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Science, Nano-Science and Nano-Technology Content in Nigeria's Elite and Popular Press: Focus on Framing and Socio-political Involvement

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Abstract

In Nigeria, there appears to be a gross paucity of research data on press framing of science. Moreover, we do not know how the print media frame nano-science and nano-technology which tend to hold some promise for Third World development. Neither do we know the extent of social inclusion nor the depth of political engagement in the communication of science and technology in the Nigerian press. This study investigates the extent to which science and nano-science are framed in one elite (*The Guardian*) and two popular newspapers (*Daily Trust* and *Leadership*); and if there is a significant difference in framing. It adopts the content analysis research technique involving a selection of newspapers between January 1 and December 31, 2012: the year Nigeria revised its Science and Technology Policy. Results indicate that: there is a near absence of nano-science content in the analysed papers while the coverage of other science issues abounds. Where it occurs at all, nano-science is framed as an emerging field. Frames dealing with risk/controversy, socio-economic implications, or safety/ethics rarely occur. Health/medicine, ICT, biotechnology, and high-tech issues are covered more than other science issues. Political actors, lay people, NGOs, corporations and community leaders are not significantly included in the coverage as are science publishers, scientists, the media, and government agencies. These findings have several implications for science journalism practice and development in Nigeria.

Keywords: Techno-science, media coverage, content analysis

1. Introduction

In many developing and the developed parts of the world, public knowledge and understanding of science is low. Though the level of awareness is far better in the developed world, awareness of nano-science and technology as a subject is very low or far lower in the developing world. It is therefore necessary to explain the concepts to ease understanding.

Nano-science as captured in Leinonen and Kivisaari (2010) citing (PAS 71 2005) is, "a study of phenomena and manipulation of materials of atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale." They define nanotechnology as, "design characterisation, production and application of structures, devices and systems by controlling shape and size at the nano scale." Nano-material is described as that, "with one or more external dimensions, or an internal structure on the nanoscale, which could exhibit novel characteristics (e.g. increased strength, chemical reactivity or conductivity) compared to the same material without nanoscale features. The nano as a unit of measurement represents one billionth. That is to say, a nanometre is one billionth of a metre.

Nano-science and nano-technology have several societal implications some of which are beneficial to humans. Roco and Bainbridge (2005), wrote about some 13 anticipated developments including possible technical breakthroughs, beneficial applications, possible risks, and social changes. Leinonen and Kivisaari (2010) explain that based on Roco and Bainbridge's work, nano-technology could contribute to the solution of the following social problems: healthcare and working capacities of aging population; collapse of birth rate in most advanced nations below level required for population stability; poverty and inequality, most urgently in under developed nations; and loss of jobs in advanced nations as work goes to nations with lower wages, weaker worker benefits, and worse workplace safety. Others are: threatened exhaustion of natural resources; environmental degradation including global warming; and incurable illnesses including cancer and AIDS; etc.

The solutions to these social problems are made possible for example by the convergence of nano-technology with biotechnology, information technology and nano-technology for instance, to treat chronic illnesses. It could also be in the form of using nano-enabled technologies to improve efficiency in the use of non-renewable resources or the application of nano-biosystems to detect and treat cancer or AIDS at the subcellular level (Roco and Bainbridge 2005; Leinonen and Kivisaari 2010).

On its part, the European Commission (2010) emphasises three key nano-technologies to prioritise in communication. These are as follows: nano-medicine, nano-energy and nano-environment, and; nano-and information and communication technology. It defines nanomedicine citing the European Science Foundation among other as, "the science and technology of diagnosing, treating and preventing disease and traumatic injury, or relieving pain, and of preserving and improving human health using molecular tools and molecular knowledge of the human body. Nanomedicine is said to include these major areas: (i) analytic tools, (ii) nanoimaging, (iii) nanometerial and nanodevices, (iv) novel therapeutics, (v) theranostics, (vi) drug delivery systems (vii) regenerative medicine, (viii) nanoprosthetics and (ix) clinical, regulatory and toxicological issues.

