

Full Length Research Paper

Earning trust and building credibility with a new paradigm for effective scientific risk-benefit communication of biotechnology innovations

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Biotechnology has tremendous potential to transform agriculture and contribute significantly to reduce hunger, malnutrition and food insecurity. Many benefits of biotechnology have been recorded over the years, yet the fears surrounding biotechnology adoption persist in the same measure. Unfortunately, the reasons for opposition to biotechnology have remained the same over the years. The developing world has become a battle ground up for grabs by the proponents and opponents of biotechnology adoption for years. Change in public perception and acceptance of biotechnology has been minimal in spite of the strides experienced by some countries in its adoption. The missing ingredient is inadequate targeted communication that relates to the risks and benefits of the technology to sway the decision making processes to accelerate adoption of biotechnology in the developing countries. To do this, a new paradigm that understands the need for effective strategy in and the role of scientists is needed. The new paradigm should also entail embedding of communication in curriculum and training courses. This paper offers the concepts of a new paradigm of risk benefit communication to enhance success of the technology adoption in Kenya and Africa by extension.

Key words: Risk communication, Biotechnology, Genetic Engineering, GMOs, Biosafety, Food Safety, Developing countries.

INTRODUCTION

Risk-benefit communication is an important component of the process of developing and commercialization of biotechnology products across several sectors; health, agriculture, environment, and industry. There has been mixed reactions to the adoption of the technology in different parts of the world and also based on the distinction of these industries. For decision, making both risk communication and balanced information sharing

about the benefits of biotechnology is equally crucial. At the same time, for decision making and implementation of biotechnology especially in developing countries, the target audience whether policy makers, regulatory agency, technical players or the general public is crucial as this determines depth, nature, and method of delivering the information. The reality is that risk communication is and should be treated as a two way

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process that involves receiving fears and concerns of stakeholders and designing mechanisms and processes to deliver feedback and to address them (interested and affected parties) (Koch and Massey, 2011). Scientific and technical matters may be dominant themes in risk communication but wider concerns including socio-economic nature usually play an important role as well. There are 3 important entities in risk communication: government and regulatory agencies communicate risk as developers and implementers of ensuing regulations, whereas product developers do so with regard to introduction of new products, risk management measures, and possible liability. Activists on the other hand use risk communication to raise concerns and to support their positions on the activities and products they are opposed to. The media since they thrive on market ability of negative information (fears and controversy) become regular purveyors of risk communication. This is the more reason for credibility and trustworthiness of risk communicators. Scientists usually take an important slot in ensuring that there is evidence-based communication.

Society is going through a phase of so much mistrust. Biotechnological solutions have unfortunately fallen into this space of mistrust. This distrust has been infused into the biotechnology space and has wreaked havoc literally as it has led to diminishing of noble efforts geared toward poverty, hunger and malnutrition elimination especially in developing countries (Bailey et al., 2014; Caulfield et al., 2006). According to Koch and Massey (2011), risk communication around biotechnology has not been effective.

It remains true that scientists or organizations' ability to offer constructive communication is based on whether the audience perceives it as trustworthy and believable or not. According to Covello (1992), public assessment whether a source can be trusted and believable is asked on these key indicators: ability to express empathy, caring, competence, expertise, honesty, openness, dedication, and commitment. These factors act to build the foundation of trust. Trust and credibility are the most difficult to gain in this biotechnology discourse. Once lost, it is even more difficult to regain (Dunn, 2019). In deed the history of distrust of the biotechnology industry and its persistence is a very clear indication of this very fact that trust has never really been built (Kozubek, 2017).

