MEDIA COVERAGE OF SCIENCE AND TECHNOLOGY IN AFRICA

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INTRODUCTION

The media have a critical role to play in facilitating the public understanding of science and technology. Journalists typically assume the position of "intermediaries" between the scientist and members of the public who are interested in a given scientific subject or issue. For this reason, according to Farr (1993), any attempt to understand the social representation of science – that is, how science is captured in the public imagination – would be incomplete without analysing the media representation of science.

Yet in Africa, very few studies have systematically investigated the volume, quality, scope, and perceptions of the coverage of science and technology. One such study by Rooyen (2002) examined the state of science and technology coverage in the print media of South Africa. It concluded that there were relatively few science and technology articles in the sample of newspapers studied.

Some analysts have attempted to examine the factors that account for the type and extent of coverage that science and technology get in the media. An analysis in *Nature* (2009), for instance, attributed these patterns of coverage to the form of expectations that scientists have towards journalists and vice versa.

Whereas news organisations in many advanced economies are scaling back significantly on the resources they devote to covering science and technology, interest in this field is growing in Africa. According to Irwin (2009), during a major conference on science journalism in 2009, speakers from Africa "were optimistic about a surge of interest in science and science journalism in their countries" as were their counterparts from the Middle East and Latin America.

OBJECTIVES

Through a comparative analysis of the coverage of science and technology in the print media of selected African countries, the aims of this study are:

1. To appraise the range of thinking and research about the relationship between science and technology and the media.
2. To gather empirical evidence on the nature of science and technology reporting in the African media.
3. To establish the trends and patterns of science and technology reporting in the African media.
4. To assess the volume, quality, and scope of science and technology coverage in the African media.
5. To appraise the perceptions of key actors regarding the type of scientific coverage evident in the African media and the factors that account for it.
6. To examine the conditions that foster and those that impede the coverage of science and technology in the African media.

RESEARCH DESIGN AND METHODOLOGY

The study was implemented in Cameroon, Kenya, Ghana, Namibia, South Africa, and Uganda through a combination of qualitative and quantitative approaches. Qualitative assessments based on key informant interviews were employed to gather the opinions of scientists, policymakers, and journalists about the coverage of science and technology in selected countries.

Quantitative assessments were based on content analysis of articles on science and technology published in one major national daily in each of the countries sampled. The newspapers in the sample included five published in English and one in French. The content analysis yielded some descriptive and some inferential data that gives a detailed and multi-faceted picture of the amount of coverage and the characteristics of science and technology reports as measured on various dimensions like tone and source.

Key Informant Interviews

Interviews were conducted with about 90 key informants – about 15 per country – involved at various levels and to varying degrees in reporting, research, and policymaking on science and technology. For consistency across countries and to ensure meaningful comparison of responses, a standardised interview guide was employed and administered by research assistants familiar with the media in their countries.

Two sets of interview guidelines were used, one for scientists (see Appendix 1) and one for journalists (see Appendix 2). Many items in the two guidelines are identical. However, the distinctive institutional features of the media industry necessitated the addition of items to capture aspects that are unique to journalism. A separate instrument was therefore found appropriate for this purpose.

The questions around which the key informants were interviewed were by and large drawn from issues, observations, insights, and criticisms encountered in the literature on the relationship between science and technology and journalism, communication, and the news media. The investigators surveyed the growing body of literature and thinking (research, analysis, opinions) on such broad subjects as sciences communication and the public understanding of science.

The interviews then provided an opportunity to interrogate the outstanding issues with the perspectives of key informants working in, or with experience of, the fields of science and technology and journalism in Africa.

Content Analysis

Science and technology articles were coded on a number of variables ranging from those that dealt with the "formal characteristics" of stories (typically elements such as author, topic, length, illustrations, prominence, placement) to those that dealt with the

"structure of the news narrative" (typically elements such as tone, source of information, main agent, event, context) (Bauer, 1994).
The unit of analysis was the article, which was treated as a whole unit of meaning. For each country or newspaper, we generally considered a standard number of 15 science and technology published between January and August 2011. The study had no interest in comparing the volume of articles published per country over a specific period, which would have necessitated systematic sampling. For our purposes, however, 15 articles per newspaper were considered an ideal number to enable us identify the common elements and general trend one would expect to find in the coverage of science and technology in a given country. It should be noted though that for practical reasons, there were variations from the standard 15 articles in some countries.

The data was gathered with the help of a coding form, which was administered independently by a research assistant in each country. The coding procedure involved coders scanning the headlines as the basis for identifying stories about science and technology. The material was collected from online editions of the newspapers for convenient access as the electronic archives were easier to retrieve. The variables of interest are listed in the coding form (see Appendix 3).

SCIENCE, TECHNOLOGY AND THE MEDIA

Making Sense of the Relationship

It has long been acknowledged that the media play an important role in society by providing information that is critical to the way people comprehend and make sense of the world in which they live (see for example Hartley, 1996; Luhmann, 2000; McQuail, 2005; O'Shaughnessy & Stadler, 2008; Erll and Rigney, 2009). The media do these by representing issues, interpreting and evaluating them and in the process helping make sense of the world and events on behalf of their audiences (O'Shaughnessy & Stadler, 2008).

In terms of communicating science, the media are seen as "brokers between science and the public, framing the social reality for their readers and shaping the public consciousness about science-related events. They are, for many readers, the only accessible source of information about science and technology" (Nelkin, 2001: 205). In short, the way people understand science and technology is influenced to a significant degree by media coverage, interpretation and presentation.

Several issues determine media coverage of issues and events. One of the commonest factors is that whatever media cover must be newsworthy, and that it must interest a large number of people. In other words, it must appeal by speaking to the news values of significance and relevance (Galtung & Ruge, 1965; O'Shaughnessy & Stadler, 2008).

Despite the above arguments, however, some issues are often given a wide berth especially when they are considered complex or of little interest to the majority of

society (Stocking, 1999). Unfortunately, science and technology are among the areas that the media often pay little attention to. This is based on numerous factors one of them being the assumption that there is little audience interest particularly because science is generally and technology are generally difficult to understand both for journalists and audiences.

Thus a majority of what is covered as science and technology is often simplistic and designed to appeal to as many people as possible, a phenomenon that can be referred to as the least common denominator approach to coverage. Given the rising commercialisation of media and commoditisation of information, news must have a buyer (Allan, 2004). In essence, it is assumed that the more complicated news is, the fewer buyers or consumers it will attract. This is something most media are aware of and are hardly willing to risk especially when they understand all too well what this means for circulation, readership, listenership and viewership.

What this study and survey of the literature do, therefore, is to appraise the factors inform media coverage of science and technology, and what theoretical arguments can be advanced to explain the apparent dearth of science and technology in the African media. The literature suggests that the limited coverage is a consequence of the media seeking to set the agenda, to frame issues, and to prime the public to attend to particular issues. It is also a consequence of an ever-fragmenting audience brought about by media liberalisation and competition. The limited coverage could also be a result of modest knowledge of science and technology within the media (Stocking, 1999).

Knowledge Gap

Science and technology should ideally be of great interest to the media because of the import of such issues to society. Unfortunately, there is a widely held view that this is hardly the case because journalists and the media often do not possess the knowledge and attendant interest to cover science and technology.

Whereas technological issues such as the impact of new innovations and computer and mobile technologies have captured media attention, many serious issues relating to science and technology are hardly understood and as such not given adequate coverage. This is especially so in Africa where there is no critical mass of journalists with specialised scientific and technological expertise; and where there is a lack of skills necessary for comprehension and interpretation of science and technology information for onward dissemination to disparate audiences as news, features and other texts.

Stocking (1999: 30), for example, has cited lack of knowledge as one of the reasons for the little and low quality of coverage offered science and technology. He argues that "journalists' lack of scientific knowledge or training is one of the most commonly cited reasons for reporting patterns that media critics define as problematic". Given this lack of knowledge, many journalists do not possess the skills to question scientific and technological innovations particularly when the innovators or scientists seek to hide their negative aspects. For this reason, Caulfield (2004: 38) argues that

when scientific findings are negative, the results are "either de-emphasised or simply not published. This bias is picked up by the popular press and conveyed, largely uncritically, to the public".

This has led to claims by Bubela and Caulfield (2004: 1399) that even though the media play a critical role of providing information about scientific issues, some reports are often "inaccurate or exaggerated". Although their report is based on Canadian media coverage of genetic research, it demonstrates the incapacity of the media to offer critical and meaningful coverage of some difficult issues like those related to genetics. The failure to understand such scientific issues has led to "genohype" or sensationalisation of genetics, which "may have an adverse impact on the public's ability to participate in policy discussions and on the utilization of genetic services because it creates inflated perceptions of the value of, for example, specific genetic tests" (Bubela & Caulfield, 2004: 1399).

Sensationalism and sometimes false or uninformed coverage of science and technology can generate what Ransohoff (2001: 185) calls "false hopes and unwarranted fears … sensationalism may threaten effective involvement by desensitizing the public to information about medical science through repetitive cycles of excitement and disappointment".