In the area of energy, nanotechnology is said to present itself for use in solar technologies, hydrogen production and storage, and fuel cells. Besides, through the application of catalysis, nanotechnology also may permit more sustainable production of pharmaceuticals, environmental protection, and the generation and distribution of energy.

It is also possible to improve the quality of water using nanoparticle-based filters, detect pollution through remote, miniature, nano-based sensors and the production of eco-friendly materials such as biodegradable plastics, less toxic rechargeable batteries, and self cleaning, nano-coated glass. Concerning information and communication technologies, nanotechnology is said to bear the potential of improving information processing systems resulting in more potent hardware and other merits such as large memory-storage capability, faster access, data conservation during power interruption and better computer-physical world interface.

In the next section, we shall see if the Nigerian Science, Technology and Innovation Policy accommodates nano-science and nano-technology. We shall see also what sorts of nano-science and nano-technology activities occur in Nigeria.

1.1 Nigeria's Science, Technology and Innovation Policy and its Nano-science and Technology Activities

The Science, Technology and Innovation (ST&I) Policy enunciated by Nigeria's Federal Ministry of Science and Technology in 2012 replaces an earlier one faulted as not being elaborate enough. The mission of the national ST&1 Policy is to, "evolve a nation that harnesses, develops and utilises ST&I to build a large, strong, diversified sustainable and competitive economy that guarantees a high standard of living and quality of life for its citizens" (Federal Ministry of Science and Technology 2012).

The general policy objective is that of building a virile science, technology and innovation capacity and capability required to produce a modern economy while the specific policy objectives include, in brief; knowledge acquisition, institutional support, innovation, encouragement of diffusion of local technology, development of ST&I data base, creating and sustaining reliable mechanisms for funding, initiating and strategising on bilateral and multilateral co-operation in ST&I.

An important aspect of the ST&I Policy that we need to underscore because it borders on this discourse is the one that seeks to, "promote activities that enhance effective ST&I communication and inculcation of ST&I culture in Nigerians". Similarly, one of the policy strategies of the document is the item that also addresses the concern of this discourse. It is that of, "popularising ST&I through regular technology fairs, exhibitions, S& T clubs and the mass media (films, newspapers, radio, television, Internet, etc."

Very significantly, Nigeria's National Science, Technology and Innovation Policy in its 12th item addresses itself to, "New and Emerging Technologies (Nanotechnology and New Materials" and under it, two sub items namely:

(i) Building institutional capacity and capabilities in new and emerging technologies.
(ii) Encouraging collaborative R&D activities between industry, higher education, and research institutions on new and emerging technologies.

With the ST&I Policy in place, it is only fair to ask: what sorts of nano-science and nanotechnology occurrences are witnessed in Nigeria? The *Second Annual Report on Nano-science and nano-technology in Africa* by Tobin and Dingwall (2010) states regarding publication output that, "Nigeria is the second most active country in nano-science and nano-technology in sub-Saharan Africa region after South Africa. Nigeria has held this position consistently over the past 10 years."

The report further states that universities in Ibadan and Ife have been the most prolific and confirms that there is a national initiative on nano-technology as well as participation in regional and global activities. The report also

identifies four main themes as being relevant to Nigeria's needs. These include nano-medicine for disease detection and therapy, nano-energy, nano-biotechnology and nano-porous materials – areas that coincide well with the European Commission focal areas of priority for communication as seen earlier.

Lastly, *The Report on Nano-science and Nano-technology in Africa* (2010) concludes that there is a National Agency for Science and Engineering Infrastructure (NASENI) which sees nanotechnology, "as one of the key emerging areas where Nigeria is lacking in expertise (along with ICT and biotechnology)… thus nanotechnology has been identified as one of the 'technologies of the future' for Nigeria and is therefore given priority for research and development." NASENI has also established a National Centre for Nano-technology and Advanced Materials and there are collaborations with the US-Africa Materials Institute, Africa Institute of Technology, Federal Institute of Industrial Research, the European Union and several other bodies.

The essence of this study is to see the extent to which the Nigerian press reflects activities concerning nano-science and nano-technology. Our next focus is on the print media landscape in Nigeria.