In this paper, we critically look at what strategies to employ especially in delivering effective science and risk-benefit communication. Apart from taking communication lobbying, and consensus building as an integral part of scientists' research plan, we also advocate scientists to build architecture of communication in relation to, understanding the decision making process in the target organization or governments so as to achieve the necessary success (France and Gilbert, 2019). This strategic planning on communication cannot be un-ethical but a necessary mechanism to ensure that the technology finally achieves its intended goal of changing

lives especially for small holder farmers in the developing countries (Besley et al., 2017). Finally, this paper presents a new paradigm for science communication aimed at dramatically improving the odds of success and adoption of modern biotechnology products in Kenya and Africa at large.

MATERIALS AND METHODS

Mixed multi-dimensional data collection methods and tools were used in this study. Primary data was collected through interactive semi-structured interviews and focused group discussions, and interviews with key informants. Secondary data collection was done through desktop reviews, and informally through the various activities (observing Lecturers, YouTube interviews with communicators) and events organized for Dr. Norman E. Borlaug Fellowship during a 3-month period at Michigan State University. Secondary data was collected through desktop collation and analysis of publications, documentaries and documents from the leading science communication experts and websites that were made available through the Michigan State University Library and other related organizations. Additional primary data was collected through a biotechnology industry survey using a semi-structured questionnaire. Key Informant Interviews (KII) was conducted with various players in including, farmers in Michigan State, Science communication and Biotechnology Professors from Michigan State University, biotechnology companies in USA, Biotechnology and related companies and NGOs in Kenya, Borlaug Dialogue delegates and other stakeholders at the 2019 World Food Prize (WFP) Symposium in Des Moines, Iowa. Direct observations were also employed to collect data on effective science communication from the numerous panelists and scientific papers' presenters at the 2019 WFP Symposium in Des Moines, Iowa, USA. The focus of the questions focused on understanding the difficulty of biotechnology communication with regard to: Facets of risk-benefit communication, the role of scientist, and premise of effective risk-benefit communication in biotechnology.

Organization of research questions in the framework for major issues in biotechnology

Food safety

Here, the study explored the question such as; are genetically modified (GM) foods and crops safe? Is the regulatory process effective and fool proof? Second is that would like to know what foods have been modified by this means? These are now available in several databases as Questions and Answers (QA). Unfortunately, many people are not aware or do not take the time to visit the websites to appreciate the scientific consensus about the evidence of safety of GM foods.

Environmental safety

While there are real and perceived risks of adoption of genetically modified organism (GMO) to the environment, the nature of risk managements put in place if well communicated could form an important basis for more acceptance of the GMO crops. As a matter of fact the general public should be invited into co-creating solutions and measures to ensure responsible adoption of the biotechnology. The study therefore explored the gaps and opportunities for

effective communication around this issue.

Third, socio-economic/ethical issues: many studies have shown that the most opposition to biotechnology has little to do with the scientific safety or view of the process. Much of the opposition is embedded in socio-economic and ethical matters disguised as science. This is why a communicator must delve beyond what is said to dig out these matters, bring them to the fore and address possible solutions together with the community. The study sought to understand the gaps in knowledge attitudes, and practice of scientists in communication and how to bridge any gaps.

The results of the study were organized as a new paradigm for successful scientific risk-benefit communication coalesced broadly into the facets of; risk communication in biotechnology, the role of scientists, and the underpinnings of risk technology debates.

RESULTS

Understanding the facets of risk-benefit communication in biotechnology

The results of this study revealed that there are basically two areas of risk-benefit communication that should be considered. The first is about the processes and regulatory framework in place to evaluate and manage the risks. For the developing countries and especially the Kenyan case, this involves communicating on the roles and regulations in place by government bodies to ensure that there is vigilance through the whole process of developing and commercialization of biotechnologies. The second area involves risk communication about the biotechnology itself (the science). This deals with specific risks-benefits about specific crops for specific applications in a specific part of the world.

