SCIENTIFIC ANIMATIONS WITHOUT BORDERS (SAWBO): ANIMATING IPM INFORMATION AND EDUCATION EVERYWHERE

Julia Bello-Bravo^{1*} and Barry Robert Pittendrigh² describe an emerging, information and communication technology for development (ICTD) high-throughput library system of scientifically accurate animated videos – localized in several languages and both highly accessible and deployable in the field via a freely accessible Android-based app – that makes possible a continual creation and deployment of existing and novel IPM techniques virtually anywhere in the world; ¹Department of Food Science and Human Nutrition, Michigan State University, East Lansing, MI, USA; ²Department of Entomology, Michigan State University, East Lansing, MI, USA; *Corresponding Author: bellobra@msu.edu

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Introduction

Arguably, integrated pest management (IPM) systems in the developed world are already well-structured not only around insect control for feed and food crops but also for minimizing postharvest losses due to pest attacks. As such, those who would use IPM approaches will typically have easy access to critical IPM knowledge in their own languages, have access to reliable and highly regulated control approaches, and can readily find or create tools and resources to deploy and maintain those IPM strategies. Such IPM strategies also frequently have direct or indirect institutional support from relatively well-funded public and/or private organizations (e.g., extension services, or manufacturing companies for pesticides or biological control agents). In the developing world, in contrast, the exact opposite is often the case. There, getting IPM information to farmers and to critical others along the value chain of particular food and feed commodities is profoundly challenging. There is often little institutional support, which is frequently underfunded in any case, while accessing and delivering critical knowledge is made extremely challenging by a large number of languages - e.g., 50-70 languages or dialects respectively in Ghana and Ethiopia. Additionally, many farmers in these countries are often low- or non-print literate learners who live in remote rural areas - two more factors that make delivering needed IPM knowledge a significant challenge.

In 2011, we launched "Scientific Animations Without Borders" (SAWBO), a university-based program scientifically researching and addressing how to deliver communityand life-changing IPM strategies around topics such as food security, health issues, and women's empowerment to lowto non-print literate farmers in developing world contexts (Bello-Bravo *et al.*, 2011). The most visible work products of this project are scientifically accurate educational animations that can be overdubbed into local languages as needed and displayed on information and communication (ICT) devices



Figure 1. Screen shots from SAWBO animations on (A) malaria prevention and mosquito control, (B) hermetic sealing of grains to prevent postharvest loss due to bruchid damage and (C) biological control of a legume pod borer (*Maruca vitrata*).

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(e.g., projectors, tablets, laptops, TVs, but, most importantly, on cell phones) in order to deliver information on a given concept or idea to local people in their own language. SAWBO creates these animated videos by iteratively working in a four-step (internally peer-reviewed and member-checked) process with global and local knowledge experts to develop a best-practices visualization that addresses various developing world issues around IPM, agriculture, health, women's empowerment, and so on:

Defining the specific idea or concept for animation. Identifying a concept or technique, useful and implementable for a low- or non-print literate target audience, that can affect positive quality of life changes in a community, e.g., improved IPM, crop production, storage, postharvest food security, strategies for disease prevention, the empowerment of women through agricultural or microfinance processes, and so on.

Developing a script. Utilizing the knowledge base developed with global and local experts to frame the critical concept in a comprehensible and implementable description useful for target audiences.

Storyboarding the animation. Outlining the visual narrative and thematic assets for the animation (i.e., the characters, visual backgrounds, and farm or medical tools) that will be adequate for conveying the critical concept to the target community in a culturally competent way.

Producing the animation. This involves producing a short, scientifically based best-practices animation on the critical concept – playable on any video-enabled information and communication technology (ICT) device (especially cell phones), and downloadable anywhere there is Internet access – that can be overdubbed into local languages as needed.

