Policy Relevance and the Ethical Conduct of Science

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Abstract

Scientific enquiry and the communication of science are essential to achieving development goals. The demand for evidence-based policy poses a challenge to maintaining the ethical conduct of science. The modern scientist faces intense competition in light of the changing nature of collaborative efforts, the quickening pace and increasing complexity of research endeavours and a growing emphasis on commercialization of research results. Academic performance criteria continually change, becoming more demanding and increasing complex to measure. The integrity of the scientific community is challenged by cases of falsification, fabrication and plagiarism. The mass production of science outputs, evidenced by the incredible rise of predatory journals poses risks for the veracity of science. Yet, scientists are not the only ones driven by performance targets. Under the constant scrutiny of governing boards, research and development funders – both public and private – are increasing pressed to demonstrate outputs, outcomes and impact. There is an urgent need for independent research but also a need for consensus with regard to policy guidance. Consensus studies expect scientists to make sense of the available science and find a way of presenting the controversies, contradictions and convergence of evidence to guide policy decisions. Policy consensus dialogues can valorise science guidance. These practices adopt multidisciplinary approaches, bringing top rated scientists from a variety of disciplines around the table to contribute best practice examples, share experiences and lessons learnt against the background of solid critique of existing research.

1. *Scientific enquiry and the communication of science are essential to achieving universal goals*

Scientific enquiry and the communication of science are essential to achieving universal goals related to development. In an era where evidence-based policy planning and decision making is in vogue, we are called to contribute to a better and more sustainable future for all.

Throughout the ages, such developments have embraced science, its independent discoveries and advice, trusting the integrity of scientists (National Academy of Science, 1992). However, in today's world of fake news, polarised and vocal public voices and significantly improved public access to a diversity of information sources, the integrity of science is challenged and often mistrusted.

The publication of scandals in science compounds this. These bring into question the ethics of science and of the scientist themselves. As my home University believes that "Research Matters". It matters

because not only does the knowledge, technology and innovation that results matter for societal development, but what we research and choose not to research also influences society.

For all scientists, conducting science is our everyday business. We are curious about the world, what constitutes its components, elements and substance. We observe change and ask questions about what drives it. We are curious about what will drive change in the future and how what we know and do not yet know can shape and improve future well-being.

We value the unknown and enjoy the challenge and excitement of discovery. This discovery of new knowledge, technologies and innovations are exhilarating. While the pursuit of these moments requires hard work, dedication and long-term commitment; discoveries and the acclaim that they bring, are not everyday happenings in the life of a scientist.

Contrary to current drives in higher education to produce 'ready for work' graduates, many of us were not formally trained to be scientists. Yes, we are trained in the knowledge and skills of our particular profession, but rarely in the foundational ethics of being a scientist. We learn most of what we know about identifying research problems, selecting samples, conducting experiments, analysis, writing up results and drawing conclusions as well as how to publish and present research from mentors or perhaps, just being on the job. Each of these research components demands integrity and the highest level of ethical behaviour. When scientists are not honest, responsible and acting independently, they bring the credibility of the scientific community into disrepute and mistrust, breaking the social and moral contract between science and society (World Economic Forum, 2018).

Scientists have long maintained an informal system of ethics and guidelines for conducting research (National Academies of Sciences, Engineering, and Medicine, n.d.). After a series of well-publicised ethical breaches and war crimes in the mid-twentieth century, numerous codes of ethics have been published (Niemi, 2016). Most recent cases represent isolated individual dishonest misdemeanours. While some involve the lack of independence of research institutions. Most scientists would be quick to claim that we do not act in dishonest or misleading ways. But societal trust is eroded by such incidences. Trust is fragile and difficult to restore once breached.

Research requires decisions at each stage in the process and in every day of our practising lives. We cannot afford to be sloppy or inattentive to our responsibilities to conduct science in an irreproachable manner. The fact that the current digital environment makes it more likely that any misdemeanour will be exposed, means our integrity is, now more than ever, in the spotlight.

The ethical conduct of science, is, therefore, an essential. It is the responsibility of those involved in research to become familiar with the procedures so that they know what to do if misconduct is observed and can be vigilant of one's behaviour (Martinson et al., 2005).

2. *Definition of what can be covered by the expression "ethical conduct of science."*

For centuries scientists have relied on each other, on the self-correcting mechanisms of publication of data, peer review, replication and collaboration that are intrinsic to the nature of science and on the community to safeguard the integrity of the research process (National Academy of Science, 1992; Carpi & Egger, 2019).

Scientific ethics calls for honesty and integrity in all stages of scientific practice, to produce unbiased scientific knowledge, which is critical when others try to build upon or extend research findings. Research misconduct can have devastating consequences to the perpetrator, the person who reported the misconduct and the institution where it occurred. Science may ultimately be self-correcting and the research literature may be corrected, but a tarnished reputation never disappears. (Eisner & Vasgird, n.d.).

The ethical conduct of science includes upholding safety requirements, the respect of human rights and the humane treatment of animals. Of course, the specific ethical considerations will differ across disciplines and core methodological approaches of disciplines – such as in foundational science, applied sciences and social sciences. These cannot be explored in a lecture of this nature. As discussed in other sessions, the invention of and growing applications of IA, digital technologies and big data harvesting bring new challenges to the ethics of science. Many new elements have to be included in ethics applications due to these technologies and the need to protect personal privacy and rights.