Because of the foregoing, there is a tendency by the public and different members of the society even when focusing on the same aspects to draw differing conclusions and especially those that foster their position (Iraki-kipkorir, 2017). The mere fact that a communication has been made does not necessarily translate into an effective campaign. Failure to ensure success in communication is the reason many interventions have struggled. When scientists get alarmed that they communicated but nothing followed, the meaning may as well be that the audience was probably not touched and affected by the information given or that it was not the appropriate audience for that matter. It is therefore critical that an effective method for assessing effectiveness based on specific objectives be utilized by scientists involved in various biotechnology projects (ISAAA, 2020).

When disseminating information to the public, three things are important: it should be readily available, easily understandable, and interesting (with short and punchy content). Otherwise, the public will have limited interest in following through with the information. The choice of a medium is also critical: Whether one chooses television, radio, and print media such as newspapers, magazines or the internet and especially the escalating use of social media platforms (blogs, face book, twitter, and Instagram)

is a key ingredient of success.

Understanding the role of scientists in earning credibility and building trust

The other result coming from the study noted that there has been a changing dynamic of public trust among different entities over the years. Scientists were once considered the most trusted and reliable source of information. However, this has changed over time; they are no longer primary source (Lemaux, 2003). Instead, the media asks politicians, clergy, and public activists on views even of the kind that require scientific knowledge that these organizations and people may be lacking. The other emerging and trusted source is the social media influencers. Which is only a recent phenomenon but whose impact is causing positive as well as negative ripples in the communication space. This is a key reason why science alone has not won this battle of strategic information sharing. But on the other hand this offers a unique opportunity to enlist the concerns and fears of the public and thread these through the channels of communication. Gathering information and giving of feedback then become just as crucial if not more crucial than simply passing information. Scientists should accord equal amount of time if not more time to the aspect of collection of feedback from the target audience. Proactivity in communicating rather than reactivity is the key to exploiting the opportunity to take the public perceptions in and deliver influential information. Credibility and trust are earned and kept when scientist are proactive, communicate openly and respond adequately to every feedback required by the public.

Premise of the most risk communication debates

Finally, the results also revealed that the multifaceted issues characterize the debates around GMO. Public debates relating to GMO foods and crops are multifaceted. The most prominent components include discussions around: potential benefits, risk to humans health, ecosystems, farmers profits, food security, control and loss of control regarding decision making in the food system (Bailey et al., 2014). Whereas some of these challenges may be addressed through scientific data currently available, is important for scientists to be able to dig into the data and provide answers to the questions being raised on the food and environmental safety of new GMO crops and foods (Lemaux, 2003). Though we may determine scientific risks of GM crops and foods, this is only one side of the debate. Where possible, it is important to provide peer reviewed scientific facts and offer our opinion (clearly indicated as personal opinion) (Lemaux, 2003). Otherwise, real-life stories of people's experiences provide a better attention catching episodes and increases attention span of an average reader and listener (Box 1).

Box 1: Invaluable questions as a guide toward effective science communication an organization or a scientist should be prepared to ask the questions below:

- Why do we care at all about this: This is a great place for scientists to find very common grounds with their audience? In most cases, scientists have a noble relatable reason for venturing into the field with a hope to solving real societal problems. The audience will most likely be persuaded as this need becomes clear.
- Who am I (are we) and how did I/we get into the science? What is in stake for me in this: This is the place where authenticity integrity building is truly key.
- What do we know from what is available currently in the realm of the science: This allows the audience to explore with the scientists and hopefully allow them to come to independent but mutually beneficial conclusions?
- How does the public view and perceive me or our organization with regard to science being communicated: This true position of the public opinion and perception about scientist is the 1st step in drawing strategy to communicate effectively.
- What can we do together as a community: This encourages buy in, it's the place to get the fears and clarify any outstanding doubts in the minds and hearts of the audience?
- How shall we continue to partner far beyond the implementation of this project or product beyond the life cycle for sustainability: There are things we need to do and this is how we have responded. This is calling the audience to need for action and demonstrates scientists as a partner in offering a solution to a common enemy.

Box 1. Real-life stories of people's experiences.

