Biotechnology communication needs a rethink

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Biotechnology, like any other stream of science becomes irrelevant if it cannot be used by society at the right time. To get people to use biotechnology it should be acceptable, understandable and accessible to them. Herein lies the role of biotechnology communication. Making biotechnology relevant through communication is becoming more and more crucial to make people realize the importance of solutions to multifarious problems that biotechnology has to offer like food security, health, environmental problems and so on. This article underscores the communication approaches which need to be taken to reach that target.

Keywords: Biotechnology communication, media coverage, society, science communicators.

Introduction

DO you remember the tsunami in December 2005? It is recorded as one of the worst natural disasters in history and its effects, the destruction it brought about to life and property, as well as the rescue efforts formed fodder for news channels for weeks after the event.

What we missed out on was that these communication channels and other existing technologies were not effectively used to ensure that news of the impending tsunami was spread rapidly to those living in coastal regions around the Indian Ocean. Hence it can also be remembered as the worst failure of science and technology (S&T) communication.

Development of S&T is crucial for mankind, but even the most advanced science is rendered ineffective, if its importance and results are not effectively communicated to the public.

Science and technology cannot be implemented if society refuses to accept it

S&T becomes relevant only when it is implemented. Understanding and acceptance of any science by society is crucial for its implementation[1]. Understanding on the other hand is possible only with effective communication. Besides, implementation of a new research or a new technology also involves change in age-old perceptions, mindsets and habits. Perceptional change requires continuous interactions, making people understand the short- and long-term benefits, specially if they are not apparent to them. All these socio-economic aspects of S&T make communication of science crucial for its successful implementation[2].

Biotechnology received inadequate attention from science communicators

'A lie gets halfway around the world before the truth has a chance to get its pants on'

– Winston Churchill

Nowhere is it true than in the case of biotechnology, especially genetically modified (GM) crops. It has been characterized by inadequate science communication efforts. May be it was considered that the technology spread and caught the imagination of people only because of the advantages it brought about. The result was that misconceptions about technology spread like wildfire.

Research shows that earlier biotechnology was largely framed as scientific progress. However, in the latter half of the 1900s, which represents the period of greatest diversity of biotechnology frames, there was an increase in the public accountability frame. Findings also show that food biotechnology is rarely reported in comparison to other genetic issues[3].

A comparison of coverage of medical and agricultural biotechnology over the years and across countries shows that while medical biotechnology has been largely positively projected, agricultural biotechnology has been projected largely in a negative frame. In the case of agricultural biotechnology, potential environmental risks like 'uncontrollable' or 'irreversible' escape of transgenes with potential consequences for biodiversity, wildlife, and ecosystems, and potential food safety risks like possible 'allergic reactions' to modified proteins have been overemphasized, while benefits like higher crop yields, lower cost of food production, reduced pesticide use, and employment of soil and water-saving cropping methods have been neglected. However, medical biotechnology coverage has largely been dominated by projection of its benefits of healthcare quality improvement and cost reduction[4].

This has influenced public perception of the technology and shaped the public understanding. The public understanding of the technology has influenced public decisions and formulation of guidelines/regulations related to

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the technology (Framing Biotechnology Policy in the European Union 2012). For example, Indian regulations on bio-safety have evolved through the years and resulted in the three-tier regulation system involving the Department of Biotechnology and the Ministry of Environment, Forests and Climate Change, Government of India (GoI).

Besides, most debates about agricultural technologies have centred around genetically modified crops, distracting them towards the ethics of the issue rather than the crucial question which is, what technologies, extant and evolving ones, do we need to use to address our food and nutrition issues? So the focus on GM and safety of some technologies that have been propagated has really thrown out the baby along with the bathwater, raising doubts in the minds of the public whether S&T is at all necessary to solve problems of food security. This has largely been due to the failure of communicating the benefits of agricultural biotechnology and its limitations[5].

Biotechnology is an example in which communication efforts received inadequate attention at the cost of propagation of the technology.

The cost of denial

Many a time in history either miscommunication or lack of communication has taken its toll on the health of the people. A classic case is what the denial of AIDS-HIV in South Africa over years cost the nation. In 2008, University of Cape Town researcher Nicoli Nattrass, and later that year a group of Harvard scientists led by Zimbabwean physician Pride Chigwedere each independently estimated that South African President Thabo Mbeki's denialist policies led to the early deaths of more than 330,000 South Africans[6].

Barbara Hogan, the Health Minister of South Africa (appointed by Mbeki's successor), voiced shame over the findings of these studies and stated: 'The era of denialism is over completely in South Africa'.

Another case in point is the MMR vaccine controversy. This was initiated in 1998 after the publication of a paper in *The Lancet*, which claimed that application of the MMR vaccine led to colitis and autism spectrum disorders. It was later proved that the researcher had manipulated evidence and broken ethical codes. But even before the claims could be verified, the news spread like wildfire and had a huge impact on vaccination programmes worldwide.