Anchored in multimedia and adult learning theory (Clark & Mayer, 2016; Taylor & Marienau, 2016), but above all by observational experience in the field, to date, SAWBO has made available 70+ animations localized in more than 100 languages. All are freely available to any group for educational purposes only and can be accessed via an Android-based app wherever Internet (cell phone) access exists. This is critical in the developing world, and Africa in particular, where the daily increasing infrastructure of the Internet (Kenny, 2000; Oyelaran-Oyeyinka & Adeya, 2004), and widely available cell phones to access it (Mayton, 2015; Porter et al., 2016), make cell phones extremely well-suited as an ICT device for information delivery (Asongu & Nwachukwu, 2016). As such, a great diversity of individuals and groups have used or continue to access these animations, including researchers and extension agents in remote rural locations in Africa, small and large NGOs, hospitals, as well as government and international agencies; the World Health Organization, for instance, worked with SAWBO to create and deploy an animation to educate people on the Zika virus and the mosquitoes that transmits it. Just as critically, however, local low- and nonprint literate farmers who have seen SAWBO videos can further share them with others via ICT (usually cell phones) as well.

SAWBO and Integrated Pest Management (IPM)

While SAWBO has led IPM research on cowpea cropping systems in West Africa focused on central topics around (1) improved storage, including "triple bagging" (hermetic sealing) cowpea grains and the use of jerricans, to prevent post-harvest bruchid damage, (2) the use of neem seed extract and other non-synthetic control agents to protect cowpea crops from bruchids, and (3) solarizing cowpea seeds prior to storage to kill bruchids that can occur in seeds (Bello-Bravo, Lutomia, & Pittendrigh, In Press; Bello-Bravo, Olana, Enyadne, & Pittendrigh, 2013; Bello-Bravo, Seufferheld, *et al.*, 2013; Maredia *et al.*, 2017), such research also necessarily included efforts to understand the potential for the use of animated educational videos supported by ICT (cell phones).

For example, we asked: can the same animated visual imagery be used across different cultures? The answer was yes, so long as voiceovers in the video were translated and rerecorded in dialectically accurate local language. People were willing to watch and learn from, and reported enjoying, the animations even when the characters did not look local (Bello-Bravo & Baoua, 2012; Bello-Bravo, Dannon, Agunbiade, Tamo, & Pittendrigh, 2013; Bello-Bravo, Olana, et al., 2013; Bello-Bravo, Seufferheld, et al., 2013). We also asked: can animated videos better affect learning gains than other approaches? While the answer was yes – for instance, end-users (farmers in rural Benin and Mozambique) who watched the animations twice on a cell phone or laptop learned as much as those who attended a one to two hour extension talk on the same topic (Bello-Bravo, Tamò, Dannon, & Pittendrigh, 2017) (Figure 2) - forthcoming research suggests that still greater learning gains resulted by using animated videos in conjunction with facilitated topic discussions after viewing. Most recently, we have asked: do low- to non-print literate viewers of IPM knowledge delivered by animated video take up or implement the IPM proposals shown? Once again, the answer is yes - from preliminary results in rural Mozambique, we have observed that two years after farmers viewed an IPM (hermetic bean storage) video (with no other interventions), more than 90% had adopted the depicted technique, although it was previously unknown in the area - so long as the IPM proposal is feasible and culturally relevant locally. It is important to note that there was a significant local need for this technology (i.e., storage of seeds for the next planting season), the farmers already owned the necessary inputs (i.e., a jerrican and small sheets of plastic), and the intervention involved training them how to use these aforementioned materials effectively. Thus, the contents of the video filled a gap in knowledge in a local value chain. The findings around a need for dialectally accurate local language use, for refiguring extension services teaching around facilitated group discussions of video animated curricular IPM content, and framing IPM solutions in culturally competent ways all represent key insights for current IPM delivery strategies in general.