DISCUSSION

Understanding the facets of risk-benefit communication in biotechnology

Why communicate and what is there to communicate anyway?

Millions of dollars go into the science research and technology innovation in the area of biotechnology only for the results and products to sit on the shelves for years because of lack of approvals by various governments and regulatory agencies worldwide. A good example is the Insect Resistant Maize for Africa (IRMA) Project in 1999 developed by the Kenya Agricultural Research Institute (KARI) and the International Maize and Wheat Improvement Center (CIMMYT) (Olembo et al., 2010). On the basis of pragmatism, it would make sense to balance out this expenditure by directing some of it to the bottleneck that has the potential to either delay or deny a technology from being utilized perpetually. Even when the scientist have budgeted well, it is prudent to know that success is not always about providing the people with more scientific facts but to use tried and time tested skills from the 'science of effective communication' to relay the information in a manner as to improve greatly, the odds for success (Iraki-kipkorir, 2017).

Strategies to help communicate with public audiences

The understanding of basic tenets of biotechnology

provides a basis for effective communication. Finding ways to simplify the terms of biotechnology without losing meaning is critical. It is important to communicate in an easy to understand manner and terms. But we must have some basic means of stating role of genes and genetics in understanding the evolution of agriculture and foods today. The audience also needs to understand the evolution in the methods of yesterday and the ones used today verses those used centuries ago. Without these basic tenets, it will be very hard to discuss risk and benefits with the audiences (Iraki-kipkorir, 2017).

In organizing the content of training, scientists first need to put the biotechnology into the context. A good place to begin is to communicate a general theory of history of foods and agriculture. This will put biotechnology into perspective as one of the technologies that has been used by man to affect food supply such as domestication, mechanization, use of chemical inputs, processing, among others (Garvey, 2013). Evidently, each of these processes has raised questions of risk, and benefits in every era. The general understanding about how these changes have affected the food supply chain and types of foods available become critical. For example, people generally do not appreciate the reason why foods in restaurants and groceries taste the way it does. But this ignorance or lack of understanding become hindrance in raising the awareness about how the food of tomorrow may need to look and taste like. By not appreciating these changes, a majority of people then cannot appreciate biotechnology and genetically modified foods could lead to changes in our food system. The benefits of classical breeding as expressed on the basis of amount of land that would be required to produce the

Box 2: Enhancing effectiveness of biotechnology communication using analogies relatable to the audience.

Explaining genetics using simple analogies:

One important hurdle that exists between scientists and general public on risk communication is the difficulty of finding suitable and friendly terms to use for common scientific terminologies. For example, the idea of genes, DNA and genetic information presents a special challenge in many communities where communication comes in. According to pioneering work of (Lemaux, 2019), genetic information in a cell is recipe that determines what the cells can do and imparts the plants or animals' characteristics. That recipe is made up of chemical units. If each unit in a wheat plant were represented with a letter of the alphabet, it would take 1700 books of 1000b pages each to carry that information. Or if each gene in a plant is represented as a pop-it bead, the string would be about half a mile (800m). Such illustrations basing on daily relatable objects will help them to get the best understanding.

What happens when we do a genetic crossing?

The analogy can be extended to add that, in classical breeding, only half of the information is retained, and, randomly. Scientists can then enrich the information by back crossing but the breeder cannot read the information and hence cannot ascertain the kind of negative effects that may occur (Wieczorek and Wright, 2012). The parallel idea on genetic engineering can also be communicated by intimating that 'in genetic engineering, it is possible to move only a small text like half a page (single pop-it bead) and that text can be read before it is moved'.