1.2 The Print Media Landscape in Nigeria

Given the fact that this is a study of how three Nigerian newspapers cover and frame science, nano-science and nano-technology, it is necessary to have a glimpse of the Nigerian print media environment. According to the *UNDP's Guide to the Nigerian Media* (undated), Nigeria had its first newspaper in 1859 during the colonial era. Today, the print media have more than a hundred newspapers, magazines, periodicals and online sites. The sector is variously described as, "adversarial, usually combative and confrontational,… sensational, populist." A few are truly national, most are local or regional and there are also specialised publications mainly in the areas of football, energy, health, women, fashion and lifestyle/gossip.

For the purpose of this discourse, *The Guardian*, *Daily Trust* and *Leadership* are our focus. The *UNDP's Guide to the Nigerian Media* (undated) characterises *The Guardian* as, "serious, sober, and appeals largely to the upper/middle class… respected for its news and opinion…strong on politics, business, arts and sports…liberal, the most influential newspaper in the country." *The Guardian* is privately owned and based in Lagos.

Daily Trust and *Leadership* are also privately owned dailies but operate from Abuja and tend to reflect Northern Nigerian interest. The UNDP guide describes *Daily Trust* as, "seeing itself… as the voice of the North", and "renowned for its back page columnists." There is hardly a wholly science newspaper in Nigeria.

2. Statement of the Problem

We live in a world of techno-science and as Kleinman (2005) states, "citizenship in this tehno-scientific world demands that we learn to grasp the issues raised by our environment. We must nurture the building of tools that will allow us to engage in a critical understanding of developments in science and technology." This is particularly challenging in the Third World especially in Africa including Nigeria where attention paid to education is comparatively low, the literacy level is dismal and developments in science and technology are rudimentary. However, the media of mass communication including the cyberspace and other traditional channels of communication play a crucial role in creating awareness of science and technology (through the dissemination of facts, data, pictures, etc.) in whatever form that they find expression in a given society. This role is fraught with problems and challenges.

To demonstrate this, Unesco (2011) in a sponsored research on the media coverage of science and technology in Africa conducted by a multinational research team based in Makerere University, Uganda noted that, "science and technology issues are often considered complex, or that journalists in Africa lack specialised knowledge and competence to cover them." The cause of this situation the researchers observed may not be unconnected with poor investment in capacity building and the seeming distrust among scientists about journalists' ability to present accurate science stories without distortions.

Even outside Africa there are concerns about science journalism. Kennedy (2010) asks: "is science writing a disappearing culture?" Also, Russel (2010) points to the news media being short staffed with people covering special beats such as science, the skewed nature of science reporting in favour of consumer health and medicine, the tendency of science news being increasingly written by non specialists or generalist reporters as well as the trending recourse to the new media.

In the area of nano-science and nano-technology – an emerging science little understood by both the public and some communicators – several studies in places such as Australia (Petersen *et al*. 2010), China (Xie, Tang and

Xie 2012), Euro-America (Listerman 2008), United Kingdom (Anderson, et. al. 2005), Germany (Donk *et al*. 2012; Heidmann and Milde 2013; Guenther and Ruhrmann 2013); Europe (Murphy and DelleCave 2010; Kurath and Gisler 2009; Peters 2013; European Commission 2010); Slovenia (Groboljsek and Mali 2012) and Finland (Leinonen and Kivisaari 2010) also identify problems of coverage, framing, perception, sourcing, attribution and reportage of nano-science and nano-technology news.

In Nigeria, as noted earlier, we do know there is a science, technology and innovation policy. We also do know that there are science, nano-science and nano-technology experts and that activities in these areas occur in the country. We equally know that the print media particularly newspapers bear science information.

However, we do not know the extent to which the Nigerian newspapers attend to or frame nano-science and nano-technology issues. Neither do we know if there is any difference in framing between elite and populist newspapers nor the extent to which social and political forces are involved in the science news. These then, are the issues before this study.