It did not stop here. Later, despite this evidence about the invalidity of the paper, on June 2012, a local court in Rimini, Italy, ruled that the MMR vaccination had led to autism in a 15-month-old boy. Unfortunately, the court based its judgment centring on the discredited *The Lancet* paper and largely ignored the scientific evidence presented to the contrary[7].

Such miscommunication can sometimes play a critical role in preventing timely and affordable healthcare. Cost of medicines and vaccines increase because of expensive litigations and they are sometimes banned till the litigations are complete. Several lawsuits filed against manufacturers of vaccines in the 1980s and 1990s in USA alleging that vaccines had caused physical and mental disorder in children, led to a leap in the cost vaccines like the MMR vaccine.

Climate change: how communication helped change from non-acceptance to motivated action

Through the 1960s and 1970s, when the warming effect of greenhouse gases (GHGs) like carbon dioxide was identified and scientific evidence on human emissions of GHGs was increasingly being confirmed, the phenomenon was still alien to the people.

Over the years, thanks to multifarious efforts to communicate it, people became familiar with the phenomenon. However, like all sciences, the results of climate science too had some amount of uncertainty. In this case, it was to some extent greater as well. One reason being that it was a new science and researchers were still understanding its parameters; the other being that several factors had to be taken into account to measure its impacts, which were also multifarious.

As the science behind the warming potential of GHGs became evident and the source of these gases attributed to use of fossil fuels, different interest groups started focusing on discrediting the scientific theory. Their communication highlighted the uncertainty part of the science and started creating doubts in the minds of the audience[8]. Scientific uncertainty was used as a tool to question the very existence of climate change and its cause. With time, as the science became more and more robust, another strategy was used to instill doubts about the science. Legitimately contentious issues like 'whether climate change is a serious threat' were clubbed with those which were already proved through scientific consensus like 'whether climate change is due to human activity'. This clubbing of issues created confusion in understanding them.

However, strategic communication by advocacy groups and the media overcame most of these obstacles and was able to underline the seriousness of the issue. This was also accompanied by the Intergovernmental Panel on Climate change (IPCC)[9] efforts to make the scientific measurements more robust, improve scientific consensus and communicate them effectively.

Consequently, media coverage of the issue has escalated several times over the last decade and articles doubting the science have become almost negligible. Recent research shows that coverage of climate change in the international as well as in Indian newspapers has significantly increased in the last decade with significant increase since 2007, another major increase in 2008 and a huge surge in 2009 (ref. 10). South America/Africa,

Oceania, Asia/Middle East and Europe saw an increase in coverage 85%, 79%, 68%, and 67% respectively in 2009 compared to 2004, whereas America saw a rise of 59% (ref. 11).

Several factors may have contributed to the increase in coverage and there were many interesting peaks and troughs noted, clearly indicating some of the reasons that can be attributed to this increase. For example, 1997 saw the first surge in climate change stories with the formulation of the Kyoto Protocol. Subsequently, a steady increase with intermittent crests and troughs was noticed since 2005. This was followed by a surge in 2007 and then in 2009 during the release of the Fourth Assessment Report of IPCC and the Copenhagen Summit respectively[10].

Besides, climate change stories saw a surge every year on the World Environment Day. The approach of coverage of the issue has also changed significantly given that climate change has assumed global importance and it now encompasses a number of factors, including social, political, economic and scientific. Another important reason behind the increase in coverage is the focused effort on the part of international organizations like the United Nations Environment Protection, IPCC, some governments and several non-governmental organizations to increase the coverage.

This influenced public understanding of the issue which increased substantially as did the public acceptable of the problem. A study by Yale University, USA shows a worldwide improvement in public understanding of the issue. The effect was also evident as governments worldwide reacted to the warning either by formulating policies to reduce GHG emissions, or by joining international negotiations to reduce them. Heightened public understanding resulted in the call for actions resulting in a strong influence on policy. It undoubtedly is one of the most successful examples of science communication across the world[12].

Other evidences of successful communication include the gradual adoption of new technologies like policies promoting alternative fuels and people's enthusiasm to save energy and adopt alternative fuel technologies[13].

Communication alters behaviour

Communication has been found to have had a significant effect on the behaviour of people. Just like communication of climate change and the risks associated with it has led to change in policies, it has also let people to think about changes they should bring about in their lifestyles. Communication of the risks of smoking has not only had significant changes on tobacco policies of countries, but also an impact on smoking behaviour[14].

Case studies and experiments have shown that organized efforts have led to increase in the number of requests for information on energy conservation and also the actual energy consumption pattern[15]. Television and newspaper advertisements by the Government about energy-efficient appliances like refrigerator, television, etc. have led to an increase in their usage in the Indian market. Likewise, effective communication of the benefits of biotechnology can impact its uptake.