Of course, for classical breeding, the information must come from same species whereas in genetic engineering, the text may come from any living organism. This is only possible because all information in all organisms is written in the same language (Wieczorek and Wright, 2012). A frame work for effective sharing of the information could follow the steps below:

1. A look at how biotech is already helping and impacting agriculture (benefits and risks).
2. A look at the Biotechnology Pipeline: there are so many products of biotechnology in the market and many more are being churned out daily. There are unlimited opportunities for use especially in the pharma and medical field and there are significant experiences with this.
3. A look at regulatory structure (the testing of GMO food and environment) and the scientific organizations and international consensus regarding these crops' adoption.
4. Interjecting a bit of humour: humans receive information best if they can have an opportunity to be happy while also getting helpful feedback. Though most scientists consider science a serious and tough subject, the infusion of humour is not to water down the science but rather to build trust by relaying that scientists are human too and may even share common interests with the public including a sense of humour!

Box 2. Real matters with potential to help the scientists get a basis of relating benefits of biotechnology to the common public.

same amount of food in the USA based on the productivity of 1929, the land requirement is almost 10 times more (Fernandez-Cornejo et al., 2014). A projection of how much this can influence food and agricultural productivity in Kenya can offer some relatable insights. These are real matters that when discussed and shared with audience has potential to help the scientists get a basis of relating benefits of biotechnology to the common public (Box 2).

Starting with the end in mind: The need for communication strategy

Because of the multifaceted nature of debates around biotechnology, clarity and expected end of communication is important. It is evident that science and risk-benefit communication in particular require goal clarity about whom it is intended and for what results. Many times scientist attempt to give a summary of the

science but without taking the time to understand the audience to be targeted and the results this communication ought to achieve (Besley et al., 2017). Evidently, every player requires a unique messaging even from the same scientific data and results. For example, policy makers require different messaging, presentation, and delivery than farmer groups, lobbyists or even the media.

Having a goal for each communication will allow scientist's package targeted information to respond even to unspoken nuances by their target audience. It is also very important that scientists appreciate the fact that they are starting at a disadvantage mainly because the early part and introduction phase of biotechnology was mishandled and public was treated to tons of negative messaging that will take years to correct (Gassen, 2007). In Kenya, Health Ministry banned import of GMO foods because of an alarmist publication purporting GMOs cause cancer. Years later after the research informing the decision was retracted, and discredited, the decision still holds (MoSPH, 2012). It is very important to map out how decisions are made and who is making them whether it be advisors to the president, government ministers, or cabinet secretaries so that they can be appropriately targeted with relevant messaging to remove the fog and ease their decision-making prospects.

In the Kenyan case, communication targeting the political class with a message of how this technology would lead to solutions in the country's key primary area of food security and contribute to the manufacturing pillar of the Big 4 agenda seemed to be the kind of messaging required to allow government re-consider continued development of the biotechnology crops in the country (Vijida, 2019). The cabinet decision that allowed the country to proceed with commercialization of Bt. cotton was lauded as a positive step in the right direction. Well planned risk-benefit communication strategy will have multifaceted approach to address the specific needs of specific stakeholders and ensure that appropriate feedback is obtained.

Need for biotechnology and biosafety communication strategy more than in any other technological advancement

One wonders why in the technology space, we have accepted technological innovations some which have more proven direct harm to us with little protest as compared to the GMO crops and foods. Our study especially wanted to understand the reason why biotechnology in food applications has held such a polarizing position. Food is central, universal and almost sacred part of human beings. Anything modification affecting food touches on our beliefs, lives, culture, future, and all of these at the same time. Ignoring this nature of food and biotechnological innovations and

purely focusing on the scientific benefits is the shortest route to raising resistance from the public.

For example whereas there are many technologies used in crop biotechnology including the tissue culture, marker assisted breeding, and mutation breeding, the gene insertion remains most controversial whereas the data available points that tissue culture introduces more genetic variability than the gene insertion. This experience also demonstrates that the technology is not the matter per se but rather perceptions shaped by anti GMO lobby groups and group think culture that has engulfed the world these days.