3. Objective and Research Questions

The major objective of this study is to determine newspaper framing of nano-science and nano-technology in the elite and popular press in Nigeria. In order to realise this aim; the study seeks answers to the following research questions:

(a) What is the level of attention accorded science, nano-science, and nano-technology issues in *The Guardian, Daily Trust* and *Leadership* newspapers?
(b) How do Nigerian newspapers: *The Guardian*, *Daily Trust*, and *Leadership* frame nano-science and nano-technology?
(c) To what extent are social and political forces involved in science content in *The Guardian, Daily Trust* and *Leadership*?

4. Theoretical Framework

Communication theories have a wide range of utility. To West and Turner (2010), theories help us cultivate critical thinking skills, recognise the breadth and depth of research, make sense of personal life experiences as well as foster self-awareness. In the arena of public communication of science, Bucchi (2008) speaks of a diffusionist conception and a continuity model which may occur at the intra-specialist, inter-specialist, pedagogic or popular level. The communication of science information through the newspapers falls into the popular category. Besides, Lewenstein (2003) observes that science may be communicated in the light of the deficit, contextual, lay expertise, or the public participation model. These models present a pattern for comprehending public communication of science activities. However, Roco and Bainbridge (2005) caution that, "the news model" of public involvement in which technical experts and the media impart information to a passive audience fails to bring about an informed public. We need information systems that facilitate two-way conversation". This sort of conversation is akin to what Peterson, Seear, and Bowman (2010) refer to as upstream public engagement. Furthermore, the European Commission (2010) extends the theory of public engagement where it states, "…any communication of science, research and technology should face the fact that the actors have swapped places. Indeed, society as a whole is increasingly becoming the focal actor of communication and the concept of public understanding of science has been turned around into that of scientific understanding of the public. The citizen (as moral and legal entity as well as consumer of S&T outcomes) has clearly become the central point of the whole communication exercise."

5. Literature Review: Framing of science, nano-science and nano-technology in the media

Framing is a pervading communication practice. Frames essentially help message sources to couch their communicated messages in a certain direction and allow receivers of information to gain a certain perspective of a subject. Donk, Metag, Kohring and Marcinkowski (2012) state that, "a frame is understood as a specific, unique pattern of text that is composed of several elements." They cite Entman (1993) thus: "a frame consists of the following elements. (a) problem definition, (b) causal attribution of responsibility, (c) moral judgement of the protagonists and their actions, and (d) treatment recommendations".

Donk *et al.*'s study on framing emerging technologies: Risk perceptions of nano-technology in the German press aimed to show the variety of perspectives on nano-technology by demonstrating how the German press framed nano-technology. Their methodology was a content analysis of media coverage of nano-technology in six German daily newspapers: two weekly news magazines and a weekly newspaper. The study was conducted

between 2000 and 2008. Articles such as news, features, editorials or op-eds constituted the unit of analysis. A total of 1, 807 articles formed the population. The analysis was based on Entman's four components of a frame.

In their findings, four frames namely: research and development (45.5%), economic benefits (28.1%), medical benefits (11.8%), and ambivalent (14.5%) emerged. The results of the study showed that framing was mainly positive and focused on medical or economic benefit. Their conclusion was that we should wait to, "see whether the positive media framing of nano-technology also leads to a positive public image."

Earlier, Nisbet (2008) outlined more elaborate frames that consistently appear across policy debates in science. In his article: Framing science: A new paradigm in public engagement, he identified social progress, economic development/competitiveness, morality/ethics, scientific/technical uncertainty and pandora's box/frankenstein's monster/run-away science (i.e. catastrophic). Others are public accountability/governance, middle way/alternative path, and conflict/strategy. For Nisbet, framing is used for several purposes by different groups. Scientists frame, "to motivate greater interest and concern thereby expanding the audience for science; to shape preferences for policies informed by or supportive of science; to influence political or personal behaviour; to go beyond polarisation and unite various publics around common ground; to define policy choices or options; and or to rally fellow scientists around shared goals or strategy."

In the case of the audience, frames are like patterns of interpretation allowing people to comprehend and discuss on issues. Very importantly, journalists use frames to, "condense complex events into interesting and appealing reports," while policy makers adopt frames to provide definitions of policy options and arrive at decisions. Generally speaking, frames, "simplify complex issues by lending greater weight to certain considerations and arguments over others… helping to, "communicate why an issue might be a problem, who or what might be responsible and what should be done."