Sensationalism of science particularly is seen as problematic given, for example, the risks and sometimes hope associated with some scientific discoveries. Consequently, Stocking (1999: 23) sees journalists as sometimes "making scientific claims appear more solid and certain than they are; … there are times when journalists are lambasted for making science appear more certain and baffling than it, in fact, may be".

Scientific Illiteracy

What's more, the uninformed coverage of science may lead to what has been referred to as "scientific illiteracy" (Kennedy & Overholser, 2010: vii). The argument is that because journalists often "value timeliness, speed, simplicity, and clarity … stories about science and technology may be long-building, complex, and without dramatic, time-pegged events". Yet, as Kennedy and Overholser (2010: vii) contend, "The need to grab and hold attention, to write tight stories or produce short segments, can come at the cost of context and nuance", which leads to public misunderstanding of complex scientific and technological issues.

The outcome of this is that the media often dumb down complex issues because they want to appeal to the largest possible number of people especially when commercial media, which privilege profit, are involved. This, according to Russell (2010), has created some sort of suspicion between the scientific community and journalists. This suspicion has arisen because scientists rarely well-versed in how to deal with the media:

> Scientists have viewed the media with suspicion and the prospect of being interviewed by a reporter akin to a visit to the dentist. In fact, such interviews often felt like pulling teeth, as reluctant researchers measured their words and

> feared being misquoted. Part of the tension stemmed from the scientific tradition of presenting research first to colleagues at scientific meetings and later to the scientific world through peer-reviewed journals. Only then was it considered appropriate to talk to the public through news media translators. Through it all, many scientists have felt uncomfortable with press coverage, worrying about being misquoted or having their research taken out of context. Although they place the blame on the media and its shortcomings, a large part of the problem is that many prominent scientists do not see this as part of their job and are not trained to deal with the media (Russell, 2010: 23-24).

The suspicions which Russell (2010) mentions above imply that science and technology are often given little coverage, ignored or framed within the 'juicier' issues of politics or other more appealing news and information. Hence, science and technology are often covered but within the rubric of politics, which ostensibly is more interesting to *most* media consumers. This assertion has led to the conclusion by some that "many important scientific issues only get major media coverage when they are picked up first by politicians" (Science and Media Expert Working Group, 2011).

The argument above can be illustrated by a recent example in Kenya. The announcement that a young Kenyan, Evans Wadongo, had invented a solar lamp did not receive much media coverage until he was rewarded by former Russian leader Mikhail Gorbachev for apparently transforming the lives of rural Kenyans using a solar-powered lantern. Wadongo was recognised for providing an alternative source of lighting energy. The lamp is considered a clean and healthy alternative when compared to wood- and kerosene-powered lighting sources.

What the Kenyan example tells us is that the media are selective in what they cover and how they cover it. Whereas the public interest ethos is often touted as the key determinant of media coverage of issues, there are other underlying factors that determine how and why an issue is covered.

Considerations of negativity (the man-bites-dog and bad-news-is-good-news syndromes), relevance, locality, novelty, timeliness, magnitude and severity of the impact, and visual appeal, among others, determine what is newsworthy and worthy of coverage and onward dissemination to audiences (see Galtung & Ruge, 1965; Brighton & Foy, 2007; O'Shaughnessy & Stadler, 2008). In short, to capture the attention of news reporters, correspondents and journalists and ultimately the media, the issues must be of significant interest to the audiences. What this means then is that if scientific and technological issues do not fit into the mentioned categories, they will hardly make news however important they are to society.

Granted, the growth of media around the world means there is increased specialisation, and some media organisations as well as journalists are increasingly interested in single issues which they either feel passionate about or in which they possess expert knowledge. As such, the issue now is whether they can frame science and technology and prime the interests of audiences in ways that can advance public comprehension and appreciation of the subject and the issues it raises.

Effects on Public Understanding of Science

News framing has been defined as the selection of issues to "make them more salient" (Entman, 1993: 52). This is related to the issue of agenda setting which is considered one of the key functions of the media. The agenda setting role of the media relates to the notion that the media are often successful in telling people what to think about (McCombs & Shaw, 1972; Lang & Lang, 1983) by selecting what content to publish, where to publish it (placement), and what language (framing) to use. These media processes are as relevant to the coverage of science and technology as they are to the coverage of all public affairs.

An Australian study on climate change (Harriet, 2000) illustrates clearly the contribution that the media can make to the public understanding of science. Though not directly implicated in the study, it would be impossible, without working through the media, to deal fully with the "concern that public ignorance and illiteracy about global environmental issues is leading to misinformed views, apathy, ill-considered calls for government action, and little change in personal behaviour" (Harriet, 2000: 328).

As submitted earlier, the media can affect the scope and form of public knowledge, values, and action via its agenda setting, issue framing, and audience priming functions. The media can propagate better public knowledge of scientific and technological matters by providing more information that reflects an accurate understanding of issues and problems in any particular field: health, environment, genetically modified crops, etc. The media in Uganda are, for instance, widely credited for transforming public knowledge about HIV/AIDS by persistently, consistently and accurately conveying basic scientific information about transmission of the disease.

As the preceding arguments have indicated, although the media should ideally be interested in science and technology, there are numerous challenges to contend with regarding the coverage and presentation of scientific and technological issues. Most of these relate to the notion that science and technology are complex issues requiring technical or expert knowledge. Even though this may be true, there is also the idea that the scientific community often fails to trust journalists because of the fear of being misquoted or quoted out of context.

Accordingly, although scientists and the media ought to have a symbiotic relationship (scientists as sources and the media as interpreters and disseminators of the information), the fact that many science and technology issues in which the public has a genuine interest are sometimes complex, thus denying them the priority they deserve on the media agenda.

ANALYTICAL FRAMEWORK

From their review of the body of research on which this study draws, Anderson, Petersen, and David (2005: 192) concluded that journalists, in selecting their sources, are influenced by factors such as "professional and pragmatic demands, existing knowledge of an issue, the existence of contacts in the field, and commercial pressures". Potential sources of material for journalists include press releases, news conferences, information and public relations officers, professional society meetings, scientific journals, and expert interviews. Yet, on the other hand, "… journalists often do not have the time, means or expertise to seek independent verification of facts …, and are sometimes overly reliant on pre-packaged information over which they have little control" (Anderson, Petersen & David, 2005: 192).

From the journalists' perspective, news coverage of science and technology is by and large shaped by a whole range of reasons that may include: level of understanding of the issues; time and space limitations; news format requirements; editorial control; human interest; policy activity on an issue; commercial pressures; resonance with and relevance to audiences; dramatic occurrences; and controversy. "Such factors," argue Anderson, Petersen, and David (2005: 193), "serve to 'frame' stories in ways that are likely to connect with readers' interests, but sometimes appear to non-journalists to 'distort' or 'misrepresent' science."

As sources, scientists in particular have tremendous power to shape, as well as control over, the news production process. Even when the subject of a news story is the journalist's choice, scientists are well positioned to set the parameters for the journalist's decisions about other sources, focus, and conclusions. "Many stories are source-generated – some estimates put it as many as half or more of newspaper stories – so scientists are able to strategically package news items for journalists" (Anderson, Petersen & David, 2005: 193).

These issues form the framework for the reporting and analysis of the results of this study. In the first part of the study, these issues were investigated through interviews with numerous journalists and scientists working in Africa. A number of themes stood out from these interviews, and these have provided us with the framework for making sense of the relationship between the media and science and technology.

RESULTS AND ANALYSIS

Media Policy and Investment in Science

From the above exposition, it is clear that science and technology are either inadequately covered, or that the coverage is uninformed and sometimes sensational. Results from numerous interviews conducted for this research seem to corroborate claims that the coverage of science and technology is steeped in problems due to

various factors, including the quality of coverage brought about by little competence, or lack of specialized knowledge, in science and technology issues. In other words, there are many factors informing the coverage of science and technology issues. These include media policies and the relationship between, for instance, scientists as sources of information and journalists as conveyors of that information.

First and foremost, this study sought to establish the level of commitment to covering science and technology by media organizations in Africa. It was anticipated that this commitment would be reflected (a) in the presence of explicit editorial policies on coverage of science and technology, and (b) in the level of resources invested in building the capacity of journalists to cover the field. The picture that emerged could be representative of the pattern across the continent. In almost all cases, reporters and editors interviewed said their media organizations had no explicit policies mandating or providing guidance on the coverage of science and technology. Their coverage was informed by availability of science and technology as news, and new information emanating either from news events, reports and sources. This demonstrates that while explicit policies may be lacking, there is sufficient interest especially when media managers, editors and journalists believe that science and technology news would make good reading or if there is sufficient public interest.

