2005, Ramkumar et al. 2007). Learning theories can be drawn upon to justify the use of innovative multimedia learning approaches for effective technology transfer (Chin, Kok, and Ngadi 2015 under review). Knowledge acquisition, as stipulated in dual coding theory, occurs via two sub-systems that process inputs: a verbal and an imagery sub-system. Multimedia by definition includes multiple media elements, therefore, the delivered audio and visual information from these multimedia products can be processed by the brain's separate sub-systems (Mayer, Heiser, and Lonn 2001). Using multimedia as a vehicle for technology transfer has a great potential to include interesting information in the presentation of new concepts; emotional interest theory posits that under those circumstances, one is more likely to enjoy learning, be emotionally involved in the learning process which increases overall cognitive processing (Harp and Mayer 1997). More cognitive processing can translate into greater understanding of the technologies, and therefore higher technology adoption rates.

These interesting, multisensory products, can be designed to be accessed and used through various different types of ICTs. Information and communication technologies, especially mobile phones, are widely used across the globe, even in small villages; capitalizing on these ICTs as a mechanism to reach a wide audience can overcome the current limitations of in-person training sessions. An additional advantage of conducting technology transfer using multimedia through ICTs is the fact that the information is consistently delivered each time. In traditional agricultural technology transfer, there is the potential for human error to misinform the various target groups.

Another obstacle that multimedia approaches can overcome is the issue of hierarchy; whereas traditional in-person training sessions have limited numbers of participants who are typically selected from higher positions within the group hierarchy, technology transfer through multimedia can reach larger numbers of people, irrespective of hierarchical position, at any given time (Zossou et al. 2009).

There are few studies about multimedia approaches to agricultural technology transfer (Moussa et al. 2011). Those that have been conducted have typically compared one media product, such as video or radio, against the traditional technology transfer methods. The media approaches have shown greater effectiveness in the number of beneficiaries reached, adoption rates, knowledge gain, information sharing and general overall technology transfer (Zossou et al. 2009; Shanthy and Thiagarajan 2011). Since individual media products have been shown to be beneficial in technology transfer, it would be expected that *multi*media products with several media components would yield effective technology transfer as well. Therefore, the objective of this study was to determine the differences in effectiveness of technology transfer between four multimedia approaches: video, audio narration, song and illustrations. It is hypothesized that the conclusions with respect to the effectiveness of the individual media approaches could be additive in nature so that several media elements can be presented conjointly in order to create a truly effective multimedia approach to technology transfer.

5.3 METHODOLOGY

This work was conducted under a research partnership established between McGill University and the AfricaRice Centre through the project titled “Enhancing food security in Africa through the improvement of rice post-harvest handling, marketing and the development of new rice-based products”, whereby post-harvest handling included parboiling of rice paddy. More specifically,

this study aimed to address the project objective to develop multimedia products to enhance transfer of technology to appropriate stakeholders, including rice processors. The study was conducted in the activity region of the AfricaRice – McGill project in the Collines Department in Benin. The AfricaRice Centre, located in Benin, was responsible for engaging the NGO, the extension worker, and for facilitating the selection of villages for the study, described in further detail below.

5.3.1 TECHNOLOGY FOR TRANSFER: DRYING TABLE FOR PARBOILED RICE PADDY

The technology to be transferred that served as the content of the multimedia products in this particular study was a drying table for parboiled rice paddy. Rice paddy parboiling is a pre-cooking process whereby steam is used in order to retain the nutritional qualities and improve the storage properties of the rice. The parboiling process consists of washing the paddy rice, soaking it overnight, steaming it for a short period of time and then drying it before it is ready for further processing or storage. The current method of drying parboiled rice paddy in rice-producing and rice-processing developing countries, such as Benin in West Africa where this study was conducted, generally consists of spreading the wet rice paddy on a tarpaulin that is laid upon the ground. However, the proximity of the parboiled rice paddy to the ground can easily result in impurities, such as dust and stones, being mixed into the rice. Stray animals can also easily access and eat the parboiled rice, or defecate on it. These physical impurities can hinder further processing, namely milling, decrease the overall quality of the rice and consequently, decrease its market value. Losing parboiled rice to animals through this current drying method also decreases the total anticipated revenue from this value-added processing.

In order to overcome these obstacles, a drying table for parboiled rice paddy was designed and built by the project team. Its dimensions were 1.5 meters wide, 3.7 meters long and 1 meter

high in order to carry a capacity of 50 kg of parboiled rice paddy, which represented one batch of parboiled rice paddy in the overall project system. This simple and yet effective technology raises the height at which the parboiled rice paddy dries which decreases the likelihood of impurities being introduced into the rice, and of losing parboiled rice due to animal consumption. Details of the advantages, characteristics and operation of the drying table are summarized in Table 1.

Table 1. Characteristics of drying table for parboiled rice paddy

	Details of the Drying Table for Parboiled Rice Paddy
Materials	It can be made from wood which is a locally available material, using local labour.
Design Characteristics	The drying table is designed to be approximately 1 m high, at about the height of one's hips in order to decrease the accessibility of the drying parboiled rice paddy to animals, while being ergonomic for the user since this height still provides ease of reach of the rice paddy.
	The table has a slight incline in the surface along the length of the table of about 2 degrees, with an exit door at the lower end to easily remove the dried parboiled rice paddy.
	There are short walls around the edge of the table that are designed to retain the parboiled rice paddy during drying.
	The dimensions of the drying table can be determined based on the desired quantity of parboiled rice paddy to be dried over a 2-cm thick layer.
	The drying surface of the table is flat and uniform upon which a tarpaulin should be placed in order to uniformly spread the wet parboiled rice paddy.
Operation	The tarpaulin used on the drying table can be a black plastic sheet that can absorb and radiate solar heat to dry the parboiled rice paddy, or a material made from natural fibres such as jute which can enable aeration and drying to occur throughout the parboiled rice paddy.
	In order to encourage uniform drying of the parboiled rice paddy, it should be stirred at 30-minute intervals and can be done by hand or with a simple tool such as a plank of wood or small rake.

5.3.2 DESIGN OF MULTIMEDIA APPROACHES

The four multimedia approaches— video, audio narration, song and illustrations—were designed to transfer the technology of the drying table for parboiled rice paddy by describing the above-mentioned characteristics, advantages and operating instructions. This study was conducted in Benin where rice is produced and parboiled; therefore, these multimedia approaches were designed for a target audience of rice producers in the French- and Idatcha-speaking country. A local singer-songwriter, a local illustrator and a local translator were identified by the authors and research team and were commissioned to produce these multimedia products in conjunction with the authors.

The video was produced by one of the authors (Chin) who recorded video footage at the AfricaRice Centre in Benin during the construction of the drying table. Local carpenters were involved in the construction and therefore appeared on-screen. A storyboard was created whereby the narration was developed to complement the visual information conveyed. The narration was first recorded in French, and then translated into the local dialect of Idatcha and inserted into the video (Appendix 8.1 Narration in Video and Audio Media Products). An advantage of using video as a medium through which to transfer technology is illustrated by the fact that locally-appropriate language audio tracks can be easily substituted into the original video. Videos can therefore potentially reach a large audience since the visual presentation of technological information can remain consistent while simply inserting any number of appropriate language tracks depending on the target audience.

The audio narration was the audio file extracted from the video; thereby containing the exact same information as the video, in the local dialect (Appendix 8.1 Narration in Video and Audio Media Products). Audio narration was a media approach included in the study since the aural nature resembles that of radio which is a typical means of information dissemination to farmers in developing countries. The verbal nature of information delivery is very similar to everyday conversations, making it an accessible method of communication for all audiences (Abdul Kargbo 2008).

The song was composed by the local singer-songwriter and the illustrations were created by the local illustrator and his team, based on verbal and written exchanges between the respective artists and the authors. These artistic methods were chosen for inclusion in this study since they have not been thoroughly examined as a method of technology transfer, yet have the potential to effectively convey messages (Curtis 2011). The goal of the research was described to the artists,

including: the drawbacks of the current method of drying parboiled rice paddy; the new drying table technology for parboiled rice; the characteristics, advantages and operating instructions of the drying table, and of equal importance, the fact that their respective media product was to be tested for its effectiveness in technology transfer.

The singer-songwriter composed the song whereby he created a story, incorporating a few characters (Appendix 8.2 Translation of Song). It was composed in the local traditional style of music, in the local dialect. The song was explained to the authors who evaluated it for clarity, content and delivery in order to ensure accuracy before the approval of the final product.

The illustrator and his team developed fictitious characters through which to convey the technology. The illustrations included textual dialogue which was written in the national language of Benin: French. The choice to include textual information in French was taken since it is the language that is taught in the educational system throughout the country. Correspondence occurred between the illustrator and the authors in order to ensure appropriate accuracy of the technical information before the approval of the final product (Appendix 8.3 Illustrations). The illustrations were done by hand, in colour, and then made available as an electronic file. Hard copies of the illustrations were used for the study; each illustration was printed on an A5 sheet of paper and laminated in order to increase its durability.

5.3.3 STUDY DESIGN

The study was conducted in the Collines Department of Benin which is a rice-producing and rice-processing region. Three villages were randomly selected to participate in this study: Dassa, Iléma and Zankoumandon. The randomization procedure selected villages that are representative of the overall study region, accounting for both the geographic dispersion from the main city of such rice

producing and processing regions, as well as the range of membership sizes of women's parboiling groups. Women's parboiling groups are organizations that work collectively with the goal of generating revenue through this value-added processing; they are often self-organized, with elected executives, shared financial and material resources, whom carry out rice processing as a group and hence share in the profits, some of which are reinvested into the group. Within each of the three villages, three women from each of four women's rice parboiling groups were randomly selected. The four multimedia approaches—video, audio narration, song and illustrations—were each randomly assigned to one of the four women's rice parboiling groups per village. Although this experimental sample size was small, it was determined to be of sufficient statistical power having met the minimum number of replicates required, and was limited primarily due to time constraints posed in carrying out the fieldwork.

5.3.4 DATA COLLECTION AND ANALYSES

The AfricaRice Centre coordinated the hiring of a local agricultural extension agent from an NGO with whom there is an existing, strong agricultural extension partnership. This local agricultural extension agent was responsible for scheduling meetings between the authors and study participants, and for providing translation services. All of the women's parboiling groups had prior, established relationships with this NGO and AfricaRice. They had previously received extension services from both the NGO and AfricaRice and they have always been keen to learn about new technologies. Therefore, they accepted the invitation from the NGO and AfricaRice to participate in this study without hesitation. The objective of the study was explained to the participants and informed consent was obtained for participation in the study (Appendix 8.4 Consent Forms). A socio-demographic survey was conducted on an individual basis. Three

measures of effectiveness of the multimedia at technology transfer were collected using: a knowledge questionnaire, an applied knowledge task, and a preference survey.