Nisbet's structure of frames contains more elements than Listerman's. In his article on framing of science in opinion-leading news: international comparison of biotechnology issue coverage, Listerman (2008), influenced by the cultural theory identified the following frames: utility, risk, control, fate and morality. His study was a content analysis of a representative sample of coverage about biotechnology in two opinion-leading newspapers in Germany, Britain, and the United States. He found out that there was a stronger general uncertainty regarding biotechnology in Germany and in Britain compared to the United States and concluded that this, "may be connected to more attention to 'problematic,' aspects of the technology when forming opinion about it."

In the United Kingdom, Anderson, Allan, Peterson and Wilkinson (2005) studied the framing of nano-technologies in the British Press from 2003 to 2004. The sample included 10 UK-based national daily newspapers and eight UK-based national Sunday newspapers. They found out as follows: Press coverage of nano-technology during the period was concentrated in a relatively small number of elite newspapers meaning that the visibility of the issues had been largely restricted to relatively small middle class and business groups. A significant proportion of all articles featured a science-related frame indicating strong news interest in the scientific implications or application of nanotechnologies. Some of the frames included science fiction, scientific discovery, business story, social implications, funding, educational, medical discovery, celebratory, etc. The stories were not typified as belonging to a specific news genre, they included hard news, science, health, educational, and business sections. General correspondents most often wrote the articles with only 13% of the sample written by science correspondents and just 4% authored by technology correspondents or editors. Scientists, both academic and commercially based were the most frequently quoted or cited sources. The possible benefits to be derived from nano-technology received more extensive coverage than possible risks, highlighting a considerable degree of uncertainty about the exact nature of the technology. Coverage tended to simplify and individualise complex scientific debates by aligning news sources in a manner that emphasised their different viewpoints. The study concluded that carefully examining the news frames used in news coverage can contribute to stimulating a comprehension of the way some descriptions of nano-technology receive endorsement over others.

Two studies conducted in North America, specifically the United States and Canada also provide insights to the framing of nano-science and mano-technology issues in the media. Laing (undated) found out that three dominant frames in 86 percent of analysed news included profiling new technologies (47%), societal risk/benefit discussion (21%), business and market news (18%). In addition to these, eight (8) percent of the stories dealt with profiles of institutes or facilities, five percent covered economic impact and a mere one percent pertained to regulatory, legal and/or patent issues. Closely related to this study, Stephens (2005) who examined news narratives about nano-science and technology in major United States and non United States newspapers made

discoveries that did not depart significantly from Laing's study. Here the five recurring frames were scientific discoveries or projects (27%), social implications and risk (17%), business story (11%), funding (9%) and celebratory theme (7%).

Regarding the framing of nano-technology in a developing country press, Kamanlioglu and Guzeloglu (2010) found out that, in the Turkish media, the most prominent frame is scientific discoveries or project (19%), commercial practices (17%), future benefits (15%), business stories (11%) and education (9%). The findings here are similar to the American studies. What is very significant in the Turkish study compared to the others is that the economic and commercial aspects of nano-technology were rated in terms of framing, far higher than social effects and risks.

6. Research Method

This study adopted the content analysis research methodology. The purpose of content analysis according to Deacon, Pickering, Golding and Murdock (2007), "is to quantify salient and manifest features of a large number of texts, and the statistics are used to make broader inferences about the processes and politics of representation." Theme analysis was the unitisation where certain recognised themes in the text were allocated predetermined categories. The population consisted of weekly science sections of the *The Guardian*, *Daily Trust* and *Leadership* newspaper from January 1 to December 30, 2012. These newspapers publish science reports weekly as special sections or pull outs. The study undertook a census sampling of the population.

The major categorisation system adopted classified science issues into 10 areas viz; nano-science/technology, health/medicine, natural sciences, energy/environment, space/astronomy, agric/crop/animal science, geology/earth science, ICT/biotech/ high-tech/robotics, research and development/policy/funding/training, and "others". Categorisation for framing of science issues included information, risk/controversy, socio-political, economic implications, and safety/morality/ ethics. Nano-science issues were categorised into emerging beneficial science, emerging risky science, and controversial science.