Furthermore, some media houses demonstrated some interest in covering fields related to science and technology. This was especially clear when the news attracted great public interest, and when government, donors, researchers, civil society and other actors were willing to take up and react to the issues contained in the articles. For example, some media outlets regularly feature dedicated coverage on scientific subjects, with health being a widely covered area although it is often treated as distinct from science. "The unwritten policy is that we try to give attention to developments in science that ... affect the citizens in one way or another," says Charles Wendo of the Ugandan newspaper, *New Vision*. Wendo qualified as a veterinary doctor and then took up a career in journalism.

It is noteworthy that the issues that capture the attention of the media also attract audiences. This is based on the fact that the media seek to cover issues they think would attract the most number of people as news is increasingly becoming commoditized, and must ultimately find a buyer in a competitive commercial media environment.

However, the minimal coverage that science and technology receive can be attributed to lack of capacity coupled with the little investment made by media houses to enhance the competences of their journalists to enable them give science and technology issues informed coverage.

The inability of journalists to give science and technology informed coverage is in part ascribed to gaps in journalism training. This is because there is often little or no balance between academic and vocational courses. Oftentimes the focus is on skills or the craft of journalism. Francis Asamoah Tuffour of the *Ghanaian Times*, for example, says training institutions in his country hardly offer science as a subject. "At the Ghana Institute of Journalism, they don't place emphasis on science, only politics and sociology," he says, noting that whatever knowledge of science and technology he possesses was acquired through his work.

This happens in many journalism schools and institutions in Africa where the focus is on acquiring skills to practise journalism rather than on deeper knowledge to understand the issues the future journalists will encounter or cover. Such conclusions reinforce the widely held view that journalists hardly possess the requisite knowledge to cover science and technology unless experts are brought in to interpret and simplify the issues for them. "I trained as a journalist and not as a scientist. Sometimes it can be difficult for journalists to get it right," says Thandi Skade of South Africa's *The Times* newspaper.

Even when journalists have the knowledge of science and technology, media organizations may have little space to accommodate them and their stories. Corollary to this is that journalists then have no incentive to cultivate interest in science and technology if this knowledge is irrelevant in their workplaces. The domino effect of this is that science and technology then drop off editors and media organisations' radar.

The above arguments lend credence to the fact that there are very few cases of pro-active investment in capacity building by media organisations. For those that did, we found an example in Uganda. According to *New Vision's* Wendo, "The organization invests in training although not at an advanced level. It is mostly in form of short courses. When I was new to journalism, *New Vision* sent me for a two-week course on writing medical news." But such cases are few and far between. Only a handful of media organisations offer capacity building opportunities for journalists. In most cases journalists have to use their own initiative to find these opportunities to enhance their skills, and this applies as much to science as to all the other fields that journalists cover. The rare opportunities that science and technology journalists get typically come about when interested organisations like international, non-governmental, and scientific agencies offer such opportunities as a way of trying to raise the capacity of journalists to cover their specific issues.

While capacity is important to the quality of coverage accorded science and technology issues, other factors influence media coverage of such issues. These include controversy, sources of information, and the relationship between journalists and the media on one hand, and the suppliers of the information on the other. These issues are discussed below.

Coverage of Controversial Science

Controversy has long been known to be a staple of the media and is arguably the most enduring determinant of newsworthiness. How the media deal with controversial science and technology issues can have critical implications for public knowledge and interest in the field.

However, there is seldom controversy in science and technology issues especially when these are based on sound research. Besides the notion that scientific and technological issues are difficult to comprehend, there is an overarching view that stories on such issues might not be appealing to the common people. The media often give coverage based on the notion that controversies will appeal to the lowest

common denominator in their effort to improve their audience and attendant revenue share in what is becoming a highly competitive commercial media environment.

Nonetheless, the study inquired into the strategies that journalists employ to ensure that their reporting is fair, balanced and informative on science and technology issues that are controversial. The experiences some of the journalists interviewed described demonstrate the difficulties the media face in this endeavour. There are numerous ways of mitigating controversy, mainly by ensuring that stories are not only properly researched but also sourced and corroborated (see further discussion of this issue below). "We ensure that the stories are balanced by speaking to many people including researchers and independent sources," says Esther Nakkazi, Ugandan correspondent of *The EastAfrican*. She says that journalists prefer information that is based on research, which tends to be more credible and easily verifiable.

Yet she also notes that controversy is sometimes 'good' because the "media is about business" and sensationalism is good for business. This is of course similar in many countries where sensationalism seems to have taken root and issues are hardly given deeper coverage and analyses. Another respondent, Gerald Tenywa of *New Vision*, supports this claim. He says that stories are often reactive and sensational because journalists "take a conflict approach to reporting" in order to attract audiences.

Tenywa blames the unrelenting cut-throat competition for what he considers 'shallow' reporting of science and technology. To beat their competition, journalists sometimes do not take the time or bother to confirm information before publication, he says. This is especially true when the information comes from 'authoritative' sources like the scientific community. "For instance if they tell you today that Lake Victoria is drying up, that's what reporters will report. That may not be true. Even if it is, the story will lack context and explanation."

Sensationalism and Mistrust

Although accuracy and balance are considered key pillars of journalism, it seems that competition and incompetence have played a role in sensationalism and in the dumbing down of important issues. Whilst this cannot be generalised, the number of such claims in this research means this is unfortunately a regular occurrence in African journalism. In fact, incompetence and lack of expert knowledge have been identified as part of the problem and have created tension and mistrust between journalists and scientists. This mistrust has been perpetuated by the fact, and sometimes myth, that journalists will always misreport or sensationalise information.
"There is some kind of cold war between the media and scientists. Scientists are reluctant to give information because they fear that the journalists will report inaccurately," argues Tenywa whose statement is supported by William Balikuddembe of *The Sunrise* newspaper and chairman of the Uganda Science Journalists Association. Similarly, Elise Tempelhoff of South Africa's *Beeld* newspaper, Newton Mthethwa of *Construction News* magazine in South Africa, and Ochieng Ogodo, chair of the Kenya Environment and Science Journalists Association, do share that sentiment.

Balikuddembe claims that "scientists are generally reluctant to engage with the media by providing news, information, and opinions about their work because of fear of being misquoted and also due to lack of communication skills." On the other hand, Tempelhoff, Mthethwa, Ogodo believe that the fear of 'misinterpretation' has made it difficult for scientists to work with journalists, which in turn has made it difficult for the media to seek information and comments from the scientific community who feel their views would be misunderstood both by journalists and information consumers. This may be compounded by journalists' lack of expert knowledge as well as unwillingness to consult and to research or corroborate information. As science and technology are sometimes complex, issues and information may then become harder to comprehend and interpret, which may result in ambiguity in journalistic reports. To South African journalist Loni Prinsloo of *Creamer Media*, scientists are sometimes difficult to understand because of their technical training and outlook. But, as Prinsloo posits, it is the responsibility of the journalist to understand them and to "translate information" offered "into what the readers can understand."

Journalists' Understanding of Science

In Cameroon, Divine Ntaryike reflected on a story he did about the administration of doxycycline as a measure to prevent cholera in Douala. The issue at stake was whether it was appropriate to prescribe this antibiotic for people who had no cholera. The argument was that the drug was intended for the treatment of cholera and its use for prevention could cause resistance among its users. Ntaryike explains: "I spoke to pharmacists who were against the use of the drug and also doctors who were recommending it. At the end of the day, however, it was hard to draw a line as each of the parties held strongly to their points." In any case, the differing opinions between the two 'experts' should ideally be investigated further. This may involve seeking independent verification of the efficacy of such medicine. But scarcity of resources, a condition that the majority of media organisations in Africa suffer from, implies that independent testing is impossible. However, as Prinsloo suggests, this failure to investigate fully could also be an outcome of journalists' unwillingness to invest time and other non-fiscal resources in efforts to understand scientific issues.

Nonetheless, as journalistic tenets demand, multi-sourcing, corroboration and attendant accuracy are essential to good reporting. This is because it is vital to double-check the information from a single source for veracity, validity and reliability. This view is shared by numerous interviewees. For example, Ogodo from Kenya says that it is vital for journalists to ensure that their reports are accurate and reliable: "The best way to ensure a report is fair, balanced and informative in the normal practice of journalism is to have more than one voice. It is vital to compare what you have in your hand with what you have somewhere else. You also have to consult with the experts."

Ogodo's views are shared by Cameroonian journalist Kini Nsom of *The Post*, who posits that it is essential to seek different opinions particularly when an issue is either controversial or difficult to comprehend. "We cover controversial issues by talking to different scientists who have different opinions," says Nsom. This indeed was the

approach his newspaper used in reporting about a recent clinical trial in the city of Douala. Some in the scientific community argued that the trial was harmful to the human subjects who were involved. There was no agreement among scientists as to the effects of the trial. As Nsom explains, "We spoke to the victims, to those who organised the testing process and those who had contrary facts and views, and of course the government had a say too."

In another example, Randy Sa'ah who reports for BBC Radio's *Network Africa* in Cameroon also relied on collecting a variety of views when dealing with claims that sex workers in Douala were being used in a clinical trial without being given sufficient information about the consequences of their participation in the study. In describing the reporting strategy he used, Sa'ah points out: "I spoke to the doctors who were carrying out the research, government officials and the victims themselves."