The knowledge questionnaire consisted of multiple choice and true or false questions pertaining to the information presented through the multimedia approaches about the drying table for parboiled rice, for a total possible score of 28 points. The knowledge questionnaire was administered prior to exposure to a multimedia approach in order to evaluate one's level of knowledge about drying of parboiled rice paddy, including the drying table. The resulting score was the pre-media knowledge score. Each of the randomly assigned multimedia approaches were presented to the participants of the respective parboiling groups. A copy of the respective multimedia product was given to each of the parboiling groups to share with the rest of their group members. The participants were informed that they would be re-evaluated about a week and a half later on what they had learned from these multimedia products. The same knowledge questionnaire was then re-administered in order to determine a post-media knowledge score. A change in knowledge score between the pre- and post-media scores was expected to represent a change in knowledge level about the drying table; a higher gain in knowledge score was interpreted to signify a greater effectiveness of technology transfer, hypothesized to be due to the multimedia approach. An ANOVA was conducted to determine the statistical significance of effects on this change in knowledge level.

The applied knowledge task that was used to evaluate the effectiveness of the multimedia approaches consisted of asking the parboiling groups to have a drying table constructed based on the information learned from the multimedia products. Sufficient financial resources were made available to cover the cost of building a drying table to ensure that it was completed before the planned subsequent follow-up. The resulting tables were then evaluated and scored based on a set

of criteria that were expected to be found within the drying table, for a total possible score of 15 points.

After the post-media knowledge score was obtained, all of the participants were exposed to all four of the multimedia approaches. A preference survey was conducted in order to see which of the multimedia approaches was most preferred by the participants; it was hypothesized that a well-received multimedia approach may contribute to its effectiveness at transferring technology. Feedback about the choice of preferences was also obtained.

5.4 RESULTS AND DISCUSSION

5.4.1 PROFILE OF THE RESPONDENTS

The majority of the women were between 31-50 years of age (77.7%) with the 41-45 year age range having the greatest number of women (22.2%). Almost half of the women had no formal education (47.2%), while the most educated women had received 9 years of formal schooling (11.1%). All of the women spoke the local dialect of Idatcha, 72.2% spoke Fon and 44.4% spoke French. About a third of the women were able to read and write in Idatcha (38.9%) and French (33.3%), while almost half of the women were illiterate (47.2%). All of the villages surveyed had electricity and 83.3% of the parboiling groups reported having good roads that connect their respective villages to others.

In addition to rice parboiling as a source of revenue of which all women were involved, 69.4% of women are also rice producers. Amongst the parboiling groups, 75% of them used improved parboiling equipment which includes a parboiling insert. The average number of years of parboiling experience was 14.4, with a range of between 2 and 40 years. The number of years of existence of the parboiling groups ranged from 2 to 25, averaging 7.8 years, and an individual's membership in a parboiling group ranged between 2 and 14 years and averaged 6.7 years. The

majority of the parboiling groups currently dry their parboiled rice paddy on a tarp on the ground (83.33%), while the rest use a raised concrete drying area.

The women were surveyed for information and communication technology (ICT) ownership in order to evaluate the relevance of multimedia approaches to technology transfer. Almost all of the women own a mobile phone (86.1%), the majority own a radio (66.7%) and media player such as a CD or DVD player (66.7%), more than half of the women own a television (58.3%), while none own a computer. Most of the women that do not own the above-mentioned ICTs, excluding computers, do have access to them through friends or family.

Most of these socio-demographic parameters were homogeneous across multimedia treatments and villages. The baseline characteristics that were significantly different amongst the multimedia treatment groups were: the use of improved equipment (p=0.0014), good roads (p=0.0002), radio ownership (p=0.0244), parboiling experience (p=0.0125), age of parboiling group (p=<0.0001), and years of membership in a parboiling group (p=<0.0001). Amongst the villages, parboiling experience (p=0.0494), age of parboiling group (p=<0.0001), and years of membership in a parboiling group (p=<0.0001) were also significantly different, as well as the pre-media knowledge score (p=<0.0001).

5.4.2 EFFECTIVENESS OF THE MULTIMEDIA APPROACHES

5.4.2.1 KNOWLEDGE GAIN The overall change in knowledge score between the pre- and post-media knowledge scores ranged from 10.71 to 28.57% and averaged 17.54%. The results of the change in knowledge score between pre- and post-media knowledge scores by multimedia treatment are listed in Table 2. Two participants were absent during the administration of the post-knowledge questionnaire due to illness. Two effects that were statistically significant on the

change in knowledge score were village and the linear and quadratic effects of the number of times that an individual consulted the multimedia product. Since the parboiling experience, age of the parboiling group, years of membership in a parboiling group and the pre-media knowledge score were significantly different amongst villages, as noted in the profile of respondents, it can be understood that these varying levels of exposure to and experience in parboiling may have an effect on one's comprehension of new parboiling-related technology (Table 3). Therefore, it can be reasoned that multimedia approaches should be designed with the target audience in mind, taking into account their level of familiarity with the overall concepts and adjusting for the amount and type of information provided.

Table 2. Overall average knowledge score data

	Video (n = 7)		Audio narration (n = 9)		Song (n = 9)		Illustrations (n = 9)	
Knowledge level	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Pre-score	71.43	1.91	70.24	3.76	68.25	8.49	69.45	2.97
Post-score	86.74	3.15	88.49	1.49	86.51	4.38	87.30	1.68
Knowledge gain	15.31	3.68	18.25	3.55	18.25	6.32	17.86	1.68

Table 3. Overall knowledge gain by village

Village	Estimate of knowledge gain	Standard Error	Pr > | t |
1	14.7183	0.8475	<0.0001
2	21.8946	0.9237	<0.0001
3	16.1399	0.8645	<0.0001

The linear (p=0.0114) and quadratic (p=0.0368) effects of number of times that one consulted the multimedia product illustrates the increased effectiveness in technology transfer when the information is made available and accessible to the targeted beneficiary. The participants stated that they have never been provided with tangible resources after in-person trainings are

completed, and were therefore very appreciative of the multimedia products that were left with them to consult on their own terms, so that they could consolidate their learning and share these resources with others. Considering that the number of times that one consulted the multimedia product had a statistically significant effect on the change in knowledge score, and therefore technology transfer, it can be justified and encouraged that multimedia products should be made available and accessible to targeted beneficiaries. The availability and accessibility to these multimedia products does not necessarily require them to be free; it has been shown that targeted beneficiaries are willing to pay for information if it is thought to be of use (Okry, Van Mele, and Houinsou 2013).

Since there was found to be an effect of the village on the change in knowledge score, the effectiveness of the multimedia approaches was studied within the villages. There was an effect of multimedia on the change in knowledge score in one of the villages (p=0.0396), in which there happened to be the greatest initial and final scores, yet the smallest average change in score. The participants who were exposed to the illustrations had the greatest change in knowledge score (17.86%), followed by the audio narration (15.48%), song (13.10%) and video (12.50%) (Table 4). There were differences between illustrations and video (p=0.0894), and illustrations and song (p=0.0920). A reason for which illustrations yielded the greatest gain in knowledge score may be due to the fact that almost half of the participants were illiterate; although there was textual information on the images, the fact that the illustrations were clear, explicit and detailed provided a visual universal message that could be easily understood and interpreted. Illustrations can be made to include only the necessary information as compared to photographs or video shots; although the latter are still visual representations of information, they may contain superfluous or

irrelevant visual cues that may hinder the interpretation of the message (Medhi, Prasad, and Toyama 2007).

Table 4. Knowledge score data from Village 1

	Video		Audio narration		Song		Illustrations	
Knowledge level	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Pre-score	72.62	1.68	73.81	1.68	75.00	0.00	71.43	0.00
Post-score	83.93	1.79	89.29	0.00	88.10	1.69	89.29	0.00
Knowledge gain	12.50	1.79	15.48	1.68	13.10	1.69	17.86	0.00

The illustrations may have also yielded the greatest change in knowledge score since they were the most often consulted multimedia product; the participants who were assigned the illustrations consulted them, on average, 4.33 times, whereas the song was consulted 3 times, and the audio narration and video were each consulted twice. The convenience of having a physical copy of a multimedia product that does not require any external ICTs may have facilitated and encouraged the use of the illustrations, exposure to the information and hence increased knowledge gain and technology transfer. However, in order to maintain low costs during technology transfer by eliminating the cost of materials required for printing, laminating and distributing the illustrations, and while reaching an even wider audience, such illustrations can be made available digitally. The facility through which the participants were able to access the hard copy illustrations could potentially be achieved by providing digital versions that could be accessed, viewed and shared via mobile phones. The reality of the reach of global ICT use can be portrayed by the fact that the vast majority of the participants in this study personally owned a mobile phone (86.1%) and others had access to one through friends or family. In addition, the sense of community within a village can facilitate sharing of ICT resources, enabling access to multimedia approaches to a greater number of people (Reitmaier, Bidwell, and Marsden 2011). Creating illustrations that are

available electronically may be a viable way of reaching a large audience at a reasonable cost to effectively transfer technology.

5.4.2.2 APPLIED KNOWLEDGE TASK: CONSTRUCTION OF A DRYING TABLE The study participants brought their assigned multimedia products back to their respective parboiling groups to share the newly acquired resource with the rest of their group, in order to have a drying table constructed based on the given multimedia information. All of the constructed drying tables were commissioned to local carpenters. The participants had shared their multimedia products with their respective groups before commissioning their drying table. The orders were first placed and explained by the participants to the carpenter, and all of the parboiling groups suggested that their hired carpenter consult the multimedia product that they were given. The scores of the constructed drying tables ranged from 85.71 to 100% and averaged 98.91%. The percentage of the parboiling group that was exposed to the multimedia product had a statistically significant effect (p=<0.0001) on the score of the constructed table. This exposure to the multimedia approach was a direct result from the fact that the participants were given a physical copy of their respective multimedia product which enabled sharing of information, as was the cause for the change in knowledge score due to the number of times that one consulted it. Multimedia approaches to technology transfer were able to reach a larger number of beneficiaries than the in-person interactions between the agricultural extension agent and the women since the multimedia products were provided to the participants who then shared them with their colleagues and friends.