Finally, the categorisation for socio-political inclusion variables in science news coverage was as follows: political actors, lay people, NGOs, corporations, media, government agencies, community/religious leaders, scientists/science organisations, and science publishers/journals. *The Guardian* was selected purposively to represent the elite press. *Leadership* and *Daily Trust* were purposively chosen to represent the populist press.

7. Results and Discussion of Findings

Results and data presented here are discussed in terms of the objective and research questions set earlier in the study as follows:

7.1 *The extent to which Nigerian newspapers namely: The Guardian, Daily Trust and Leadership attend to science issues.*

Fig. 1 Frequency of Coverage of Science Issues

Science issues	***The Guardian***		***Leadership***		***Daily Trust***		**Total**	
	N	%	N	%	N	%	N	%
Nano-science/Technology	4	3.60	2	1.08	0	0	6	1.82
Health/Medicine	28	25.23	27	14.67	32	94.12	87	26.44
Natural Sciences	21	18.91	6	3.26	0	0	27	8.20
Energy/Environment	10	9.00	23	12.5	0	0	33	10.03
Space/Astronomy	20	18.01	17	9.23	0	0	37	11.24
Agric, crop, animal sciences	0	0	14	7.60	0	0	14	4.25
Geology/Earth Science	7	6.30	2	1.08	0	0	9	2.73
ICT, Biotech, HTech, Robotics	13	11.71	53	28.80	1	2.94	67	20.36
R/D, Policy, Funding, Training	6	5.40	29	15.76	1	2.94	36	10.94
Others	2	1.80	11	5.97	0	0	13	3.95
Total	**113**	**33.74**	**184**	**55.93**	**34**	**10.33**	**329**	**100**

As shown in Figure 1, science issues covered by the three newspapers during the period of study amounted to 329. *Leadership* though a populist newspaper and based in the north of Nigeria reported 55.93% of the issues while *The Guardian*, an elitist newspaper reported 33.74% of the issues. *Daily Trust*, another populist newspaper based in the north recorded 10.33% of the coverage. For *The Guardian*, Health/medicine (25.23%), natural science (18.91%), space/astronomy (18.01%) and ICT, biotech, high-tech, and robotics received 11.71% of the coverage. Other areas of science got scant coverage.

For *Leadership* newspaper, more attention was paid to ICT, biotech, high-tech and robotics (28.80%), research and development, policy, funding and training (15.76%); health and medicine (14.67%) while energy and environment scored 12.5%. *Daily Trust* concentrated its science reporting in the area of health/medicine at the frequency of 94.12%. Other areas of science received little or no coverage. The findings here compare with Unesco/Makerere University (2011) study which showed that environment/ecology, biomedicine, and technology and food science and nutrition received more media coverage in Africa. Dunwoody (2008) also reported that, "for media outlets in many countries, the bulk of what passes for science writing is about medicine and health." Is there a significant difference in the coverage of science issues between the elite newspaper (*The Guardian* and populist papers (*Daily Trust* and *Leadership*)?
There appears to be no significant difference between elitist and populist newspapers analysed in the study regarding coverage and framing of science issues. As Figure 1 again shows, both sections of the press cover little or no nano-science issues: *The Guardian* (3.60%), *Leadership* (1.08%), and *Daily Trust* (0%). In term of frequency of coverage of science issues, *Leadership* though populist has a little edge (55.93%) over *The Guardian* (33.74%) which in turn performs better than *Daily Trust* (10.33%). In terms of science themes covered, all three newspapers tended to place emphasis on health, medicine, ICTs, biotech, and high tech issues. Anderson, Allan, Petersen and Wilkinson (2005) however found that press coverage of nanotechnology was concentrated in a relatively small number of elite newspapers.

7.2. The level of attention accorded nano-science, and nano-technology issues in The Guardian, Daily Trust and Leadership newspapers.