Such multi-sourcing not only strengthens stories but also adds to their authenticity. It is also important that science and technology stories are multi-sourced so that audiences are given different perspectives and, more importantly, that information is cross-checked for accuracy.

Balance is also central to reporting. Balance here means giving both sides of the story sufficient space to articulate their views. For instance, in Ghana, where genetically-modified crops are highly contentious, balancing reports is vital to enhancing public understanding of the issue. In covering the subject, Linda Anim-Agyei of *Ghana News Agency* ensured balanced reporting by highlighting both the pros and cons of the introduction of these crops in the country. For Nehemia Owusu-Achiaw of Ghana's *Daily Graphic*, controversy in science is approached the same way as all controversial stories: "The general policy is that you have to be fair as you deal with all the parties to the story. If you're in doubt of any story, you drop it. We try to be fair and balanced … but we're human beings and sometimes make mistakes."

In some instances, encouraging public debate about controversial issues is important. Encouraging debate is part of the social responsibility of the media as they provide a platform for articulation of issues and aggregation of public opinion.

In Uganda, Wendo, referring to the controversies surrounding genetically-modified foods and the use of DDT to control malaria, explains that, "On such issues, we try as much as possible to encourage debate. We have in as many views as possible … instead of us trying to take a position as a newspaper or as individual journalists." Ugandan journalists Nakkazi, Tenywa, and Evelyn Lirri of *Daily Monitor*, all emphasized the importance of using independent sources to verify any claims by particular scientists as well as getting information from many different parties. And this is one of the means to promote public debate and understanding of important scientific and technological issues.

Obviously, the dilemma for any journalist in situations of this kind is how to answer the public's questions and to provide people with useful information on matters that are clearly divisive among those who should probably know better. As the findings suggest, a common strategy that journalists use when confronted with scientific issues on which the experts are divided is to maximise the number and diversity of sources

in the expectation that some kind of golden mean of views will emerge and enable the public to form their own judgments.

Sources of Information

There are two issues of interest when it comes to sources of information for science and technology. One has to do with the sources that journalists rely on. The other is about the sources that journalists value most.

All the journalists interviewed indicated that scientists were their main sources of information. The scientists are more valued because of the public perception that whatever information they possess is based on solid research. Given the fact that good stories have to be widely sourced, scientists become vital experts that give the articles credibility. "Scientists … are our top sources of information. This is because scientists are very important in completing a science story. You cannot complete a science story without the scientific perspective," argues Wendo. This is especially true when looking at issues that are new or difficult to understand. And this view is shared by Audrey Dekalu of the *Ghana News Agency*. To Dekalu, scientists and other such authoritative sources are critical to journalism. He gives the example of stories on schistosomiasis and river blindness whose public understanding can mainly be attributed to the role of scientists and health experts. "I wasn't sure of the facts when I spoke with the expert. After, I emailed the draft to the expert. He punched some holes into the report. After that I fine-tuned it before using it," he says.

This is a strategy another Ghanaian reporter, Rebecca Kwei of *The Mirror* newspaper, finds useful. She considers experts vital to journalism especially for the credibility of stories. "I have a lot of health experts I go to," she says referring to the issues of health in which she specializes. "I just call and ask, 'how can you break it down for me so that the ordinary person can understand. I've written it this way, does it mean the same thing …?' "

In addition to the above arguments, getting a scientist's perspective makes a story believable and more meaningful to the audience. According to Wendo, the veterinary doctor who has been a reporter and editor at *New Vision* for over a decade, journalists cannot be as authoritative as scientists unless the journalists are also scientists:

> Once in a while, you see someone nearly becoming a scientist as opposed to being a journalist. We keep reminding them that journalism is about the people not the labs and science. Many times, you will see someone writing a story from the perspective of the scientist. We ask them to go to the ground to find out what is going on. When the journalist goes to the ground, they sometimes confirm the story. They can also get additional information. For a science story to be meaningful, it must tell us what has happened, the implications, how it will affect society. It must explain the science behind the whole thing.

What's more, the ability of journalists to write simple, more 'human' stories makes the connection between news and audiences better. This is largely because people like stories that speak to their issues; they often prefer human interest to the hard news that some media publish. This could be part of civic as opposed to the overly commercial journalism. For this reason, and for stories to be more meaningful, there is always the

need to translate scientific and technical language into simple terminologies that are easily understandable even by the ordinary people.

In Wendo's view, "Scientists use complicated language, [journalists] use simple language." This implies that the relationship between the two parties is critical if scientific and technological knowledge is to have better meaning for and impact on society. This is based on the idea that if journalists understood the issues they covered, audiences would then be better informed. Yet this can only ultimately happen when journalistic reports are simple, well-written and presented, and easier to understand. In fact, Ogodo reckons that scientific and technical issues would become more interesting to audiences if they were broken down for news users who do not possess the professional knowledge or expertise. "Science news is only complex if you look at it from the scientific point of view. If it's broken down and made easy read just like any other news item, it can even be more interesting than other news," says Ogodo.

However, as journalists have discovered, scientists are always willing to give information to journalists if they are sure it would not be misinterpreted or misreported. This trust can only emerge on the basis of a relationship built on mutual understanding and appreciation of the different roles that journalists and scientists play. In short, journalists have themselves realized the importance of credible sources and balance. As Lirri says, "I get views from all the sides and I also get independent views from the activists to ensure that the information is fair and balanced. For example, when covering genetically-modified foods, you need to consider views from various sources ranging from scientists and independent sources."

There were significant mentions of the Internet as a source of information on science and technology. Similarly, the majority of journalists agreed that the dangers of science and technology journalists being compromised by their sources or promoters of particular agendas and interests were real. Yet, some also saw the possibility of shared interests in promoting the public good. "Yes," said a Ghanaian journalist, "they may want you to propagate their interests but if it's in the national interest, why not. But if it's something that's not going to be professional, I will not do it".

The quality and credibility of a reporter's work in science and technology have a lot to do with the competence and degree of authority that the sources bring to bear on any report. This applies to the coverage of all subjects. However, it is more critical to the handling of science and technology than it is to most other issues that do not necessarily require expert knowledge to interpret. Good sources are therefore the reporter's lifeline as they can help a journalist form judgements and be able to report in a way that does not create the impression that every side to a scientific issue or controversy carries the same weight. The suspense and uncertainty that the media sometimes create around scientific debates and their attempts at balancing all views can confuse audiences or even validate positions that are questionable. Falling back on credible and knowledgeable sources can therefore help in shaping the public understanding of any scientific issue.

The Growing Symbiotic Relationship

The realization that there ought to be a symbiotic relationship between the media and journalists, on one hand, and scientists, on the other, has somewhat improved the dealings between the two groups. This is something that is clear from the sentiments of the journalists and scientists interviewed.

For example, Grace Musimani, a journalist with *Farmers Online* in Uganda, says the two groups have started to cooperate because research and communication are crucial to development. Besides, scientific research and reports would not be beneficial to society unless widely disseminated to the public. This realisation informs the growing symbiotic relationship between journalists and scientists. This is driven by the fact that scientists have become important sources of information while journalism has become a vital conveyor of information to widely dispersed and disparate audiences. "The relationship between scientists and science journalists is cooperative because scientists have come to realize that in this century they have to communicate their findings … so they value the media," says Musimani. This is especially critical because, as he explains, "today scientists have realised the value of the journalists so they tend to engage with the media to disseminate their information."

These sentiments are echoed by Tenywa and Ogodo who believe that scientists and journalists share similar agendas, mainly because both work for the benefit of society. This relationship seems to work based on mutual benefit built around the fact that science and scientists are sources of news for the media and journalists. Besides, as Lirri, Musimani, and Ogodo claim, scientists are "poor communicators" who need the services of journalists and the media to disseminate research findings and information to mass audiences. "Scientists have come to realize the role of the media and are now willing to provide information," says Lirri. To do this, Skade argues that scientists have to try and cultivate good relations with journalists if their work is to benefit more people. They can do this by being "approachable" and "willing" to share information with journalists.

This engagement is of course good news for African journalists as it would not only raise the quality of information disseminated but also the relationship between journalism and the scientific community and ultimately the consumers of information generated from both groups. Besides, the need for journalists to break down scientific findings into understandable language may have motivated scientists to start dealing with journalists and the media. Having to do this certainly benefits the public who are the ultimate consumers of both media as well as scientific and technological knowledge.

To develop and support their science and technology stories, journalists need access to experts who are willing to give information and to share their perspectives on an issue. Ntaryike's experience is typical:

> Generally, scientists and researchers in the Cameroon context shy away from the media. Their reticence stems from the fact that they may be wary of

> sensationalist reporting or misinformation by the reporter or they may be linked to a government structure and fear reprisals if they speak out particularly on delicate issues. A couple of years ago, I was doing a story on why Lake Nyos could cause disaster due to the increasing erosion and possible collapse of a natural dike holding back the lake waters. But…a researcher working at the lake at the time on behalf of the government refused to comment, only to come back after I had done the story for VOA, and crying foul.