5.4.2.3 USER-PREFERENCE SURVEY The most preferred multimedia approach was the set of illustrations (Figure 1). Reasons for which illustrations were most preferred include feedback from participants who indicated that they appreciated the visual aspect of learning; the illustrations were clear and explicit in the information delivered. One of the participants stated that even though she

did not have any formal schooling, the illustrations enabled her to easily understand the message. Illustrations therefore have a large potential to reach a wide audience, including those who are illiterate, since the message can be easily understood via the visual representation of the information. An additional reason for the preference of illustrations included the fact that no external media players or ICTs are required to consult this multimedia product, as compared to the other multimedia approaches presented. The illustrations can be easily transported, consulted and shared with others. The physical quality of the illustrations were appreciated for their durability since they were laminated in plastic, making them a multimedia product that the participants think will last a long time, keeping it available to consult. Nonetheless, as discussed above, such illustrations can be made available digitally in order to reach an even larger audience who might access them through their mobile phones, which would decrease the costs related to producing physical copies.

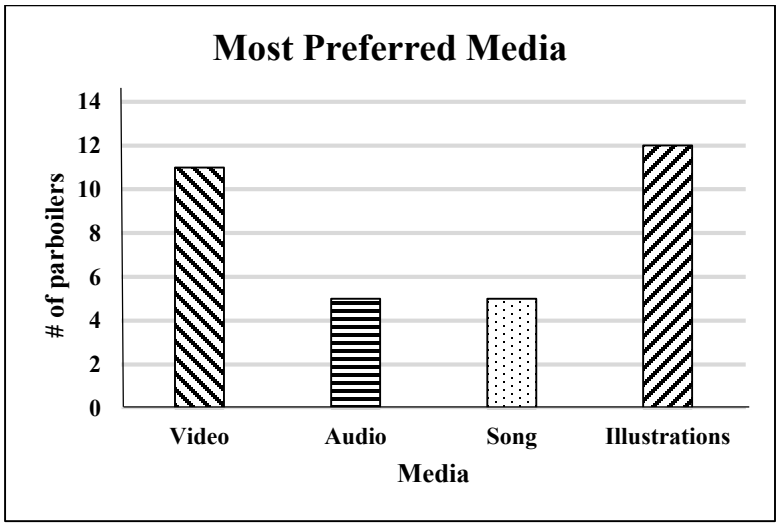

Figure 1. User preference: most preferred multimedia approach

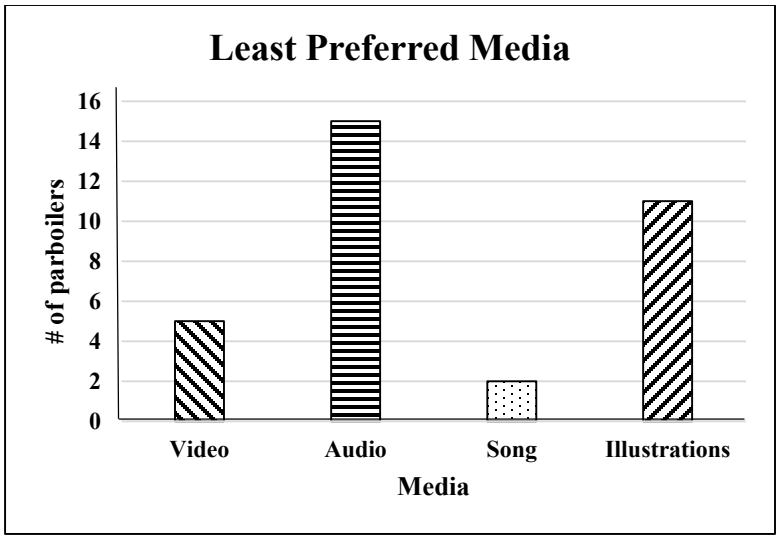

Figure 2. User preference: least preferred multimedia approach

The least preferred multimedia approach was the audio narration (Figure 2). The most often cited reason for this lack of preference was due to the fact that such an audio narration—presented to the participants as if it were a radio broadcast—was the issue of timing. The participants envisaged that radio broadcasts may not always coincide well with their schedule, thereby reducing the chances that they become exposed to the new information. Recording a radio broadcast for future consultation was reported to not be a possibility due to their resources, as compared to the possibility to do so for songs and videos. In order to overcome this perceived challenge, it is proposed that a recording be made available for listeners to acquire; this can provide more flexibility in accessing the information (van Mele, Salahuddin, and Magor 2005). Some examples of possible mechanisms through which to reach listeners include: making the recording available online for download which can be accessed on an individual basis, or downloaded by an individual and then shared with others; or, CDs can be created and made locally available.

Although the audio narration was the least preferred multimedia approach, those whom appreciated it noted their appreciation for the fact that was in the local dialect; generally, training

sessions with agricultural extension agents are conducted in the national language of which not all participants are as comfortable. This appreciation for information in the local language was also noted for the video and song. Given that multimedia approaches can reach a wide audience without requiring numerous in-person interactions, producing them in the local language is a small investment that can yield great results: better comprehension and increased technology transfer.

The appreciation of multimedia approaches, as an approach to technology transfer, were evaluated against the traditional agricultural extension method of in-person interactions. The vast majority of the participants appreciated these multimedia approaches better than in-person interactions (75%), while 8.33% of the participants appreciated in-person training sessions better since one could ask questions directly to the agricultural extension agent. The reasons for appreciation of the multimedia approaches were addressed above and are namely that they were in the local language and they were made available and accessible. The usefulness that some participants noted in having one's questions answered is important and should not be disregarded with the use of multimedia approaches to technology transfer. Traditional in-person visits by agricultural extension agents can be made to follow-up on the adoption of new technology whereby any questions can be answered; although there may still be in-person visits, the advantage of using multimedia as a primary means of technology transfer is that the information can be communicated at a larger scale and faster rate than in-person exchanges. An alternative solution to enabling questions to be answered can be to capitalize on ICTs as a method of two-way communication rather than just one-way. Targeted beneficiaries can be encouraged to use their available ICTs, namely mobile phones, to call their agricultural extension agent in order to have any required information clarified; although this approach would be the equivalent of an individual consultation, there is the potential that the agricultural extension agent could interact with more beneficiaries

than would be possible in-person. Multimedia approaches to technology transfer have shown to be appreciated and can be used to reach a larger audience.

5.5 CONCLUSION

The multimedia approaches studied—video, audio narration, song and illustrations—were found to have an effect on knowledge gain and therefore overall technology transfer. Illustrations yielded the greatest change in knowledge score, within a village where the multimedia approach had a significant effect, followed by audio narration, song and video. Visual images can overcome issues of illiteracy by conveying messages through clear depictions. Overall, multimedia approaches to technology transfer are able to reach a larger audience than in-person interactions, and yield increases in knowledge and technology transfer. Therefore, in order to improve livelihoods through technology transfer, multimedia approaches can be effectively used. A future study could be conducted with a much larger sample size in order to more confidently draw conclusions about the effectiveness of the various multimedia products used to transfer technology, beyond the limitations of the results seen in only one of the villages studied.

These four multimedia approaches were evaluated independently with the supposition that the studied effects of technology transfer may be additive in nature. It might be useful to evaluate various combinations of the multimedia approaches in order to optimize the effects of various visual and audio components of which an ideal multimedia approach can be composed. Another question that can be addressed in a future study may be the effect of the presentation of the technology; while all four multimedia approaches contained the same facts, the methods of presenting the information were different since some included procedural information while others used stories.

5.6 ACKNOWLEDGEMENTS

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6.0 CONCLUSION

The current challenges in agricultural technology transfer, that is, the scale-up of communication at a reasonable cost, can be overcome through the use of innovative multimedia learning approaches as illustrated from the results of this study. The goals of creating and testing a framework whereby multimedia approaches are used for effective technology transfer, which is supported by learning theories and information and communication technology availability, were achieved.

It is suggested from the results of the testing of multimedia approaches to technology transfer that such multimedia products be designed for the target audience, and be made available and accessible to the targeted end-users. An individual's knowledge gain, which is a measure of the effectiveness of technology transfer, is influenced by one's exposure to the multimedia product which is a direct result of being able to access it. Sharing of the available and easily accessible multimedia products also positively affected the ability to apply one's newly-gained technical knowledge. Providing the multimedia products in the local dialect was strongly appreciated by the study participants; a greater number of targeted end-users can be effectively reached through the use of local dialects since the national language is not always well understood. Including locally relevant dialects in multimedia approaches to technology transfer is a small investment that could lead to improved comprehension and overall increased technology transfer. This study yielded interesting initial results; although it was limited in scope, a future study of similar design with a greater sample size could strengthen these conclusions about the effectiveness of multimedia approaches to technology transfer.

As the presence of information and communication technologies continues to expand globally, multimedia approaches to technology transfer can be an effective means through which to reach a wider audience than in-person interactions. Greater numbers of targeted end-users reached through easily understandable information can lead to increased technology transfer and adoption which can improve their livelihoods.

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8.0 APPENDICES

8.1 NARRATION IN VIDEO AND AUDIO MEDIA PRODUCTS

Intro

Parboiled rice is a nutritious food. People like parboiled rice since it has a good taste, a pleasant odor and is nutritious. In addition to producing a nourishing rice, parboiling rice paddy can be a revenue generating activity.

However, the drying process of parboiled rice paddy can be improved in order to increase the quality. In this video, we will learn about an improved method for drying the parboiled paddy. The technology is a drying table.

After parboiling is complete, the rice paddy must be thoroughly dried before being husked. Parboiled rice paddy is drained first before being spread out for drying. Traditionally, drying of parboiled rice paddy is done on the ground, either on a tarp or a slightly elevated concrete drying area. Since the parboiled rice paddy is at ground level, impurities such as pebbles can be mixed in. Moreover, animals can easily approach it and eat it or leave feces, which would diminish the quality. These impurities require additional sorting after drying.

Proposed solution

To avoid these contamination problems, losses and additional sorting of parboiled rice paddy, a drying table can be used. To build the drying table, we need local materials, such as wood. You will need:

-wood for table legs
-timber for the frame, the crossbeams and the walls
-plywood for the drying area
-a tarp to cover the drying area, and
-nails to attach the pieces together.

The drying table that we will build in this video will be able to withstand approximately 50 kg parboiled paddy rice, spread on a layer about 2 cm thick. The drying table will be about 1 meter high, 1.5 meters wide and 3.7 meters long. The same principles can be used to build your own drying table of a size that is well suited to your production of parboiled rice paddy. The drying table should be of appropriate height, out of reach of animals and away from impurities. In order for the table to be at a good height, the legs of the table should be about 1 meter high.