Science communication models and biotechnology

Historically, the deficit model has been the dominant mode on which science communication has been structured. It posits that there is lack of information among people and providing that information will help increase scientific information[16].

The deficit model was coined in the 1980s. However, at that time it was not conceptualized as a model of science communication. It gave structure to the widely held belief that people did not know about science and had to be taught about it[17].

Two basic assumptions were ingrained in this concept. The first was the idea that public scepticism towards modern science and technology is caused primarily by the lack of adequate knowledge about science. The second was that these lacunae could be overcome by providing sufficient information about modern S&T to the people to supplant their lack of knowledge. This increased knowledge will induce the public to change its mindset and decide that both science and the technology that emerges from it are 'good things'[18]. However. with time researchers found flaws with these basic assumptions and concluded that increased knowledge about modern science does not necessarily lead to greater enthusiasm for science-based technologies. Indeed, there is considerable evidence to the contrary. For example, the more knowledge an individual has about a potentially dangerous technology, the more concern he/she may have about that technology.

With time, researchers realized that any communication that involves the general public is complex and highly contextual. Hence simple linear models like one-way transfer of information or the diffusion of innovations model would not be able to describe the science communication process. The deficit model thereby gave way to the contextual model[19]. This is a symmetrical model depicting a two-way flow of information between science and the public. According to the model, scientific information should be contextualized for the audience to help them connect to the information and understand it. It assumes an active public, where public, understanding of science is a combination of scientific and local knowledge. This model ties science to particular audiences and acknowledges that science means different things at different locations and for different audiences. However,

this model largely involves a content modification of the deficit model, where linear transmission from experts to audiences remains with a focus on information delivery.

As science communication evolved over the years, the main focus shifted from information delivery to public engagement, and we saw the appearance of the lay expertise model. It acknowledged the limitations of science, valued knowledge outside science and highlighted the interactivity of science with an intention to empower. This later gave way to the public participation model. This model seeks to view science as embedded in society and aims at democratizing the scientific process highlighting the interactivity of science with an intention to empower.

The shortcoming of the deficit and the contextual models in today's interactive society is that they take for granted the authority of and trust and respect for the expert. However, given the fact that communication technologies today with their high level of interactiveness have empowered the lay public, this remains a major flaw in the assumption of these models. As a result, these models are ineffective in communication strategies. Authority, respect and trust cannot be taken for granted or imposed from above, whether in science or any other type of social activity[20].

This implies the requirement for a space for openness to dialogues, and willingness to come out from behind closed walls of scientific laboratories so far considered the sacrosanct production centres of scientific knowledge or the ministries, cabinets and boardrooms in which key decisions about the production and application of this knowledge are taken.

The Committee on the Public Understanding of Science (COPUS) in the United Kingdom, in its report in 2002, highlighted the need for this: 'We have reached the conclusion that the top-down approach which COPUS currently exemplifies is no longer appropriate to the wider agenda that the science communication community is now addressing'. This point highlights the need for a major shift in focus from science communication to public engagement of science.

The role of a science communicator redefined

In this changing context emerges a new role for science communicators. Britain's House of Lords in a report published in February 2000, highlighted the increased importance of the dialogue approach in bringing about public understanding of science: 'direct dialogue with the public should move from being an optional add-on to science-based policy-making and to the activities of research organisations and learned institutions, and should become a normal and integral part of the process'. This change in focus has today become a prominent theme for public communication of science activities. But if we include in our discussion the stronger concept of empowerment, we come up with a different set of practices. It is here that the concept of the 'knowledge deficit' comes back into play. Put in its bluntest terms, as the 17th century philosopher of science Francis Bacon expressed it, 'knowledge is power'. Journalists operate within this philosophy. They report an occurrence or a dialogue when it takes place. The more sensitive the occurrence, the more contentious the dispute, the greater currency it has as a news story. But the journalist's profession does not allow direct participation in the process of dialogue. However, it is also true that the journalist can significantly influence the dialogue through the frames he/she applies in the news story[17].

So it is important that the journalist is careful in choosing his/her frames on the basis of accurate facts and current scientific understanding of the issues. Facts should be conveyed in an accurate and accessible manner. This is the best way that the journalist can partake of his/her role and assist in the process of empowerment. This empowerment can have significant political implications. Realizing this responsibility is a crucial part of the profession of science journalism. In this context, passionate interest rather than a distant perspective often inspires high-quality reporting underlining the greater role of diligence than objectivity and commitment to truth rather than balance. The most damaging distortions crop up when facts are reported inaccurately and wrong facts can never become the basis of good decisions[21].