Measuring Patterns in Coverage

The newspapers on which the content analysis was based are: *Mutations* (Cameroon), *Daily Graphic* (Ghana), *Daily Nation* (Kenya), *The Namibian* (Namibia), *The Star* (South Africa), and *New Vision* (Uganda). All are daily newspapers and are among the highest circulation and most influential publications in their countries. Except *Mutations* which is published in French, the rest appear in English. The articles were distributed as follows: Cameroon 16, Ghana 15, Kenya 20, Namibia 11, South Africa 15, and Uganda 16. The analysis of coverage as gleaned from 93 news articles about science and technology reveals a number of distinctive trends when we look at the variables on which all the stories could be compared, that is: format of the article; nationality of the author; origin of the article; field of science and technology; tone of the article; consequences; controversy; nature of the story; nationality of sources; and gender of sources.

News vs. Features

The format of an article was coded as either news or feature, which were the two categories of stories that the study focused on. Their characteristics and distinctions are generally straight forward, which made it relatively easy to pick them out. As shown in Table 1, almost 85% of the articles were in the category of news while only 15% were features.

The predominance of news as opposed to feature items resonates with the idea that science and technology stories are likely to get the media's attention if they are first and foremost perceived to be newsworthy. In other words, they often have to compete on the strength of the same news values on which all stories are judged regardless of the topic. In fact, even the decisions that editors make when selecting among stories on science and technology seem to be significantly influenced by how current the issues or developments reported are. Currency is ultimately what distinguishes news from other forms of reportage such as features in this particular case. The implication is that science and technology stories stand a better chance of getting of being reported if they qualify as news.

Table 1: Format of articles

Format	Frequency	Percentage
News	79	84.9
Feature	14	15.1
Total	93	100

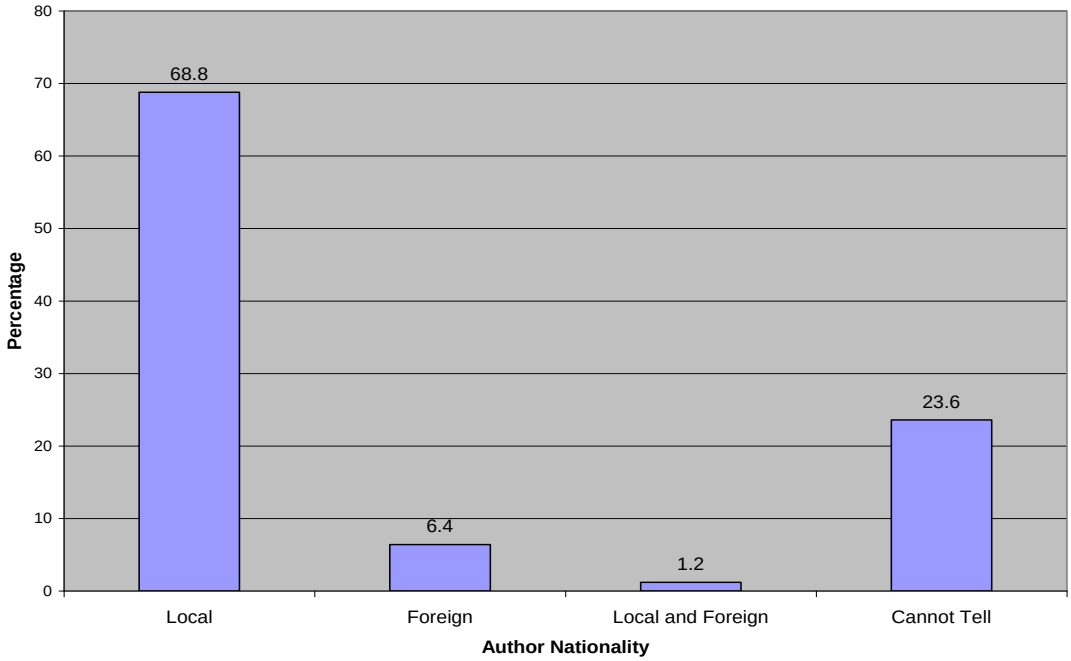
Local vs. Foreign Reporters

The study was interested in the extent to which indigenous or local journalists were active in reporting about science and technology in their own countries. Admittedly, determining the nationality of the author of a given story was hardly a straight forward endeavour. Simply judging from an individual's name would be a less than fool-proof approach, so the coders were encouraged to rely on their familiarity with the local media to determine which authors were nationals and who were foreign. Yet, even then, the coders could not tell with certainty the nationalities of the authors in about 24% of the articles analysed.

In any case, the results in Figure 1 show that about 69% of the stories were written solely by local journalists and just about 6% were by foreign writers. Only one article was jointly credited to local and foreign authors. This scenario points to a substantial level of interest in science and technology among African journalists.

What this statistic does not tell us, obviously, is the regularity or frequency of these journalists' engagement with the subject and how many of them there are. It may be the case that most of these stories were written by a small number of the same journalists – which would be a positive sign of specialisation – or that they were reported by journalists with only occasional and random interest in science and technology. Clearly, there is a need to go the next step to profile the journalists who cover science and technology in the African media. This would provide a comprehensive picture of the capacity available, the existing gaps, and the necessary interventions.

Figure 1: Nationality of authors

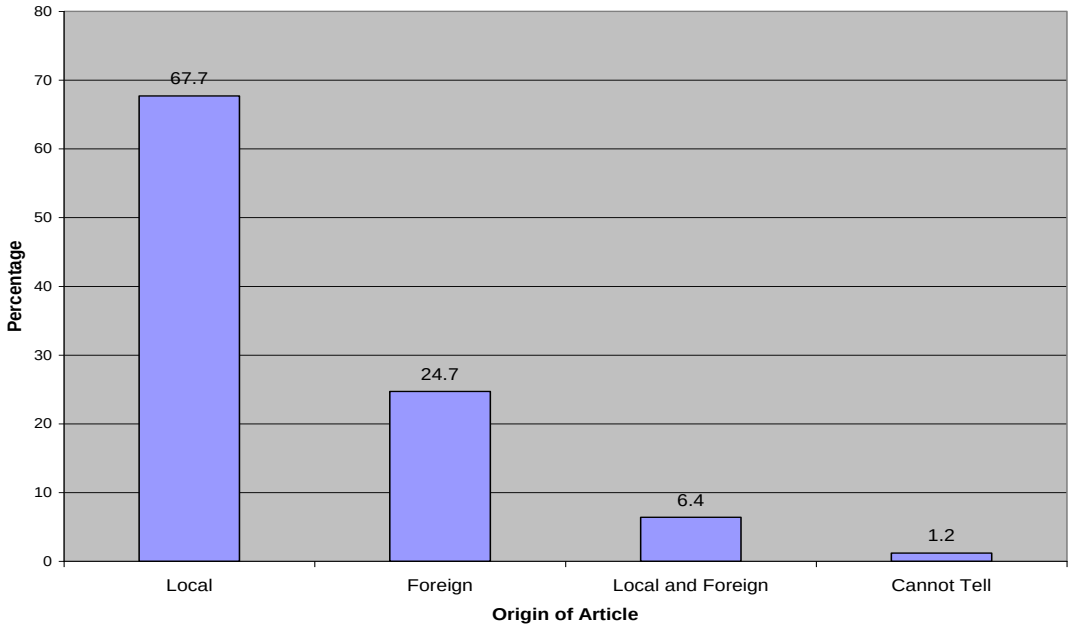


Local vs. Foreign Stories

It was anticipated that stories about science and technology could be based on issues and developments happening either in the home country or abroad. This was the basis for measuring the degree of the media's interest in science and technology issues and developments that directly affected, or were about, their own country as opposed to matters that were mostly relevant to other countries.

The study identified 68% as stories whose origins were entirely local, as the results in Figure 2 demonstrate. These were stories about science and technology affairs in the newspaper's home country. On the other hand, 25% of the articles analyzed had foreign origins while slightly over 6% had both local and foreign origins. This pattern tells us something about the preferences of the African media in terms of proximity as a news value, which is that geographical relevance is a priority in selecting stories about science and technology.