Nature of biotechnology debate and the role of scientists

Preparing scientists to drastically improve their effectiveness at risk-benefit communication

First, it is important to have in place the infrastructure for communication. Relying on traditional channels by governments like newspapers and other things may be suitable for a short while especially if they have good readability and a wider reach. In case these are missing, new channels will be inevitable to be created (Koch and Massey, 2011). This has to do with both the physical and technical structures that support ease of communication by identifying the appropriate platforms and facilitation for scientists to appear on these platforms with the right message and best possible delivery. It also involves identifying, capacity building, and training of key personnel who can be relied upon to communicate the science effectively. It involves mapping out, understanding and collecting data regarding, what kind of people, their values and fears. It encompasses the understanding of their values, needs, and interests, political as well as the socio-cultural ones. It is being able to discern what are the hidden worries that do not get to the media and yet remain extremely invaluable to the people or group (Joslyn, 2016). It may also mean mechanisms for collecting feedback on the perception of various stakeholders on the scientific community. It will also become very useful to review Biotechnology courses' offerings in degree and diploma courses with a view to infusing them with few chapters on effective communication.

From 2010 to 2012, Michigan State University (MSU) organized the *International Short Course in Science and Technology Communication*. This course at MSU stemmed from these participant concerns about the difficulty in making science communication understandable and accessible for non scientists and the general public. The course was organized as a one week intensive course which covered broadly four main areas. These courses are a good starting point as platforms for stimulating scientists to engage as

communicators of biotechnology and science in general. However, these short courses are not an end but rather a beginning and an accelerator toward a more rigorous and proactive scientific community. The aim should be to realign community to ensure that the scientists are a head of reliable, valuable and authentic information. It should be to ensure that the general public can turn to them in case of doubts or information overload.

Strategy on who is to communicate and the pillars of effective communication for scientists

There is a norm among scientific community that whoever produces the research communicates it. Most of the time, it could be the Principal Investigator (PI) or another top ranked scientist in the consortium. But who are the people to communicate? Just because one produced the research in a study, does not give one a mandate or the qualifications to be an effective communicator (France and Gilbert, 2019). Scientist must become strategic in this matter. The Institute of Food Technologists (IFT), U.S, for example have communication experts on their team that convey the IFT position on matters of food science and related industry. These communication experts must have certain characteristics of being able to connect with audience and deliver the message in an understandable and effective manner (IFT-Michele Perchonok, 2019).

Scientific knowledge alone however is powerful must not be considered as sufficient in ensuring proper risk communication (Koch and Massey, 2011). FAO (1998), had given the warning that scientific knowledge alone must not be considered flawless, value-free, and unbiased, nor should scientific knowledge be considered the only important criteria for making decisions on biotechnology adoption. For a time, scientists have been accused of arrogance and not caring about the people they aim to help with their science. The failure of biotechnology industry to introduce educational and awareness creation programmes to address the public perceptions early on, was a blunder that has ramifications to this day and may continue into the future (France and Gilbert, 2019). To succeed they must communicate respect for the concern of the beneficiaries their shared value about environment, our future, and even our children. In most countries, scientists and university professors were held in high esteem by the public even though this has been changing toward a declining trust over the years (Besley, 2017). This trust seems not to be utilized properly by scientists in communicating their research in the area of biotechnology. For effective science communication, the science community must endeavor to consistently demonstrate the following values: competence, integrity, authenticity, transparency, warmth, neutrality, and passion (Iraki-Kipkorir, 2017).

There must be careful planning to build these key

aspects which together constitute the most crucial element of effective risk communication which is trust (Koch and Massey, 2011). Scientists must not just let the science speak for itself, they must be willing to share with the rest of the public who they are, their interests, and the reason they are involved in the science they do. Even so scientific results must be presented with the view that they are simply part of alternate framings and not necessarily the panacea for all our world problems. The concept of finding the correct framing has been found to be an important element and makes the difference in whether societies accept and adopt a technology or pass on it (MacArthur Foundation, 2019).