The drying table should be have a door on one of the widths, enabling the parboiled rice paddy to be easily removed after drying. To facilitate the collection of parboiled rice paddy, the drying table should have a slight slope to direct the parboiled rice paddy to this door. To create this slope, one end of the table should be a little shorter. This side should measure 85cm high.

To provide stability to the table, there should be wooden crossbeams. These crossbeams should be nailed horizontally between the legs to support them. To align the crossbeams, slots can be made in the legs before these pieces are fastened together.

The timber should then be used to create the frame of the table. To create the frame, 2 pieces of timber measuring 1.5 meters each are required for the width and 2 pieces measuring 3.7 meters are required for the length. To increase the stability of the table, there should be crossbeams made out of planks. These crossbeams should be placed diagonally and fixed between the legs and the frame of the table.

To create the drying area, plywood should be nailed onto the frame. Plywood should cover all the space in the frame. For this drying table, plywood should cover the area of 1.5 meters by 3.7 meters.

The drying table should have walls all around to prevent parboiled rice paddy from falling. The walls should have the same dimensions as the frame. The walls should be high enough to maintain the parboiled rice paddy on the table and should therefore measure between 5 and 10cm high. The walls should be nailed to the frame.

As mentioned earlier, there should be a door in one of the widths of the table to facilitate the collection of parboiled paddy. The opening of the door should be made on the same edge of the lower side of the table. During drying of parboiled rice paddy, the door opening should be blocked to prevent the rice from falling. During the collection of parboiled rice paddy, the door could then be removed to get the rice.

Operating instructions

The drying table should be covered with a tarpaulin on which parboiled rice paddy would be spread to dry. The sheet could be made of natural fibers to facilitate aeration, otherwise black plastic to transfer heat from the sun to dry the parboiled rice paddy. The tarpaulin should be a little larger than the drying area to facilitate the collection of parboiled rice paddy. The sheet should be attached to the table with ropes to prevent it from flying away. The edges of the drying table can be drilled, and these holes can allow the ropes to be tied.

Similarly to the traditional drying method of parboiled rice paddy on the ground, on the drying table, parboiled rice paddy should be spread over a layer of about 2 cm thick. Parboiled paddy should be stirred at a frequency of about 30 minutes to encourage even drying. In addition, the drying table should be of a height that facilitates the work: parboilers no longer have to bend over to stir the parboiled paddy. To be able to stir all of the parboiled rice paddy on the table, tools like small pieces of wood can be used to reach it.

Summary and Conclusion

Here is the drying table for parboiled rice paddy! Let us recall what we have learned about the drying table.

After parboiling, the rice paddy needs to be well dried. Instead of drying near the ground, as is traditionally the case, the drying table can be used to avoid problems associated with this traditional

practice. The drying table can reduce the chances of contamination of parboiled rice paddy with pebbles and animal feces. There may be fewer parboiled rice paddy losses since animals should not have easy access to it. Consequently, with fewer impurities, sorting of the dried parboiled paddy should be easier.

This drying table can be made of local materials, such as wood. The table consists of wooden legs high enough to avoid contamination of impurities from the ground and animals. The legs should be between 85cm and 1 meter high. The table should have a frame made of timber to support the drying area. The wooden crossbeams are used to reinforce the table. The walls along the edge of the table are meant to prevent parboiled rice paddy from falling. The plywood drying area is used to support the spread out parboiled rice paddy.

The table should have a door to facilitate the collection of parboiled rice paddy. The table should have a slight slope to lead the parboiled rice paddy toward the door, therefore one side of the table should be a bit shorter than the other. One side should measure 1 meter high and the other 85cm.

The drying table should be covered with a tarpaulin that is slightly larger than the drying area. The tarpaulin can be made from natural fibers to allow aeration and drying, or black plastic that could transfer heat from the sun to the parboiled rice paddy to dry it. The tarpaulin should be attached to the table so it does not blow away.

Parboiled rice paddy should be stirred at a frequency of 30 minutes to encourage even drying. Since the drying area is raised, you would not have to bend down to stir the parboiled paddy. In addition, a small piece of wood can be used to reach and stir all of the parboiled rice paddy on the drying table.

The drying table for parboiled paddy rice has several advantages compared to the traditional drying method. The drying table can be easily built with local materials. The drying table should prevent large quantities of impurities into the parboiled rice paddy and should then enable you to get parboiled rice paddy of a better quality.

8.2 TRANSLATION OF SONG

The song describes the characteristics of the drying table and its advantages.

Have you heard the father Codjo?

Have you heard the mother of Codjo?

A drying table for parboiled rice paddy has arrived.

And everyone must have it.

So that our parboiled rice paddy no longer has impurities

And for stones to remain far.

It's an advantage for all parboilers.

My parboilers, spread the news to your colleagues.

I tell you to inform all parboilers.

And those who have heard, inform the others.

It is this drying table that will help others appreciate the value of our rice.

This drying table for parboiled rice paddy is made with our local materials.

It is raised and covered with plywood.

It is slightly inclined.

It has borders to prevent the parboiled rice paddy from falling.

It is covered with a tarpaulin.

The advantages:

This table allows us to be free and also allows all parboilers to go about other daily obligations after drying parboiled rice.

This drying table for parboiled rice paddy enables the rice to be protected from animals such as sheep, goats, chickens, etc.

It allows the rice to be free of impurities.

It makes it possible for the huller machine to do its job easily.

It enables us to have a good quality rice.