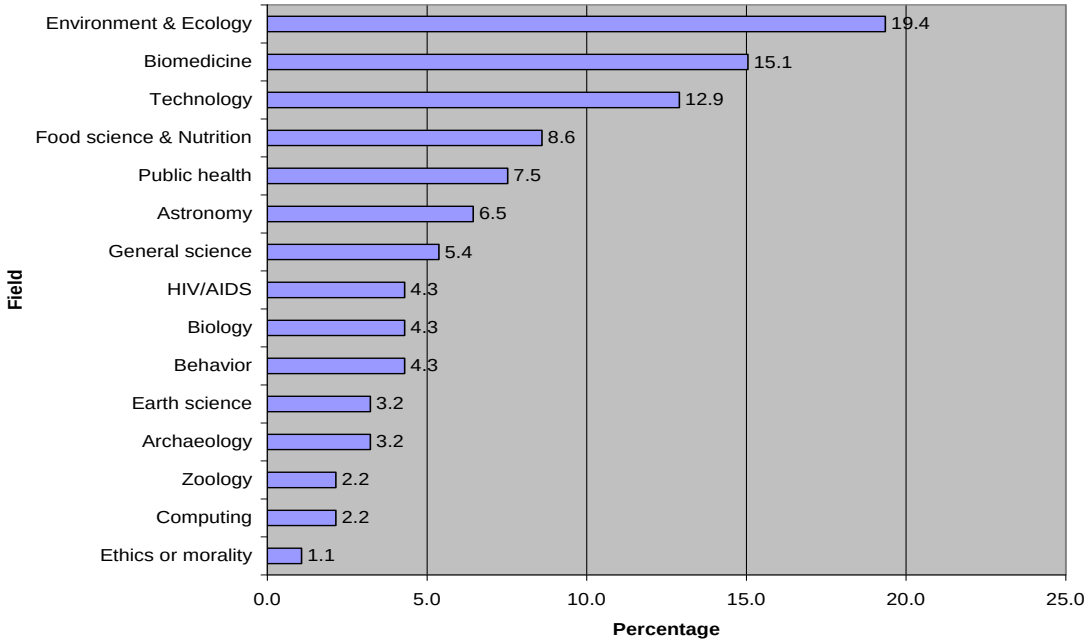
Figure 2: Origin of articles



Field of Science and Technology

Science and technology articles were classified using a modified version of a comprehensive typology that Rooyen (2002) employed for a similar study (See Appendix 3). The classification of each article was done by determining the dominant subject of the report, notwithstanding that the boundaries among various fields occasionally crisscross. The articles analyzed were categorised into 15 fields of science and technology. Looking at Figure 3, environment and ecology accounted for about 19% of the 93 stories analyzed followed by biomedicine (15%), technology (13%), and food science and nutrition (9%).

Figure 3: Field of science and technology



Negative vs. Positive Tone

Stories about science and technology could be critical and questioning or generally negative. On the other hand, they could be enthusiastic or generally positive about a specific issue. But within these extremes, the stories could also be balanced or neutral. The articles were analysed to ascertain where they stood on this continuum, as Table 2 illustrates. The majority of articles (43%) had a positive tone; quite a few (about 15%) were negative; a good number (about 28%) were neutral; while some (about 14%) were balanced.

Overall, this is a fairly even perspective of the coverage given that often when journalists are not lamenting about being at the mercy of scientists, they are being accused of being beholden to their interests. What the evidence suggests is a more nuanced situation. A journalist is expected to render a positive tone if the issues merit such an orientation. The results indicate that this happens in the majority of cases. Yet the positive view is tempered by almost as many stories that are balanced and neutral in tone.

Table 2: Tone of articles

Tone	Frequency	Percentage
Negative	14	15.1
Positive	40	43.0
Balanced	13	13.9
Neutral	26	27.9
Total	93	100

Risks vs. Benefits

Perhaps more than anything else, the public tends to interpret science and technology in terms of clear-cut consequences expressed either as risks or benefits. This is

understandable considering the normally complex subjects that science reporting deals with. Obvious benefits and risks are easier for journalists to communicate and for the public to grasp. Slightly over half (52%) of the 93 articles analysed were emphasized benefits, about 17% were mostly about risks, and close to 14% had a mix of risks and benefits, a trend depicted in Table 3.

Table 3: Consequences

Consequence	Frequency	Percentage
Mostly Benefits	49	52.7
Mostly Risks	16	17.2
Some Risks and Benefits	13	13.9
Not Applicable	15	16.1
Total	93	100

Controversy vs. Non-controversy

Science and technology are often marked by contentious debates about policies, discoveries, innovations, and so on. The issues typically pit one side against another especially when the debate involves the weighing of risks and benefits. Echoing the emphasis on benefits as earlier reported, the study revealed that most of the stories reported about science and technology were non-controversial (about 80%) compared to the few that were controversial (about 20%). Table 4 summarizes these findings.

Table 4: Controversy

Controversy	Frequency	Percentage
Controversial	19	20.4
Non-controversial	74	79.6
Total	93	100

Event vs. Process

The study looked at the nature of stories by distinguishing between event- and process-oriented reporting. Event-based stories focus on the moment, whereas process-based stories tend to go deeper, to be analytical, and to bring out underlying trends. As the data shows in Table 5, most stories about science and technology were event-based (72%) compared to those that were process-based (nearly 28%). This finding echoes what was reported earlier regarding the predominant format: news vs. features. News and events go hand-in-hand. It was therefore logical to find that these two characteristics also typified media coverage of science and technology.

Table 5: Nature of stories

Nature of Story	Frequency	Percentage
Event	67	72.1
Process	26	27.9
Total	93	100

Local vs. Foreign Sources

The research inquired into journalists' selection of sources for their stories by comparing their use of local and foreign sources to support their reporting. Sources are a journalist's lifeline, and this is more so for subjects that are technical such as science and technology. From the evidence gathered, at least 45% of the articles used mostly local scientists and authorities; at least 30% used mostly foreign scientists and authorities; and about 25% employed a combination of the two as Table 6 indicates.

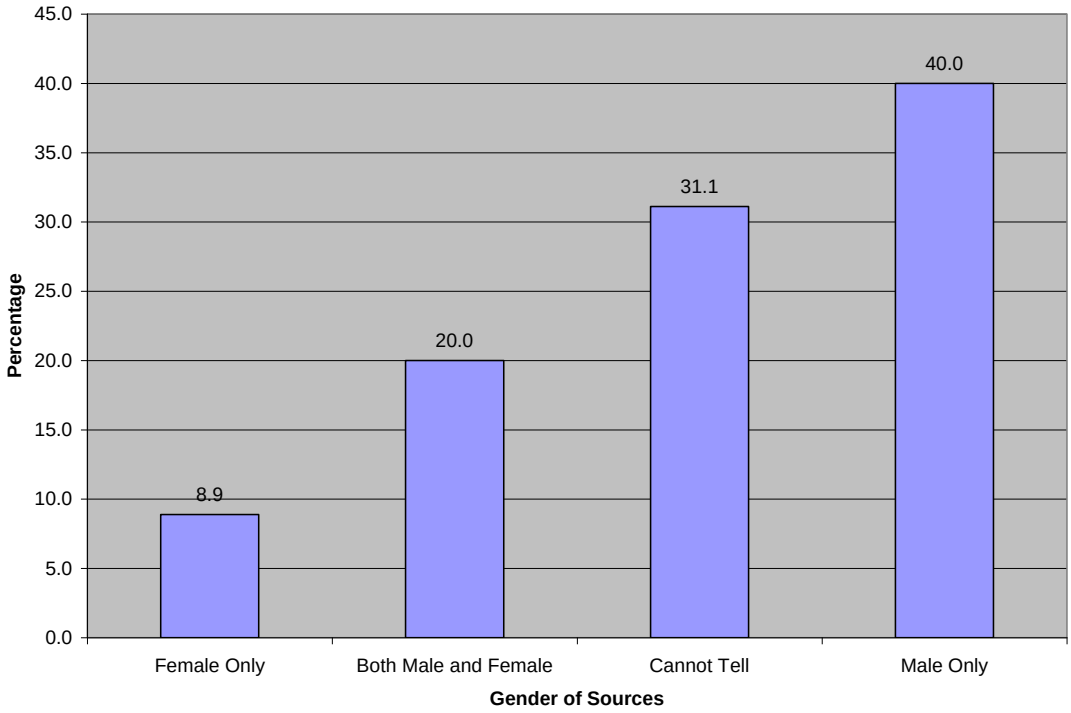
Table 6: Sources

Sources	Frequency	Percentage
Mostly Local Scientists	42	45.2
Mostly Foreign Scientists	28	30.1
Local and Foreign Scientists	23	24.7
Total	93	100

Male vs. Female Sources

Fair gender representation in the media is a perennial issue of debate. Men are known to dominate most domains of media practice including in newsrooms and in management. To the extent possible, an attempt was made to identify the gender of each news and information source in every article reviewed. The results as summarized in Figure 4 indicate that 40% of the 93 articles had only male sources compared to just about 9% that used only female sources. At least 30% of the articles used a mix of male and female sources. However, these figures have to be understood against the fact that it was impossible to determine the gender of the source(s) in as many as 31% of the articles analyzed.

Figure 4: Gender of sources



Format and Nature of Story

There was evidence of a significant relationship between the format of articles and nature of stories ($p < 0.05$), implying that news articles were more likely to be event-oriented (82.3%) while features were more likely to be process-oriented (85.7%) (See Table 7).