This study shows that nano-science and nano-technology received little or no attention in the analysed newspapers. *Daily Trust*, a popular newspaper based in the north of Nigeria recorded 0% coverage of the field. *Leadership*, another popular newspaper also based in the north had 1.08% coverage while *The Guardian*, an elite newspaper recorded 3.60%. It means that the Nigerian newspapers analysed here scarcely captured nano-science and nano-technology issues. This finding is not peculiar to Nigeria. It appears to be a general problem in developing countries. Groboljsek and Mali (2012) concluded that nano-technology is poorly represented in Slovenian newspapers. This may reflect the knowledge deficit among journalists, the low level of research and development in the area of nano-science and nano-technology in the country or the failure of scientists to interface and communicate their activities in the field of nano-science with journalists.

7.3. How the Nigerian newspapers: The Guardian, Leadership and Daily Trust frame science, nano-science and nanotechnology.

Fig. 2 a: Framing of Nano-science, Nano-tech, and nano-medicine issues

Newspapers	**Emerging beneficial science**		**Emerging risky science**		**Controversial**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
The Guardian	4	66.60	0	0	0	0	4	66.67
Leadership	2	33.33	0	0	0	0	2	33.33
Daily Trust	0	0	0	0	0	0	0	0
Total	**6**	**100**	**0**	**0**	**0**	**0**	**6**	**100**

Fig. 2 b: Framing of Science issues

Frames	*The Guardian*		*Leadership*		*Daily Trust*		Total	
	N	%	N	%	N	%	N	%
Benefits	107	96.40	132	71.74	30	88.24	269	81.76
Risk/Controversy	4	3.60	7	3.80	4	11.76	15	4.56
Socio/Pol./Econ./Implications	0	0	39	21.20	0	0	39	11.86
Safety/Morality/Ethics	0	0	6	3.26	0	0	6	1.82
Total	**111**	**100**	**184**	**100**	**184**	**100**	**329**	**100**

The very negligible number of nano-science, nano-technology and nano-medicine issues depicted in the two out of the three analysed newspapers was framed as emerging, beneficial science. As Figure 2a shows, *The Guardian* and *Leadership* which bore the reports framed the subject as a new field of science which could be used beneficially. Frames of risk or controversy did not occur. On the other hand, other science issues (Figure 2b) were framed in *The Guardian* in terms of benefit (96.40%) and risk/controversy (3.60%). There was no framing in terms of socio/political/economic implications or safety/morality/ethics. *Leadership* on the other hand framed science mainly in terms of benefits (71.74%) and socio-political-economic implications (21.20%). Framing in terms of risk/controversy of safety/morality/ethics was insignificant. On its part, *Daily Trust* framed science issues mainly in terms of benefits and risk/controversy. In sum, therefore, the three Nigerian newspapers framed nano-science issues as an emerging science with potential benefits and framed other science issues in terms of benefits. These results resonate with Heidmann and Milde's (2013) conclusion that, "content analysis of the media coverage shows that nano-technology is often framed as rather certain, and media coverage emphasises positive aspects and benefits."

7.4. The extent of social and political inclusion involvement or engagement in science reports in The Guardian, Leadership, and Daily Trust.

Fig. 3 Socio-political inclusion in science issue coverage

Socio-political variables	Newspapers							
	The Guardian		*Leadership*		*Daily Trust*		Total	
	N	%	N	%	N	%	N	%
Political actors	6	5.41	23	12.5	0	0	29	8.81
Lay people	0	0	0	0	0	0	0	0
NGOs	7	6.31	6	3.26	3	8.82	16	4.86
Corporations	2	1.80	5	2.71	0	0	7	2.13
Media	5	4.50	51	27.71	18	52.94	74	22.49
Govt. Agencies	8	7.21	34	18.47	1	2.94	43	13.06
Comm/Reli. Leaders	1	0.90	1	0.54	0	0	2	0.16
Scientists/Sc. Orgs	29	26.13	43	23.40	3	8.82	75	22.80
Sc. Publishers/Journals	53	47.74	21	11.41	9	26.47	83	25.23
Total	**11**	**100**	**184**	**100**	**34**	**100**	**329**	**100**