8.3 ILLUSTRATIONS

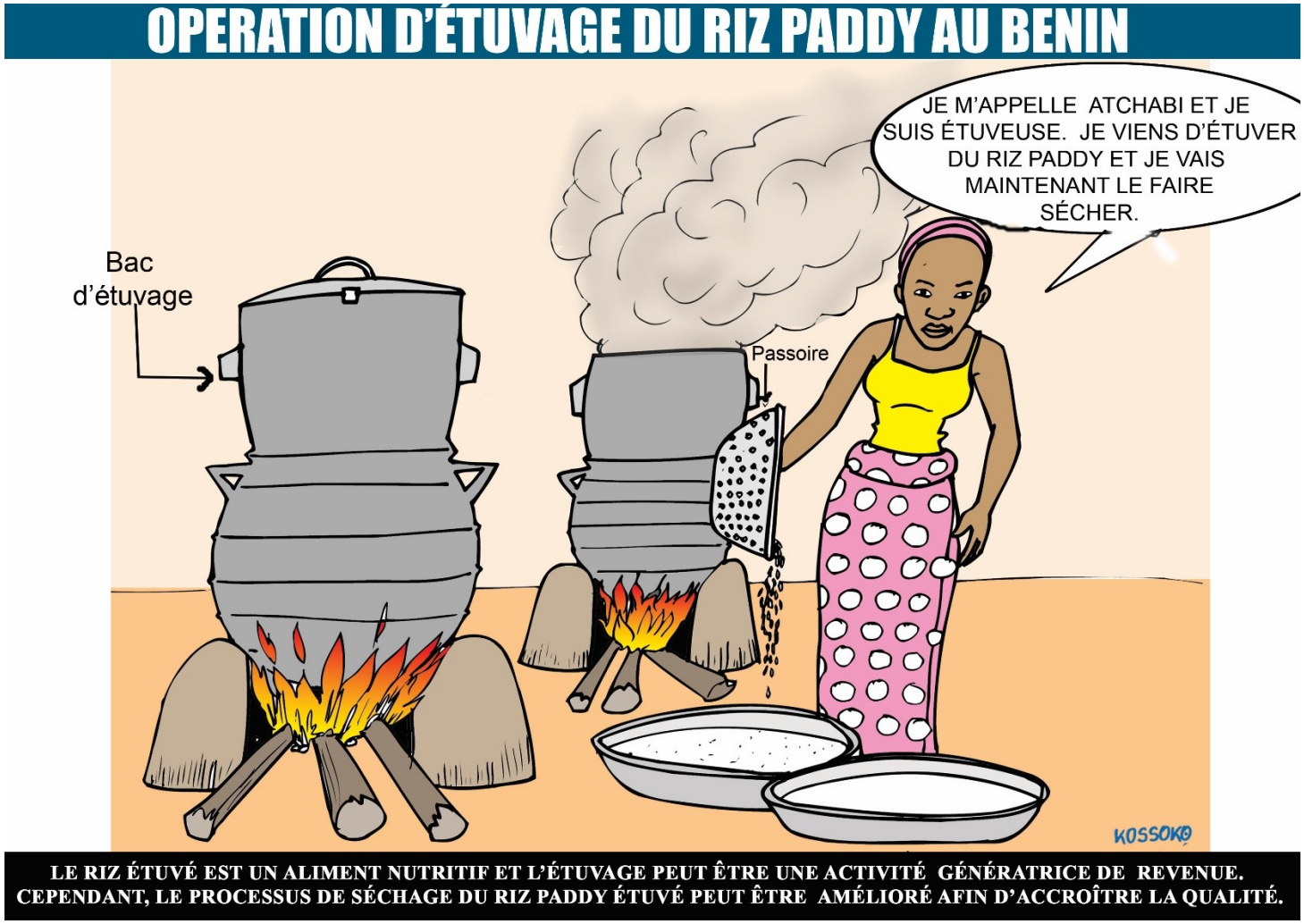

Image 1. Rice paddy parboiling

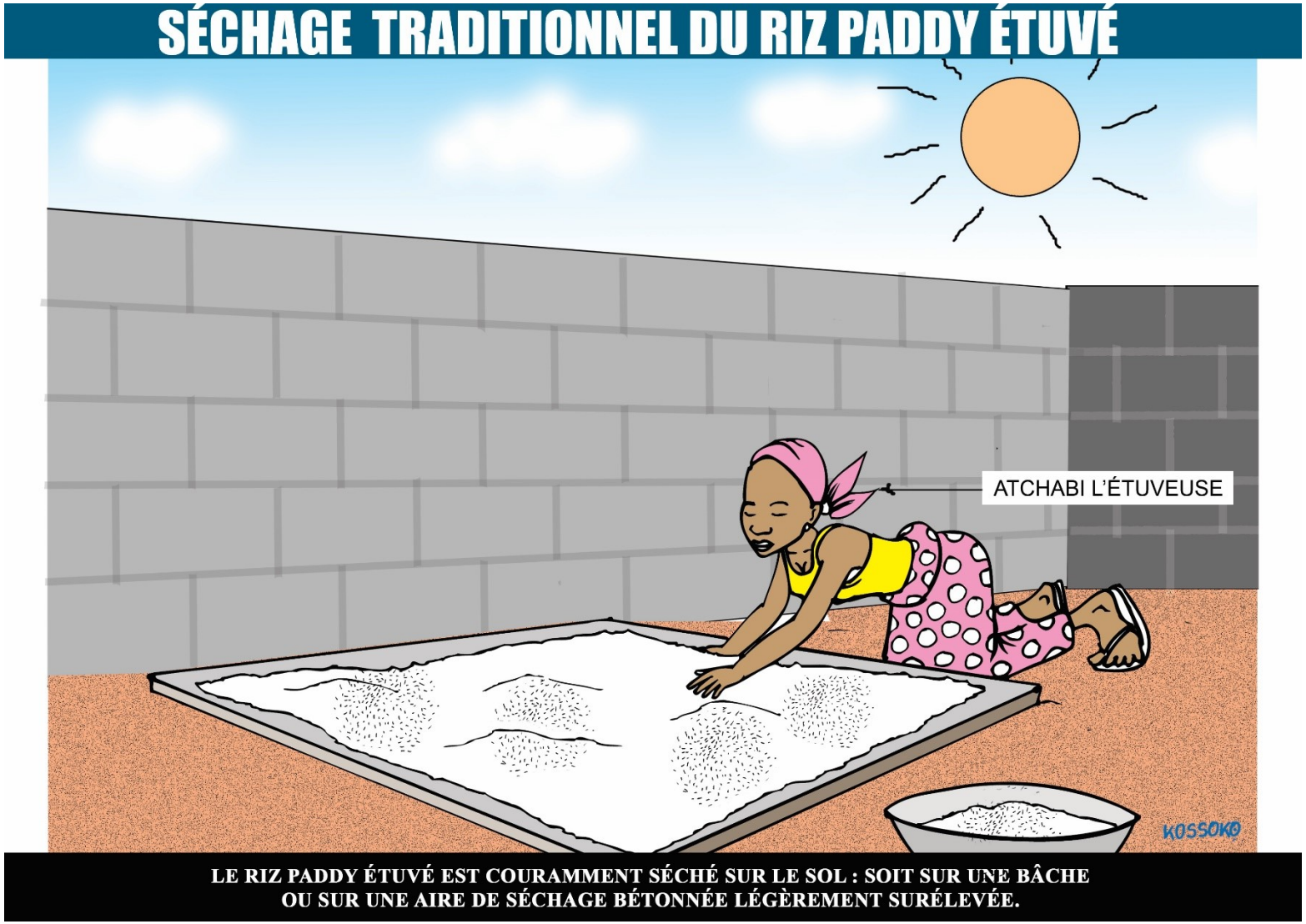

Image 2. Traditional drying method of parboiled rice paddy

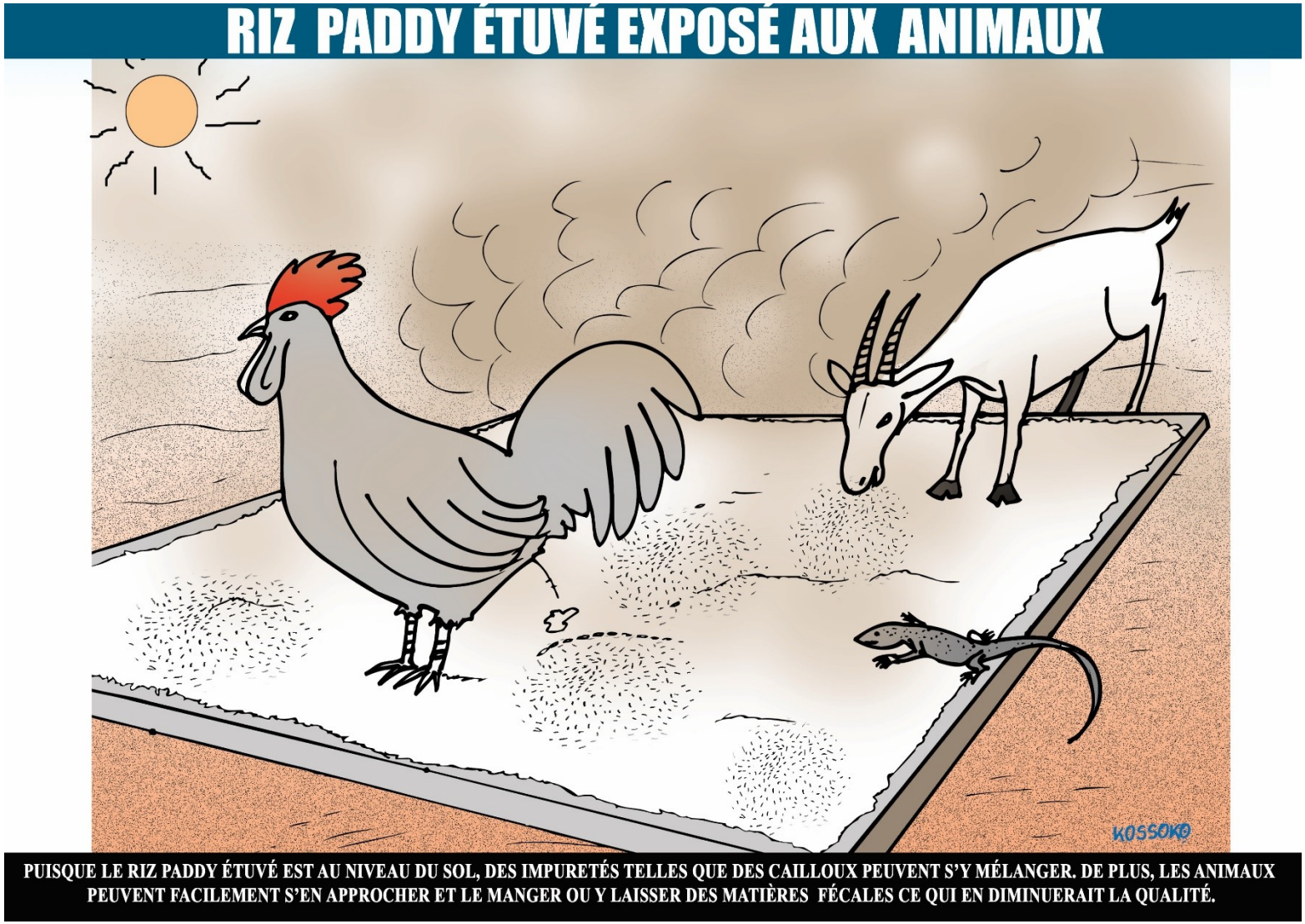

Image 3. Parboiled rice paddy exposed to impurities

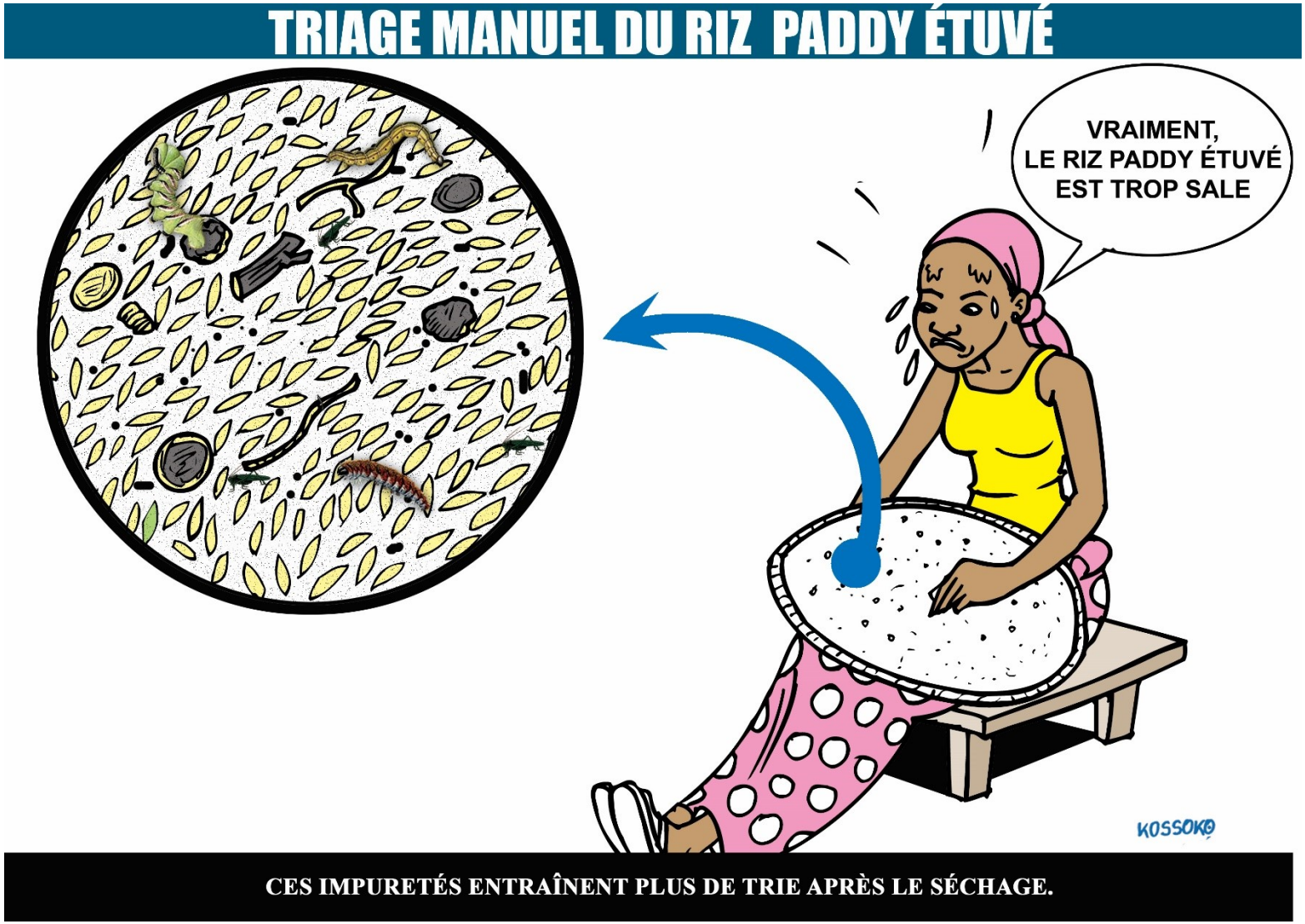

Image 4. Manual sorting of parboiled rice paddy