Table 7: Format of story by nature of story

Format of Story	Frequency	Nature of Story (%)	
		Event	Process
News	79	82.3	17.7
Feature	14	14.3	85.7
Fisher's Exact p-value = 0.000			

Author and Source's Nationality

The study found evidence of a significant relationship between the nationality of the author and the nationality of the source used ($p < 0.05$). As such, local reporters were more likely to use local scientists and authorities as sources (59.4%). Likewise, their foreign counterparts were more likely to rely on foreign experts (83.3%). Conversely, the study found no instance of a science and technology story by a foreign author that used a local expert (See Table 8).

Table 8: Author nationality by source nationality

Author Nationality	Frequency	Source Nationality (%)		
		Local	Foreign	Combination
Local	64	59.4	6.3	34.4
Foreign	6	.	83.3	16.7
Local and Foreign	1	100.0	.	.
Cannot Tell	22	13.6	86.4	.
Fisher's Exact p-value = 0.000				

Origin of Story and Source Nationality

There was evidence of a significant relationship between the origin of an article and the nationality of the science and technology expert cited ($p < 0.05$). Thus, stories of local origin were more likely to cite local scientists and authorities (63.4%), whereas stories with foreign origins were more likely to rely on foreign experts as sources (95.6%) (See Table 9).

Table 9: Origin of story by source nationality

Origin of Story	Frequency	Source Nationality (%)		
		Local	Foreign	Combination
Local	63	63.4	6.4	30.2
Foreign	23	.	95.6	4.4
Local and Foreign	6	16.7	33.3	50.0
Cannot Tell	1	100.0	.	.
Fisher's Exact p-value = 0.000				

Tone of Story and Consequences

From the results of this research, the tones of stories varied significantly by their consequences ($p < 0.05$). Negative stories were more likely to emphasize risks (71.4%) while stories with a positive tone were more likely to emphasize benefits (97.5%). Balanced stories, on the other hand, tended to focus as much as on benefits (53.8%) (See Table 10).

Table 10: Tone of story by consequences

Tone of Story	Frequency	Consequences (%)			
		Mostly Benefits	Mostly Risks	Risks/ Benefits	Not Applicable
Negative	14	.	71.4	21.4	7.1
Positive	40	97.5	.	2.5	.
Balanced	13	38.5	7.7	53.8	.
Neutral	26	19.2	19.2	7.7	53.8
Fisher's Exact p-value = 0.000					

Tone of Story and Controversy

The tone of a story was found to vary significantly by whether it was controversial or non-controversial ($p < 0.05$). As a result, positive (90.0%) and neutral (92.3%) stories

tended to be non-controversial whereas balanced articles were somewhat controversial (53.8%) (See Table 11).

Table 11: Tone of article by controversial status

Tone of Article	Frequency	Controversial Status (%)	
		Controversial	Non-Controversial
Negative	14	42.8	57.1
Positive	40	10.0	90.0
Balanced	13	53.8	46.2
Neutral	26	7.7	92.3
Fisher's Exact p-value = 0.000			

Controversy and Consequences

The controversial status of a story varied significantly by its consequences ($p < 0.05$). In other words, non-controversial articles tended to focus on benefits (56.7%) whereas controversial articles tended to be as much about risks as benefits (31.6%)

Table 12: Controversial statues by consequences

Controversial Status	Frequency	Consequences (%)			
		Mostly Benefits	Mostly Risks	Risks/ Benefits	Not Applicable
Controversial	19	36.8	26.3	31.6	5.3
Non-controversial	74	56.7	14.8	9.5	18.9
Fisher's Exact p-value = 0.026					

CONCLUSION

As evidenced from the arguments advanced herein, there are varied reasons for the dearth of science and technology issues in the African media. Foremost among these is that science and technology issues are often considered complex or that journalists in Africa lack specialized knowledge and competence to cover them. This is compounded by the fact that despite the limited competence within many newsrooms in Africa, the media have made little investment in trying to improve the capacity of journalists to enable them give science and technology issues informed coverage.

What's more, the scientific community hardly trusts journalists because of the fear of being misquoted or quoted out of context. This is despite the fact that the media and the scientific community ought to have a symbiotic relationship (scientists as sources and the media as interpreters and disseminators of the information). This is of course not peculiar to Africa although it demonstrates a worrying trend where issues considered of 'little' public interest, however vital to society, are hardly covered. As this study found, politics and other 'more interesting' issues are often given more and better coverage and space in Africa's media.

On the bright side, however, this research found out that scientists may now be changing. Their dealings with journalists have improved although the levels of such engagement still remain low, and may be limited to being sources of information, and, occasionally, analysts. The new relationships are based on the fact that journalists

need to support their stories with authoritative voices or experts, as well as access to experts who are willing to give information and to share their perspectives on an issue. Fortunately, some are always willing to talk.

The study also found that common values underpinning media operations like commercialism, sensationalism, and negativity also apply to the reporting of science and technology in Africa. Such coverage is also informed by the level of understanding of the issues; time and space limitations; news format requirements; editorial control; human interest; policy activity on an issue; resonance with and relevance to audiences; dramatic occurrences; and controversy. The foregoing issues are compounded by the fact that whilst there are news organizations with policies informing science and technology reporting, most of Africa's media do not have explicit policies or guidelines on how to cover these important issues.

Despite the bleak picture painted above, some media organizations in Africa have done quite well, and continue to improve. For instance, the media in Uganda have been at the forefront of educating the public on HIV/AIDS by persistently, consistently and accurately conveying basic scientific information about transmission of the disease. In focusing on such information, the media can affect the scope and form of public knowledge, values, and action via their agenda setting, issue framing, and audience priming functions.

Similarly, the media in many African countries have in one way or another covered and primed the public's interest in science and technology issues. However, when this is done it is not because of science and technology issues per se but because of some controversy that involves such matters. In other words, science and technology issues by themselves do not seem to evoke that much interest unless they are also associated with some controversy. Science and technology are likely to attract significant public interest when they resonate with the traditional news values – that is, those attributes of the news that tend to attract people to journalistic products in the first place.

RECOMMENDATIONS

First, the media should have explicit policies and guidelines informing the coverage of science and technology. This would ensure a proactive approach in looking for and publishing stories relating to the two areas. This will also ensure that science and technology issues are given space or airtime whenever they arise. This may also mean a dedicated team of journalists is encouraged to look for such stories. This will no doubt raise the profile of science and technology issues and undoubtedly encourage journalists to take it up as a beat.

Second, given the little competence or lack of specialized knowledge of science and technology issues, it is important for media organizations to invest in people with science and technology backgrounds rather than those with only journalistic knowledge and skills. This will ensure meaningful coverage of science and technology issues. If this is not possible, it is important that the media and editors seek expert knowledge and cultivate relationships with scientists, which will increase the chances for better coverage of science and technology. Employing or investing in

people with expert knowledge of science and technology issues may also repair the damage caused by the apparent misreporting of these issues and this may in turn improve the relationship between the media and the scientific community.

Lastly, the media industry should work closely with training institutions to introduce science curricula as a way of improving the understanding of science and technology issues. Such a foundation is crucial to long-term interest in the field and improvement in its coverage.

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APPENDIX 1: INTERVIEW GUIDE FOR SCIENTISTS

Respondent's biographical details

a. Name (full name – underline the surname/last name)
b. Scientific field of specialisation (exactly as stated by the interviewee)
c. Highest academic qualification in the field of specialisation
d. Organisation or institutional affiliation
e. Position in the organisation or institution
f. Years of experience in the field of specialisation
g. Date of interview

Interview questions

1. Do you think that scientists are generally reluctant to engage with the media by providing news, information, and opinions about their work or that of other scientists?

- If YES…What do you think are the reasons for this reluctance?
- If NO…Why do you think this is not the case?

2. Do you think that scientists and journalists have different agendas and are motivated by different goals?

- If YES…How, in your view, do the interests and motivations of scientists differ from those of journalists?
- If NO…Why do you think scientists and journalists have similar interests and motivations, and what are they?

3. Are scientists justified to condemn the media for inaccurate and sensational reporting of science?

- If YES…What instances of inaccuracy and sensationalism have you encountered in media coverage of science?
- If NO…Why do you think such condemnation is unjustified?

4. Do you agree with critics who complain that "science news is too superficial, that it lacks context, understanding, and effective interpretation"?

- If YES…Can you tell us about a science story you are familiar with that fell short of your expectations in the way these critics describe?

5. Do you agree with critics who complain that "science news is too complex, aimed only at a small, elite audience"?

- If YES…Can you tell us about a science story you are familiar with that fell short of your expectations in the way these critics describe?

6. Are you confident in the ability of the media to report constructively and informatively about science?

- If YES…What gives you such confidence?
- If NO…What should journalists do to earn your confidence?

7. Do you consider some fields of science of more value to the public than are others?

- If YES…Which fields do you wish to see covered more, in order of importance, and why?
- If NO…What should determine what gets covered?