Figure 3 indicates that, for *The Guardian*, science publications and journals made the greatest input in science reporting to the tune of 47.74%. Scientists and science organisations were involved by about 26.13%, while

political actors, lay people, corporations, media, government agencies and community/religious stakeholders' inclusion was insignificant. In other words, *The Guardian* sourced its science reports prominently from the science community to the exclusion of political, lay, corporate, governmental/non-governmental and community stakeholders. However, *Leadership* newspapers showed a broader level of involvement for more socio-political stakeholders. The media topped with 27.71% followed by scientists/science organisations (23.40%), government agencies (18.42), political actors (12.5%), science publishers/journals (11.41%). The inclusion of other stakeholders was negligible. On the part of *Daily Trust*, the data show that the newspaper generated much of its science reports by as much as 52.94% followed by inputs from science publishers/journals to the tune of 26.47%. The study clearly shows that political actors, lay people, NGOs, corporations, and community stakeholders had very marginal or no involvement, engagement, or inclusion in media coverage of science by the three Nigerian newspapers. The findings here can be compared with Anderson, Allan, Peterson and Wilkinson's (2005) study, which found out that, "scientists...were the or governmental representatives also ranked highly while spokespersons of groups...were relatively common."

8. Implications for Development and Journalism practice

In all parts of the world, development continues to form a recurring issue. This is particularly so in Third World countries including Nigeria. Development is increasingly seen in the light of improved standard of living, access to education, improved health, greater equality, improved human rights, etc. Development is also conceived and apprehended in terms of sustainability.

The impact of nano-science and technology especially for developing countries can be contemplated in the areas of nano-medicine, better water and air quality, remote environmental detection, production of more environment-friendly materials, green manufacturing and improved information processing systems. Unfortunately, nano-science/technology development is very low in the Third World whereas it holds great prospect for the region regarding its health situation, poor water and sanitation, air pollution, environmental degradation and lack of access to information.

Given this state of affairs, the press in the Third World has a great role to play by striving to give adequate coverage to science, and especially nano-science and technology seen as an emerging field. The press also has to step up its roles in setting the agenda for the development of nano-science and technology in the Third World particularly in terms of manpower development, funding, research and development, policy framework and education. Importantly, in framing nano-science and technology issues, the press should endeavour to do so in the widest possible way so that the public may appraise the field in all its scientific, economic, political, legal, social, and cultural ramifications. Finally, the press should ensure that in matters concerning science, nano-science and nano-technology, all extant voices – scientists, government, non-governmental groups, politicians, lay people, other media, community, etc. should be given sufficient outlets to participate in, be involved with, and be engaged in science. In these ways, the press would have been seen as actively contributing to the development of the society.

9. Conclusion

Based on the findings of this study, the following conclusions have been drawn:

(a) The three newspapers analysed in this study cover science issues to a considerable extent. They each devote newshole once a week to science issues. However, coverage seem to concentrate on health and medical issues as well as ICT, biotechnology, high technology and robotics, as well as energy and environmental issues.

(b) The analysis of the three Nigerian newspapers does not indicate a significant difference in framing and coverage of science issues between elite and populist newspapers. Indeed the popular newspapers such as *Leadership* had a little edge over *The Guardian* which is an elite paper in terms of the frequency of science issues covered.

(c) This study also shows that whereas other science issues received frequent and regular attention in the three newspapers, nano-science and nano-technology issues hardly received coverage in the newspapers. This may indicate lack of knowledge among journalists in that area, an underdeveloped state of the science in the country, or strictures in science-journalism interface.

(d) Where nano-science and nano-technology received coverage at all in the three newspapers studied, the issues were framed mainly as an emerging beneficial science. Other frames prevalent in other countries where the field has developed; such as risk/controversy, uncertainty, safety, ethics did not occur.

(e) Finally, this study has shown that the stakeholding for science communication is somewhat narrow because the involvement, engagement or inclusion of important, stakeholders in science journalism is not widened. Political actors, lay people, nongovernmental organisations, corporate bodies and

community voices are hardly heard. Science communication is too important to be left to the science community, government, science agencies, and the media.

It is recommended that the capacity of journalists to engage with science should be built so that the media can ably cover science beyond health and medicine, ICTs and environment. This calls for curriculum change and development, funding of training, greater media-science collaboration, and deep upstream engagement of the public in science.

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