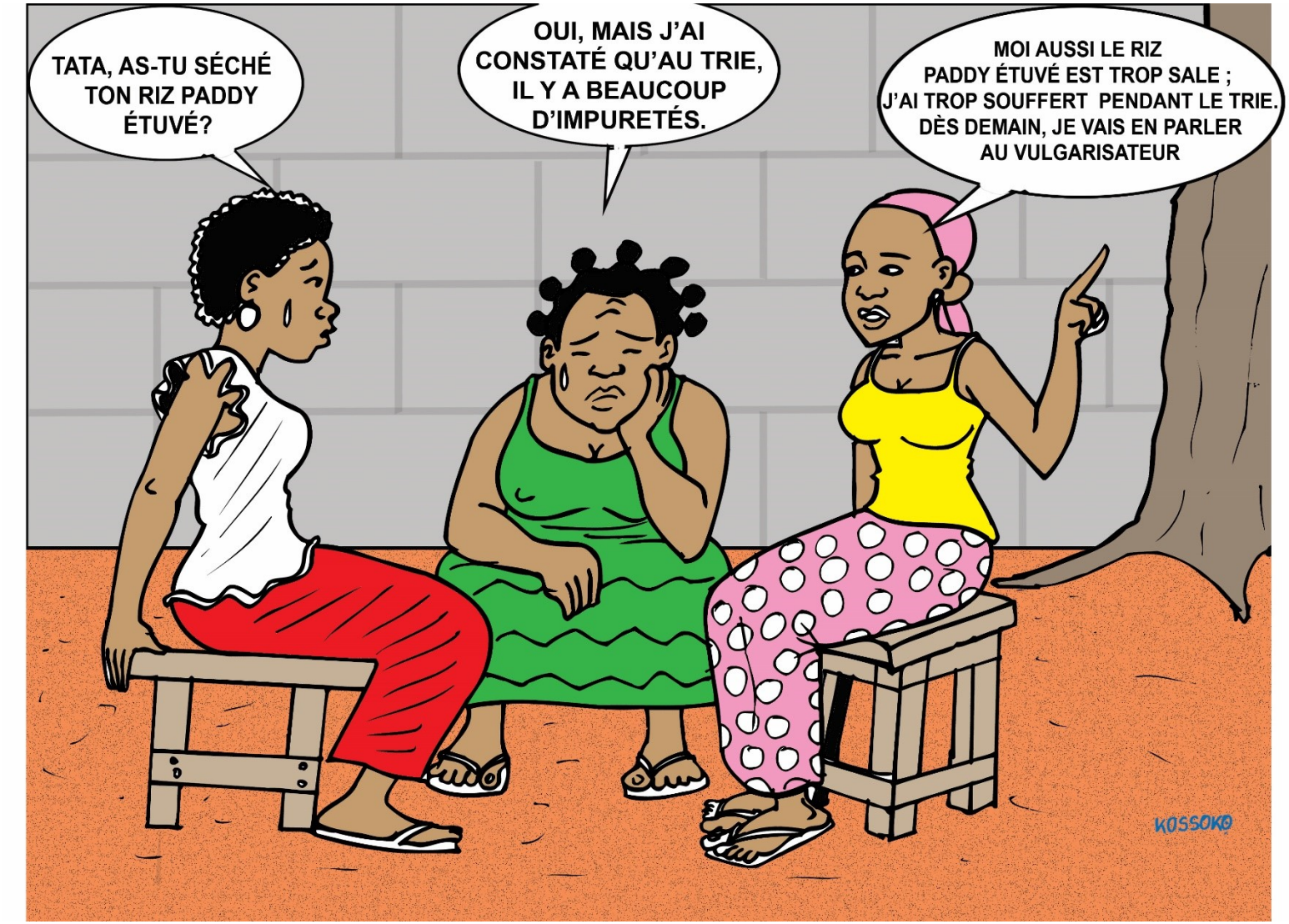

Image 5. Parboiler discussion about impurities found in dried parboiled rice paddy

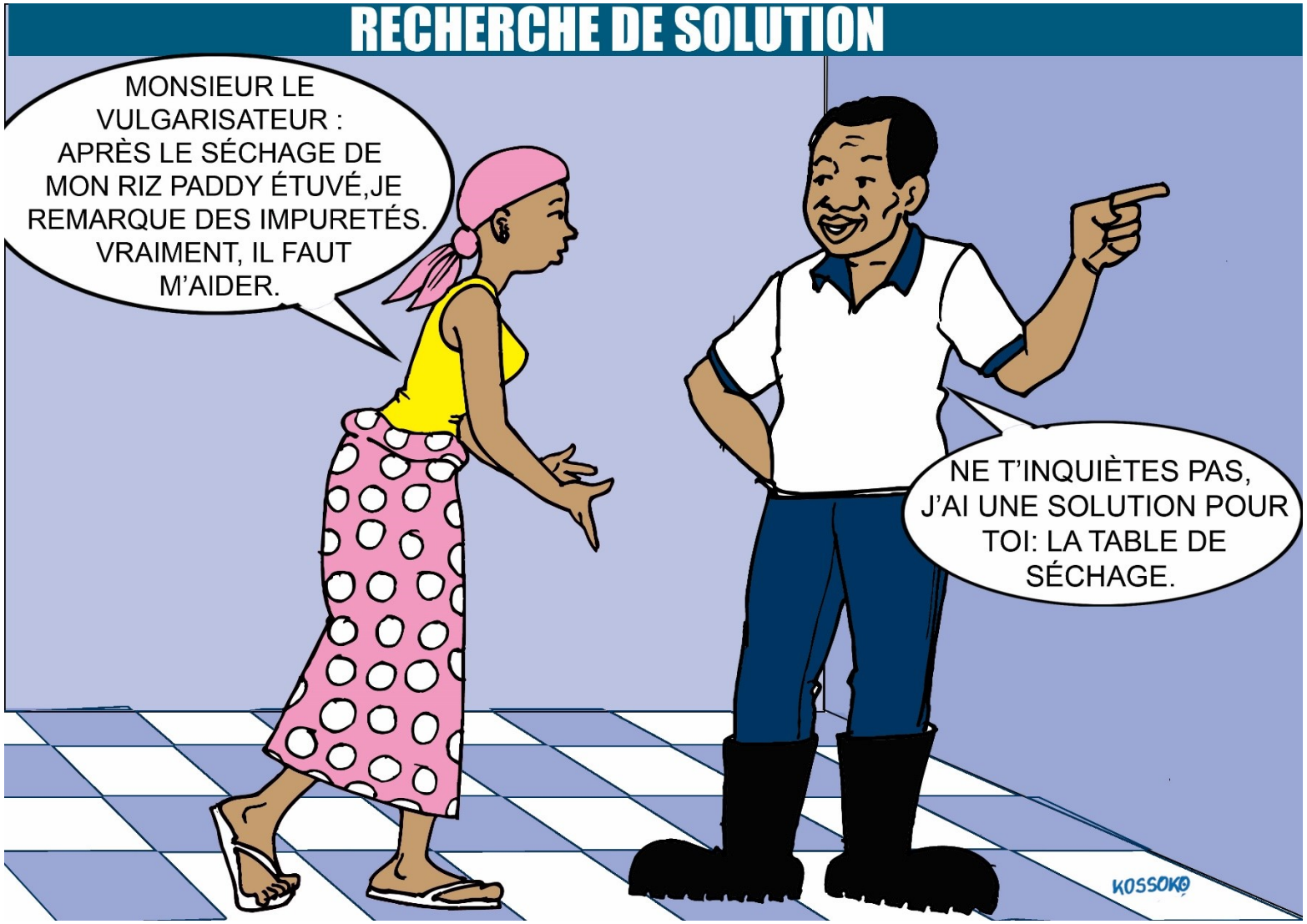

Image 6. Problem solving with agricultural extension agent

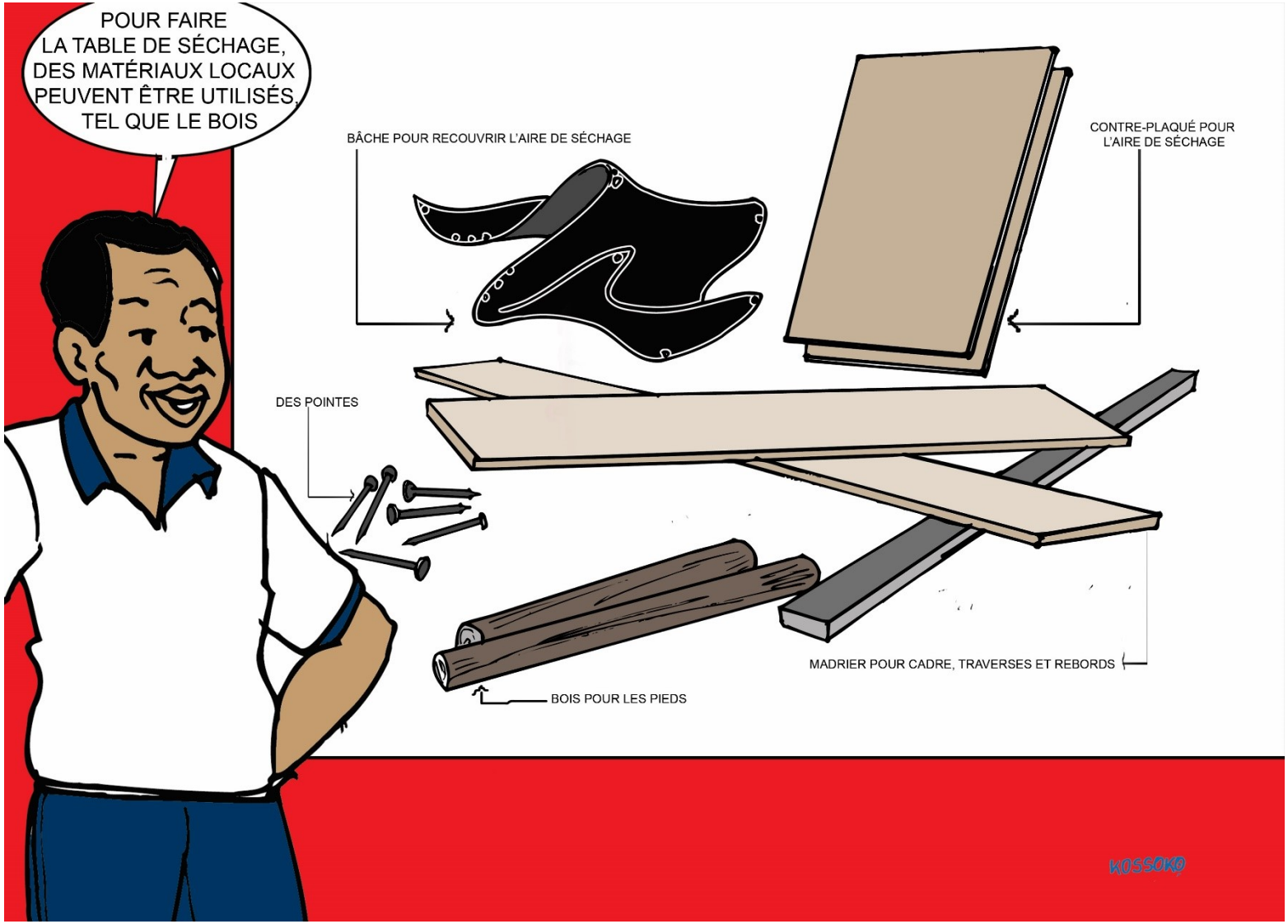

Image 7. Introduction of solution: drying table for parboiled rice paddy, required materials