8. Have you ever been approached by a journalist to give information or your views about a scientific issue?
- If YES…Were you satisfied with the outcome, and why?
9. Have you ever volunteered information or your views to the media about a scientific issue?
- If YES…What prompted you? Were you satisfied with the outcome, and why?
10. There are claims that journalists lack the knowledge to give science issues meaningful and serious coverage.
- If AGREE…Have you come across any media reports or had encounters with journalists that would support this claim?
11. Do you consider scientific issues too complex for journalists?
- If YES…Why is this so and what should scientists do to help?
- If NO…What is your contrary view, and why?
12. Do you consider scientific issues too complex for the public?
- If YES…Why is this so and what should scientists do to help?
- If NO…What is your contrary view, and why?
13. Describe the lowest common characteristics of the kind of audience member (newspaper/magazine reader, radio listener, TV viewer, internet user) that you think science journalists should appeal to in their stories.
- For example, should the primary audience for science stories be made up of the layperson, the average high school graduate, the average university graduate, any literate person, science professional, policymaker, etc?
14. How would you describe the relationship between scientists and science journalists?
- Is it, for example, cooperative, neutral, adversarial, unquestioning, or critical?
- Could you explain your observation?
15. What, in your view, would make the ideal science news story or article in the media?

APPENDIX 2: INTERVIEW GUIDE FOR JOURNALISTS

Respondent's biographical details

a. Name (full name – underline the surname/last name)
b. Scientific field of specialisation, if any (exactly as stated by the interviewee)
c. Highest academic qualification
d. Media organisation (specify the primary media platform i.e. newspaper, magazine, radio, TV, online)
e. Position
f. Years of experience in journalism
g. Date of interview

Interview questions

1. Does your media organisation have an explicit policy for or a special interest in covering science?
- If YES…What is the policy and what is the basis of that special interest?
2. How do you cover controversial issues in science?
- Give us one example of a scientific controversy that you reported or which your media organisation covered? How did you ensure that your reporting or coverage was fair, balanced and informative?
3. What are your regular sources of science stories?
- Which sources do you value most and why?
4. Some critics say that science journalists are likely to be co-opted by their sources or to serve the interests of their sources?
- If you have observed any instances of this tendency, would you tell us about it?
5. Do you think that scientists are generally reluctant to engage with the media by providing news, information, and opinions about their work or that of other scientists?
- If YES…What do you think are the reasons for this reluctance?
- If NO…Why do you think this is not the case?
6. Do you think that scientists and journalists have different agendas and are motivated by different goals?
- If YES…How, in your view, do the interests and motivations of scientists differ from those of journalists?
- If NO…Why do you think scientists and journalists have similar interests and motivations, and what are they?
7. Are scientists justified to condemn the media for inaccurate and sensational reporting of science?
- If YES…What instances of inaccuracy and sensationalism have you encountered in media coverage of science?
- If NO…Why do you think such condemnation is unjustified?
8. Do you agree with critics who complain that "science news is too superficial, that it lacks context, understanding, and effective interpretation"?
- If YES…Can you tell us about a science story you are familiar with that fell short of your expectations in the way these critics describe?

9. Do you agree with critics who complain that "science news is too complex, aimed only at a small, elite audience"?
- If YES…Can you tell us about a science story you are familiar with that fell short of your expectations in the way these critics describe?
10. Do you consider some fields of science of more value to the public than are others?
- If YES…Which fields do you wish to see covered more, in order of importance, and why?
- If NO…What should determine what gets covered?
11. Have you ever been voluntarily approached by a scientist or science organisation to give information or views about a scientific issue?
- If YES…Were you satisfied with the outcome, and why?
12. There are claims that journalists lack the knowledge to give science issues meaningful and serious coverage.
- If AGREE…Have you come across any media reports or had encounters with journalists that would support this claim?
13. Do you consider scientific issues too complex for journalists?
- If YES…Why is this so and what should scientists do to help?
- If NO…What is your contrary view, and why?
14. Do you consider scientific issues too complex for the public?
- If YES…Why is this so and what should scientists do to help?
- If NO…What is your contrary view, and why?
15. Describe the lowest common characteristics of the kind of audience member (newspaper/magazine reader, radio listener, TV viewer, internet user) that you think science journalists should appeal to in their stories.
- For example, should the primary audience for science stories be made up of the layperson, the average high school graduate, the average university graduate, any literate person, science professional, policymaker, etc?
16. How would you describe the relationship between scientists and science journalists?
- Is it, for example, cooperative, neutral, adversarial, unquestioning, or critical?
- Could you explain your observation?
17. A common complaint is that scientists are "so intellectual and immersed in their own jargon that they can't communicate with journalists or with the public".
- Is this a fair assessment?
- Could you explain your observation?
18. What, in your view, would make the ideal science news story or article in the media?
19. Has your organisation invested any resources in building the capacity of journalists to cover science and related issues?
- Could you explain the nature of this investment?

APPENDIX 3: CONTENT ANALYSIS CODING FORM

1	Country	
2	Name of newspaper	
3	Frequency	1. Daily 2. Other (specify) _____
4	Date of publication (mm/dd/yy)	____/____/____
5	Headline[1]	
	Online story link (URL)[2]	
6	Format of the article	1. News 2. Feature
7	Nationality(ies) of the author(s)	1. Local 2. Foreign 3. Local and Foreign 4. Cannot tell
8	Origin of the article	1. Local 2. Foreign 3. Local and foreign 4. Cannot tell
9	Field of science and technology[3]	
10	Context of the article[4]	
11	Tone of the article[5]	1. Negative 2. Positive 3. Balanced 4. Neutral
12	Consequences[6]	1. Mostly benefits 2. Mostly risks 3. Some risks and benefits 4. Not applicable
13	Controversy[7]	1. Controversial 2. Non-controversial
14	Nature of the story[8]	1. Event 2. Process
15	Nationality of source(s)[9]	1. Mostly local scientists/authorities 2. Mostly foreign scientists/authorities 3. Some local and some foreign scientists/authorities
16	Gender of the source(s)	1. Male only 2. Female only 3. Both male and female 4. Cannot tell 5. Not applicable
17	Key issue[10]	
18	Basis of the article[11]	

Explanatory Notes:

[1] This is the main title of the article.

[2] Copy and paste the article's specific online link (web address) into the cell under the headline.

[3] The following list is a guide and is not exhaustive: **Archaeology** (The study of the buried remains of ancient times); **Astronomy** (The science of space, the sun, the moon and the stars); **Behaviour** (Facts and theories about human behavior); **Biomedicine** (The science of clinical medicine, biochemistry and basic biology); **Botany** (The study of plants); **Zoology** (The study of animals); **Cell & Molecular Biology** (The science of the microcosmos, including living cells and their properties; **Chemistry** (The study of the elements, compounds and the behaviour of substances); **Earth Science** (A broad term, which includes geology [the study of rocks and minerals], and oceanography [the physics and chemistry of the oceans, marine biology and the exploitation of the ocean's resources]); **Environment & Ecology** (The study of the relation of plants, animals and people to one another and to their surroundings); **Food Science & Nutrition** (The science of food and how the body utilises food); **Mathematics** (The science of numbers); **Computing** (The science and technological developments pertaining to computers); **Paleobiology** (The study of fossils); **Physics** (The study of matter and natural forces); **Technology** (The study of scientific and industrial methods and their use in society and industry); **HIV/AIDS** (Scientific developments in the understanding of HIV/AIDS and the combating of the disease); **Pseudo-science** (Assertions that are incapable of being tested or refuted by evidence, including astrology); **General Science** (Science discussed as a general topic) [Adapted from Rooyen, 2002]

[4] A general descriptor of what the article is about e.g. policy; discovery or invention; innovation; business or economics; ethics or morality; finance; research findings or project; application of science or technology; politics; legislation; culture; religion; etc.

[5] The tone is "negative" when the article in general is critical of or questions a particular development or issue. The tone is "positive" when the article in general expresses promise about or celebrates a particular development or issue. The tone is "balanced" when the article has more or else equal measures of negative and positive tones. The tone is "neutral" when the article is neither negative nor positive.

[6] Determine whether the article emphasizes the benefits or risks of a particular science and technology development or activity.

[7] The article is considered "controversial" if it is apparent from the report that the subject is contentious whereby scientists, various authorities, and ordinary people are disputing the issue and taking opposing sides.

[8] If the article is about a specific occurrence e.g. breaking news, signing of an agreement, passing of a law, announcement of a discovery, etc, it is an "event". If it is

an analysis, exposition, or report about an activity, development or issue that has or has not been in the news, then it is classified as a "process".

[9] These are the individuals or groups to whom any information and views in the article are directly or indirectly attributed. It includes personalities or organizations or companies that speak or perform actions important to the story or are the subject of a significant amount of the reporting. It excludes anonymous sources.

[10]The intro/lead or first few paragraphs of the story normally capture the core issue being written about. Summarize it in a single sentence or phrase.

[11]The story may be based on original reporting or investigation by the journalist or newspaper or it may be based on a research report, a press conference, a press release, a meeting, a scientific study, an interview, an announcement, etc. In addition, specify the individual or organization responsible, e.g. a group, institution, organization, company, etc.