Scientists must truly understand the society's framework in order to provide a communication that is not just relatable but also actionable. For example, in some African societies, the way a technology is framed and presented will annul all the benefits. If a technology is packaged and presented as modern, western, it may simply be rejected on the framework that exists rather than by looking at its own merit. On the other hand, packaging a technology that communicates to people sense of belonging and ability to make their own independent choices without a nudging or a coercing may achieve better result even though the merits of the technology remain the same in both cases. In such a case, the framing makes all the difference (MacArthur Foundation, 2019). Where the scientists have failed to demonstrate the foregoing values, the chances of success are very dismal.

The other important aspect of communication is that the information must be accurate and evidence-based. At times the authors need to debunk the much miscommunication that has been circulated in the media and which have been taken as facts while they are inaccurate. For example, in many countries, the populace believes that the terminator gene is present in the GMOs, yet this is not true at all (Genetic Literacy Project, 2020). Sometimes starting from what your audience knows or has been convinced to believe becomes an important entry point for supplying accurate information on biotechnology.

Premise of most risk-benefit communication debates and navigation approach

Mitigating mistrust as a premise of risk communication debate

Mistrust has characterized most of the risk-benefit communication debates. Scientists can improve chances of success in communicating with their audience by drawing attention to successful examples in the neighboring countries and sharing testimonials demonstrating testimonials especially of farmers who have been successful. For example, crop biotechnology

has had over 15 years of successful implementation in some countries such as USA, Canada, India, China and in Africa, South Africa (Fernandez-Cornejo et al., 2014). This concept has been described as storytelling. Come to think of it, we all are captivated by stories (Sundin et al., 2018). There is nothing in endearing listeners and that works like telling stories that are not just as true but also captivating. Story telling is one of the best ways to take our audiences with communicators, to explore with them and to arrive at their own conclusion (Dahlstrom, 2014). According to the communication officers at the Feed the Future Innovation Lab at Michigan State University, storytelling was an important tool for reaching to audiences in biotechnology (Fierro, 2019) personal communication. Whereas story telling was part and parcel of some traditions, this art is one that is majorly either ignored or simply does not come naturally for most scientists. Yet, storytelling is one of the most effective ways to capture retain and inform and even educate audiences. In Africa, storytelling was part and parcel of the culture. The stories were so memorable as they were very informative. The stories do more than entertain and inform, they were powerful tools that shaped our morality, values, and contributed significantly to the betterment of the society. Story telling can therefore provide an effective tool to reach audiences with scientific information, through the narrative a context is provided and even complex scientific data can be synthesized (Dahlstrom, 2014).

At the same time, scientists must communicate the desire to help countries to build capacity especially where the technology to be adopted is a novel one. One also wonders whether in some cases, staggered introduction of technology: for example, firstly introducing Bt. cotton compared to maize in terms of adoption can give clear indication of where people are putting their fears and would cotton then perform a better job of introducing a GM technology in some cases. Starting off by introducing cotton rather than a staple food crop such as maize in East Africa, could be a better strategy in some cases. Finally, additional information sharing around letting audiences know about the foregone opportunities and including the loss of opportunity to observe the potential risks and fix them quickly, can form integral part of designed message (Wesseler et al., 2017).

In addition, the message too must be balanced in a manner that provides insights into suspected risks and addresses the important benefits that could accrue from the biotechnology. Careful wording is necessary to ensure a neutral voice in any risk communication. It may be helpful to distinguish risk assessment communication focused on the evaluation of risk and the decision documents that include risk assessment recommendations to help in the decision making process. This dichotomy can help scientists strive for a balanced risk communication. The information must also be sufficient and balanced. Balance is often very hard to

strike. However, understanding the purpose, target audience, interest, and knowledge level, time constraints, and preferred mechanism of assessing information can be helpful factors to consider (Koch and Massey, 2011). It may be vital to follow-up any additional requested information through the provided contact list, or through virtual contact points present in websites, blogs or social media pages.