Image 8. Description of drying table for parboiled rice paddy

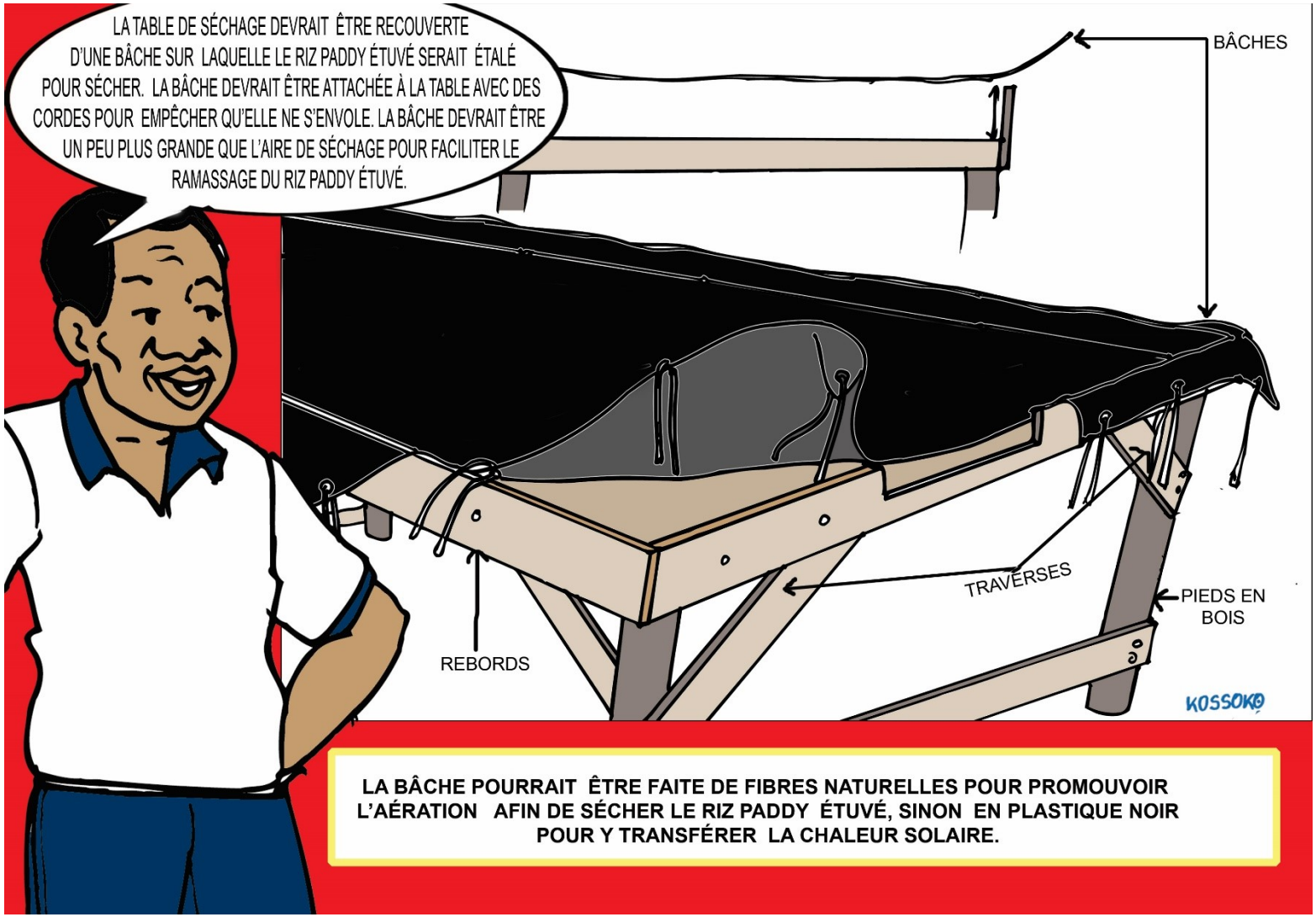

Image 9. Operation of drying table for parboiled rice paddy

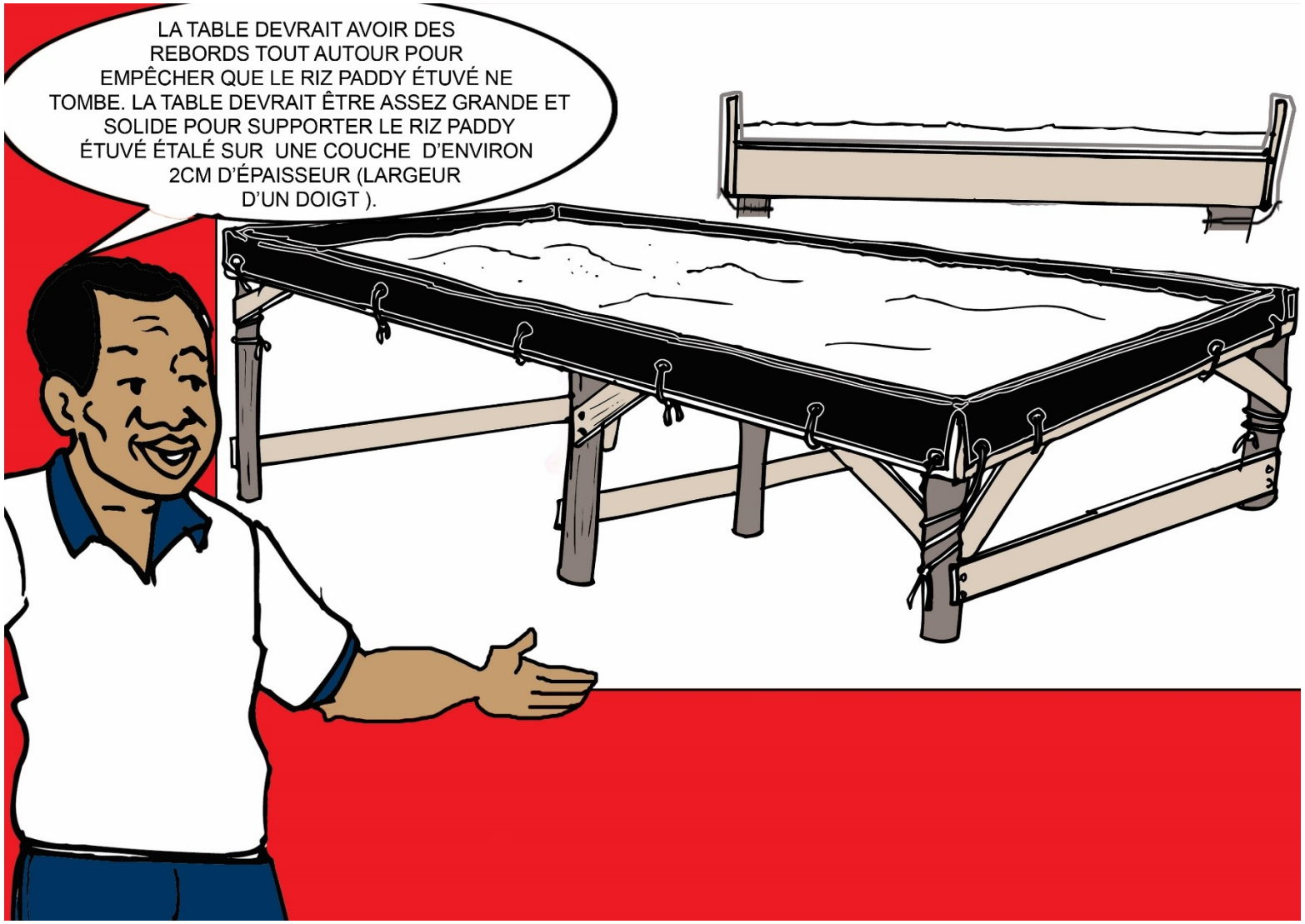

Image 10. Description of walls on drying table for parboiled rice paddy

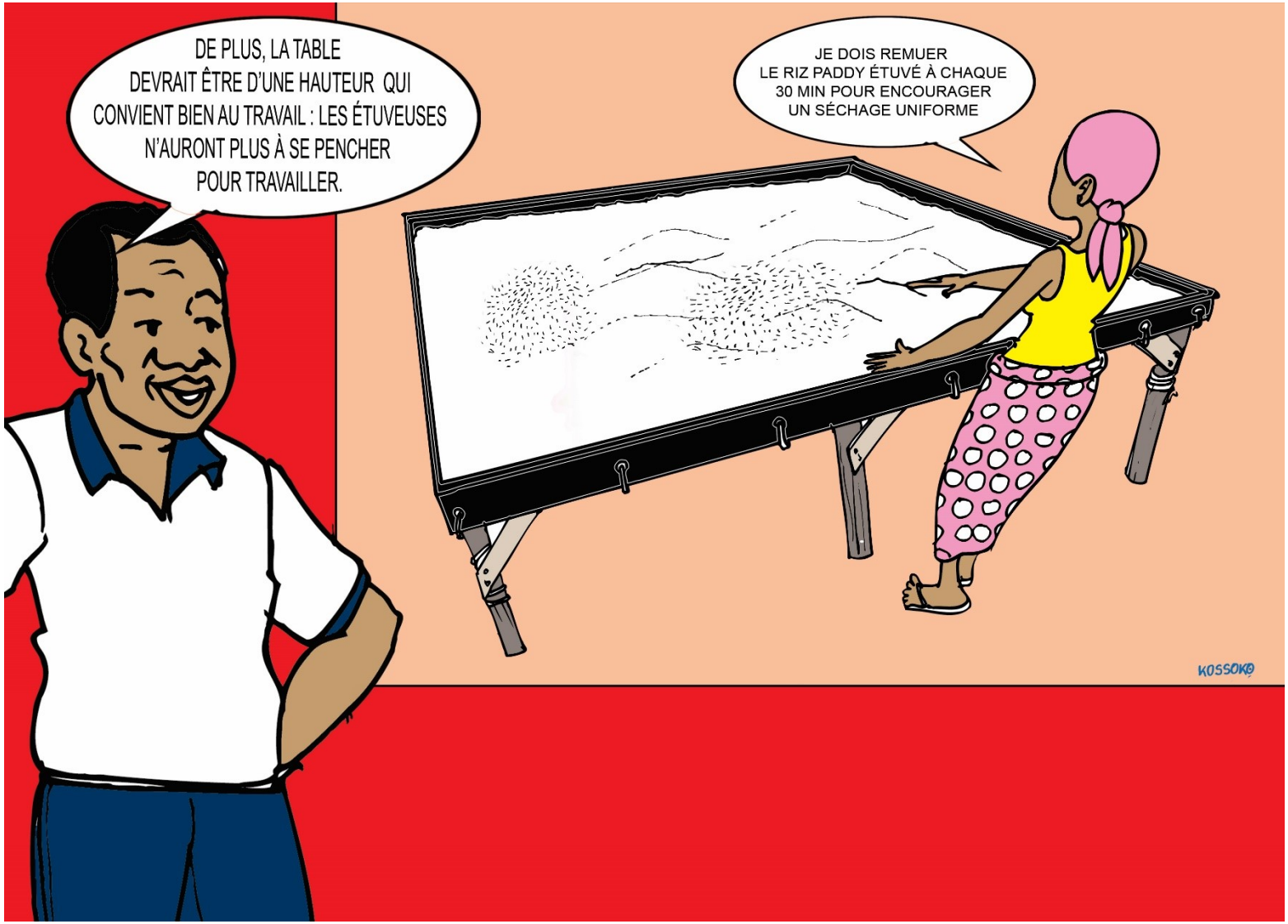

Image 11. Ease of use and operation of drying table for parboiled rice paddy

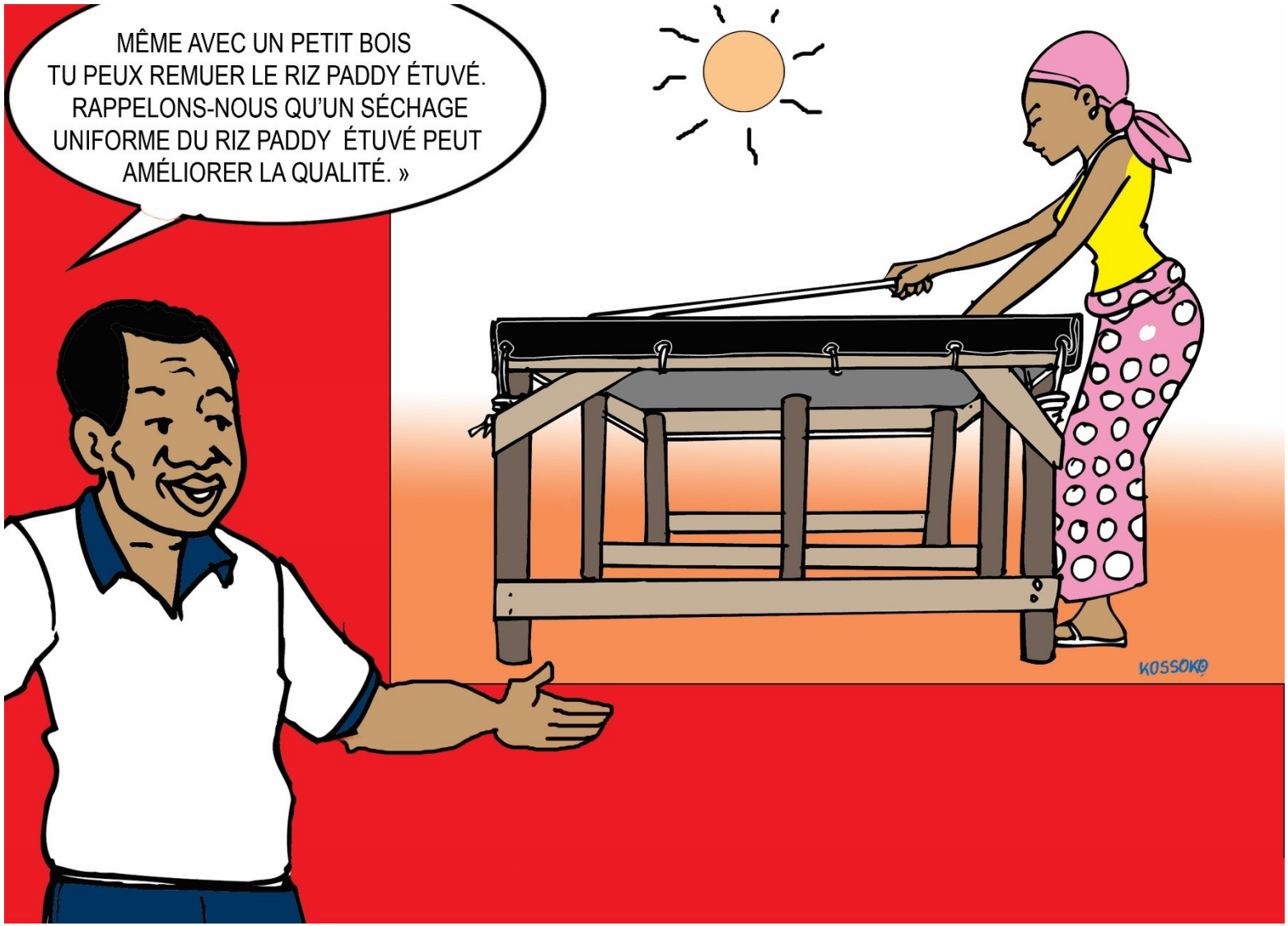

Image 12. Operation for improved quality of parboiled rice paddy

Image 13. Parboiler pleased with quality of parboiled rice paddy dried using the drying table

Image 14. Selling of good quality parboiled rice at market

8.4 CONSENT FORMS

-The Farmer Trainers and villagers who will be approached for their participation in the consultation in the design and creation of the multimedia product will be asked to consent to the following:

Project:	**Investigative study on user preference of multisensory elements in multimedia for effective information dissemination in developing countries**
Researchers:	A team from McGill University (Montreal, Canada) and AfricaRice
Purpose:	To incorporate local knowledge in the design of several multimedia products; and To determine which media is most preferred according to users
Participants' role:	To demonstrate and share their knowledge, experiences and opinions about current drying techniques used for parboiled rice
Time:	Up to seven (7) days in a village for the researchers to interview, hold focus group discussions, and film current parboiled rice drying techniques; and up to (one) 1 additional month of continued communication as required

Unless you agree, your name will never be used publically.

Items requiring consent (to be initialed or audio recorded)

1) I consent to being video recorded to:
   a. Share my knowledge, experiences and opinions about current drying techniques used for parboiled rice. Yes / No
   b. Demonstrate the current drying techniques used. Yes / No

2) I consent to appearing in the video recording described in (1-a) that can be used for an instructional video that will be viewed publically, namely through:
   a. The testing phase of this experiment whereby other Farmer trainers and villagers will view the video. Yes / No
   b. The internet.
   This disclosure cannot be retracted once posted on the internet. Yes / No

3) I consent to appearing in the video recording described in (1-b) that can be used for an instructional video that will be viewed publically, namely through:
   a. The testing phase of this experiment whereby other Farmer trainers and villagers will view the video. Yes / No
   b. The internet.
   This disclosure cannot be retracted once posted on the internet. Yes / No

4) I consent to being identified in the video recording, by:

a. My name Yes / No
b. My occupation/role Yes / No
c. My village Yes / No

I do not consent to item #3, but I consent to having a pseudonym associated with my image for items #1 and #2. Yes / No / NA

5) I consent that the McGill Research Team will have access to identifiable data (items #1, 2, 3, 4): Yes / No