Currently, we are asking: *how can accessibility and delivery of this video library be scaled up in a high-throughput and cost-effective way to make it as widely useable as possible?* As of this writing, 700+ SAWBO animations are digitally accessible, downloadable by any Internet-enabled ICT device, and

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Figure 2. Bello-Bravo *et al.* (2017) found that audiences learned significantly more from the animations (see point c) compared to traditional extension presentations (see point b) on the same topic (p<0.05).

sharable (further distributable) from device to device by Bluetooth. In Africa, we see this happening most often via an Android-based cell phone on the daily-expanding Internet infrastructure across the continent (Aker, 2010; Aker & Mbiti, 2010). And while individuals, educators, and organizations are thus empowered to browse this digital library at will and to select the most appropriate animated video to suit their needs in the field, an Android-based cell phone app that could organize, facilitate, and enhance this access would afford still greater and more efficient throughput of the animated video library.

Over the past three years, SAWBO has collaborated to develop such an interface: the SAWBO Deployer App. Individuals, educators, and organizations using the App can browse the complete SAWBO library, even if it has been updated recently by new content, and use filters alone or in combination to narrow selections by topic, language, or country (origin of the accent). Selected videos – which are short and size-optimized to minimize data plan usage – can then be downloaded to phones (or other ICT devices) for later use in the field, for personal use, for showing the animations to others, or for sharing via Bluetooth and other means. The App itself also has a function to allow transferring it to another ICT device as well.

This focus on cell phones is not just deliberate, but necessary. While people in the developing world generally take certain ICT devices (laptops, tablets, desktops, Internet TV, cell phones) for granted, cell phones are typically the most widespread, if not the only, available ICT device. More importantly, however, the technological literacy needed to access most ICT devices, even in the most basic of ways (e.g., how to hold a mouse) cannot be assumed in the developing world (Tata & McNamara, 2017); technological literacy for cell phones, by contrast, is much more reliably widespread and, where not, the training necessary to enable viewing of animated videos on cell phones is more easily accomplished than teaching computer literacy in general. Similarly, once a participant has acquired the technological literacy to view animated videos on a cell phone, they can easily transfer that knowledge to others who also have cell phones.



Figure 3. SAWBO Deployer App for Android Devices Flowchart: App enables access to SAWBO animations via the Internet for use, deployment, or sharing in the field when offline. Bluetooth® enables sharing to other ICT devices, including cell phones.

Moreover, scaling access is itself a researchable issue – such research in fact being the necessary foundation for any actual scaling itself. In collaboration with social scientists now based at Northwestern University and agricultural researchers in Burkina Faso, SAWBO investigated how one might port educational content creation itself into the hands of end-users, in this case farmers.

Results from this effort demonstrated a need for a two-step educational approach: (1) to access educational (animated video) content, and (2) to deploy it in the field. From the investigation, we found that individuals, teams, or organizations focused on educating local populations must initially have Internet access, access to deployment tools (e.g., Android or smartphones), and direct access to and interaction with local communities. These agents serve as a bridge between the Internet world and the local groups in rural/village areas. Here, as above, this may seem overly obvious to emphasize but again, one cannot assume the technological literacy needed to obtain Internet content or use the SAWBO Deployer App. While such technological literacy is easily taught, and ultimately teachable by participants to others and thus a key element in scalability itself, successful scaling at this point requires an initial knowledge holder in order to facilitate access and/or transfer that literacy to participants.

Conclusion

Transforming participant learners into participant educators is a key point for IPM scalability. Here, the limit or barrier is largely technological, i.e., that cell phone coverage, availability, and data plan affordability are not yet total in Africa. Fortunately, this technological barrier is rapidly eroding, but these barriers can also be cultural, not only with respect to changing perceptions of cell phone use solely for communication but also in gendered differences of access, use, and safety for women (Hafkin, 2000). This is critical, given the pivotal role of women in the postharvest value-chain of legumes such as cowpea (Nakazi *et al.*, 2017).

As such, SAWBO continues to create new IPM content as it enters a new phase of training trainers in the use of the SAWBO Deployer App as a way to facilitate use of its IPM animated videos in local educational programs, especially those working on IPM for cropping systems in Africa.

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