Communication in multi-institutional and multi-countries projects

Evidently, there are at any given point in time, somewhere in the world multimillion-dollar research on various biotechnologies. Sometimes these projects are funded by different organizations but within the same country. In other cases, the scientists may be working on the same thing but each one does independent work. Whereas it may not be possible at the beginning to have a centralized registry for all the different types of biotechnology projects going on, the messaging however should be same. It becomes very confusing especially in this era of interconnectedness when scientists give different messages and opinions on the same technology even when they are in different countries. Any mishap in one part of the world is instantly picked up and used as a blockade in the next country. Therefore, the least these institutions should do is to collaborate even if unofficially through their respective communication officers to realize a constant clear message to the public. Of course, there will be differences based on every country's specific requirement. But the differences are not in the science 'what to', but rather in the 'how to' and this is a marked difference.

It is also helpful to have access to a wider range of technical expertise that addresses some fears that may not be related to the technical aspects of risks of the technology. For example, some crops have passed all the biosafety tests and criteria yet concerns of the public may involve matters of possible inaccessibility of international markets through the adoption of such a technology. In such a case an expert in international trade may be the better resource to help technology adoption to overcome this hurdle (Koch and Massey, 2011).

The need for constant communication and data curating

Recently, the Kenyan Government has given approval for commercialization of Bt. cotton in Kenya. This has been received as very good news by the proponents of biotechnology and many organizations (Indeje, 2020). The fact that science has prevailed and farmers at last will be receiving good quality Bt. cotton seeds has not taken the opponents out of the way. They will be looking not just for any mishandled opportunity to raise their

voice but more so, they will be keen to explore any gaps in communication to dazzle the public and discredit all the effort being put in place to allow Bt cotton technology to work. The government must know that any gap in communication will be filled and any silence in the face of rising challenges will be interpreted in a manner that favors the opponents' course. This is the reason why the communication must be proactive, rather than reactive. This was clearly the case of the controversy leading to ban of GMOs in Kenya (Ministry of Public Health and Sanitation, 2012). The Science of GMOs came later and by then the damage had been done. The voice of farmers and the transformation they receive by growing Bt. cotton must be collected and presented in a manner that provides evidence. The result and the after stories of Bt cotton must be curated and preserved and presented in all relevant places. The government and the proponents need to receive challenges and constant feedback from the farmers and all players and address them as soon as they arise.

Conclusion

There is no technology that is 100% risk free. It is very unlikely that the various stakeholders especially (opponents) are looking for 100 risk proof technology, but rather that their concerns to be addressed in a manner that validates them. Scientists must have the understanding that the communication and the desired influence will be incremental rather than immediate. It is even probabilistic because of the many diverse, dynamic and divergent variables at play; but scientists increase their odds of winning when they are consistent and apply all the aforementioned values. Scientists can help the audience understand the need for the huge amount of biotechnology expenditure and the justification for venture capitalists and the scientific methods used to keep the cooperation and big business in check so as to stay with the scientific facts. Of late, there has been massive progress made toward public funding to allow for public-private partnerships to reduce the cost thus availing the technology more effectively at less cost. The public does not seem to be well informed concerning these new developments (Bailey et al., 2014). Yet this is an important fact that when stressed and made known and available, the government and the rest of the programmes will be well accepted. Whereas some of the topics around biotechnology innovations have experienced very heated debates, scientists must learn to neutralize the position of others without demonizing or viewing others as foolish (Gassen, 2007). Localizing data for risk-benefit communication is very important since every society offers an influence on how technologies will be perceived (Koch and Massey, 2011). In a nutshell, GMO adoption in any given country has been characterized by a champion which has been either a person or a team. It makes sense for scientists to identify

this champion and team to leverage their engagement through effective communication to the public for successful adoption of a biotechnology innovations.

CONFLICT OF INTERESTS

The Authors declare that they have no conflict of interest whatsoever.

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