The responsibility of science journalists

Science communicators as well as journalists often use certain well-defined frames in their communication. Several studies describe a set of frames that seem to reoccur across science-related policy debates. Originally identified by the sociologists William Gamson and Andre Modigliani[22] in an examination of nuclear energy, the typology was further developed in studies of food and medical biotechnology in Europe and the United States[23].

According to Nisbet 'framing offers a powerful theoretical tool for understanding the communication dynamics of science debates and the relationship to public opinion, media coverage, and policy decisions' (p. 26). He argued that scientists must deliberately frame issues in a way that they connect with diverse audiences. In doing so, he developed a reliable typology of frames for science based on past science-related policy debate research, which was originally captured by Gamson and Modigliani[22] in their nuclear energy research.

Frame typology for science debates developed by Nisbet included the following: social progress (quality of life, solving problems, in sync with nature,); economic development (economic investment, market benefits or risks; local, national, or global competitiveness); morality and ethics (right/wrong; respecting or crossing

boundaries); scientific/technical uncertainty (expert understanding; what is known and unknown, invoking or undermining consensus, (precaution in face of possible impacts or catastrophe, science as out-of-control, dangerous including potentially fatalism, path is chosen, no turning back); public accountability/governance (science in the public versus private interest, ownership and control, responsible use or abuse of power, majority versus minority opinion); alternative path (possible compromise position, middle way between conflicting views or options); and conflict/strategy (science as a game among elites, who is ahead or behind in the battle of personalities or between groups, sound science, or peer-review); Pandora's box or Frankenstein's monster with need for precaution or action in the face of possible catastrophe and out-of-control consequences; or alternatively as fatalism, where there is no way to avoid the consequences or chosen path.

Journalists should be careful in choosing the frames they use because the frames and positions taken have been found to have a significant influence on public understanding of science and on policy decisions. The frames and positions taken should be well grounded in the current state of scientific knowledge. This will need not only knowing what scientists have established as truth but also what they speculate and do not have sufficient evidence to establish. It is important to understand and effectively communicate the difference between the two. In order to do this, the science communicator should be well versed in the current level of scientific knowledge. There is also a space for coverage of diversion from scientific consensus, but when that happens, the communicator should make that clear in his/her communication.

Effective science communication would involve conveying the excitement that each scientific achievement merits and at the same time well-informed criticism of the pitfalls of science. In fact, criticism of the pitfalls should be such that they give a clue to corrections of the same. This could make science journalists an indispensable part of social empowerment. The role of journalists in reflecting the voices on the ground could also help boost social empowerment through participative science communication. It would help trigger a dialogue which could help scientists understand people's demands from science, which in turn could influence the way a nation carries out its science.

Participative communication in the context of biotechnology

Participative communication is particularly important in the context of biotechnology. The needs that biotechnology can solve are generated at the ground level and are very much associated with the lives, livelihood and culture of the people. It is necessary to acknowledge and respect these and communicate in that context. For example, many traditional societies have their own ways of using their natural resources – medicinal plants, animals. Introduction of biotechnological solutions has to take account of these uses and practices and not undermine them. Likewise, many tribal societies, pushed to the brink of existence, have their own ways of sustaining their lives and livelihoods within their limited resources under harsh natural conditions. They have developed their own methods of healthcare with the help of traditional medicine and remedies. The deficit model may reject these as being far from matters of science. But the participative model respects and values this knowledge as a source of empowerment.

India's grassroots innovation movement has gained currency under the participative model. Some of these innovations have been patented and with support from the National Innovations Foundation, have offered technological solutions to people on the ground.

Thus not only is science communication important to communicate and introduce new finds in biotechnology, it also needs to respect the traditional practices and place the good ones in scientific context.

Biotechnology communication can take a clue from climate change communication which changed an issue from non-acceptance to one of the most important problems of the century. In order to achieve this, the media needs to be sensitized. The current attitude of the media towards biotechnology needs to be assessed and methods have to be found to change this attitude. Positive stories on biotechnology will have to be highlighted to the media by triggering its interest in such stories. NGOs working in this field will have to be proactive in highlighting these stories. New tactics will have to be evolved to increase media coverage of biotechnology. For example, studies show that media covers an issue when national and international policy-makers talk about it[10]. Taking a clue from this, policy-makers need to be sensitized about the importance of biotechnology so that they could speak about it on important days like the National Science Day, etc.

Studies also show that climate change coverage increases significantly during CoP meetings[24,25]. Taking this as an example, international dialogues and debates need to be organized on issues relevant to biotechnology, so that such issues can come to the forefront.

Besides, occasions like the Environment Day and Earth Day have found increase in climate change coverage. Biotechnology can also have such designated days for revisiting the issue each year and deliberating on it so that it receives focus by the media and change public opinion about it.

The Department of Biotechnology has taken a first step in revamping its website and boosting its social media as the central tool of communication and organizing its communication around it. However, much more needs to be done on a larger scale.

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