6) I consent that an AfricaRice Support Personnel will have access to identifiable data (items #1, 2, 3, 4) for the duration of the project. Yes / No

I understand that my participation in this study is completely voluntary and that I may withdraw my participation at any time.

If you have any questions or concerns, please feel free to contact any of the persons listed below.

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Principal Investigator
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Dr. Michael Ngadi
Faculty Supervisor
michael.ngadi@mcgill.ca

Dr. Robert Kok
Co-Supervisor
robert.kok@mcgill.ca

Participant's information:

Name: _____

Occupation: _____

Village: _____

-The Farmer Trainers and villagers who will be approached for their participation in the evaluation of the multimedia products will be asked to consent to the following:

Project:	**Investigative study on user preference of multisensory elements in multimedia for effective information dissemination in developing countries**
Researchers:	A team from McGill University (Montreal, Canada) and AfricaRice
Purpose:	To determine which medium is most effective and preferred according to users
Participants' role:	To evaluate various media and provide feedback as to one's preference
Time:	Up to one (1) month for the introduction of media Up to one (1) month for the evaluation period of media users by researchers

Unless you agree, your name will never be used publically.

Items requiring consent (to be initialed or audio recorded)

1) I consent to providing demographic information about myself. Yes / No

2) I consent to answering a knowledge questionnaire prior to receiving the media intervention (pre-intervention questionnaire). Yes / No

3) I consent to answering a knowledge questionnaire after receiving the media intervention (post-intervention questionnaire). Yes / No

4) I consent to being video-recorded while applying the instructions from the media product(s) which will be used for the researcher's use. Yes / No

5) I consent to provide feedback about the instructional media, through:
   a. Video-recorded interviews that will be used for the researcher's use. Yes / No
   b. Video-recorded focus group discussions that will be used for the researcher's use. Yes / No

6) I consent to being identified in the research publication, by:
   a. My name Yes / No
   b. My occupation/role Yes / No
   c. My village Yes / No

I do not consent to item #6, but I consent to having a pseudonym associated with my involvement from items #1, 2, 3, 4 and 5. Yes / No / NA

7) I consent that the McGill Research Team will have access to identifiable data (items #1,2, 3, 4, 5): Yes / No

8) I consent that an AfricaRice Support Personnel will have access to identifiable data (items #1, 2, 3, 4, 5) for the duration of the project. Yes / No

I understand that my participation in this study is completely voluntary and that I may withdraw my participation at any time.

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Participant's information:

Name: _____

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