Research misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results (National Academy of Science, 1992). Where:

- **Fabrication** is making up data or results and recording or reporting them[1]
- **Falsification** is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record[2][3].
- **Plagiarism** is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit (Eisner & Vasgird, n.d.).

3. *Motives driving the unethical conduct of science*

The modern scientist faces intense competition and is further burdened by difficult, sometimes unreasonable, regulatory and administrative demands (Martinson et al., 2005). Besides, the changing nature of collaborative efforts, the quickening pace and increasing complexity of research endeavours and the growing emphasis on commercialisation of research results have combined to exacerbate stresses that have always been apparent to some extent in scientific research (National Academy of Science, 1992).

We live in a complex world of public service in Universities, in publically or privately funded research institutions or in the private sector itself. For those in public institutions, we are not divorced from either public or private influences, being increasingly expected to raise funding from the private sector, while striving to attain increasingly complex performance targets. These are driven not only by personal performance but drive resource allocation at all levels of academic institutions as well as the ranking of individuals and institutions. The criteria continually change, becoming more demanding and more complex to measure.

Falsification, fabrication and plagiarism are not the only strategies used by ambitious scientists to rise above the system. The drive to dramatically increase the science outputs is also a challenge. Some use cookie-cutter research papers to drive up publication outputs or carve up reports to squeeze out the maximum numbers of papers. The incredible rise of predatory journals adds to this list of misdemeanours. Their rise demonstrates the desperate state of the ethics of scientific conduct.

We all know that the credible journals are oversubscribed, the highest-ranking journals often taking longer to get papers into print, while tightening up on the prescriptions regarding pre-press release of

[1] The famous Piltdown Man scandal had scientists fooled for over 40 years (Radford, 2016).
[2] The research record includes data or results that embody the facts resulting from scientific inquiry, and includes, but is not limited to, research proposals, laboratory records, both physical and electronic, progress reports, abstracts, theses, oral presentations, internal reports, and journal articles (Eisner & Vasgird, n.d.)
[3] Some examples of these practices relate to Jan Hendrik Schön and Robert A. Slutsky (Eisner & Vasgird, n.d.). Slutsky was apparently publishing one paper every 10 days for years and including names of many co-authors to mislead editors and cover-up for what later was learned to be a false output (Eisner & Vasgird, n.d.; (Kennedy, 2002)

research results. The sheer number of submissions puts significant strain on Editors and Associate Editors of Journals to identify unethical conduct and misdemeanours. These threats choke the reviewing processes, requiring that editorial functions be executed with extreme caution to protect the integrity of the journal, the honest authors whose work is published and the reputation of the editorial team. Meanwhile, the turnaround and release of results constrain the progressive and iterative steps of building scientific knowledge.

Scientists are not the only ones driven by performance targets. Under the constant scrutiny of governing boards, research and development funders – both public and private – are increasingly pressed to demonstrate outputs, outcomes and impact. This is often linked to short-term project funding where research impact, in particular, may not be directly observed or may not be for a relatively long period in the future. But we need to develop, advance our careers and show tangible policy impact.

Increasingly, performance systems and grant evaluations also press for evidence of public engagement. But in our eagerness to tick the boxes on grant applications, project evaluation and performance assessments, how genuine is this engagement? The often well-intended investment cases or performance benchmarks may well have unintended consequences for researchers, their institutions, the funding agency and society at large.

The issue of ethical conduct of science is sharply under focus concerning the contemporary demand for evidence-based policy. Pubic policies are in constant flux. They change with regimes, political persuasions and international development agendas. They are at the same time generic and context-specific. Policies drive resource allocation and determine public investment directions. They guide intervention mechanism choice, roll out and coverage. Although often sectorial, the inter-sectoral impacts cannot be ignored. While academic performance criteria for research demand evidence of policy influence and change, should research lead to policy interference or should we instead value the independence and integrity of science and find another mechanism to synthesise research for policy consideration?

4. ***Topic selection is guided by our moral conscience but also shaped by our ethics.***

The ethical conduct of science also influences the choice of the subject area - where one aims for scientific progress that can contribute to societal innovation and improvement. Our moral conscience guides topic selection but is also shaped by our ethics. In my research domain (food security), this often means facing a crossroad between scientific rigour and human rights considerations. For example, traditional research on the impact of an intervention on food security and nutrition would require the random selection of participants and a control sample from similar populations. This is quite simply inhumane if we are subjecting people to starvation and deprivation.

As I work in the applied science field, I want to draw some examples of ethical quandaries encountered in the application of science and around the assessment of policy impact – an important new metric that is increasingly demanded by our institutions and our funders. We have heard much about the ethics of fundamental science in this conference. This is essential science and my work draws extensively on foundational science although I do not practice it. However, I wish to use the example of policy research to underscore the necessity for the ethical conduct of science across all domains of research and across the research system.

Ethics influences the very choice of the research focus area. I have a strong moral imperative to applying my mind to research where progress can make a real difference to people's lives and to society. As a fifth-generation offspring of migrants from the Netherlands, Ireland and England who sought a new beginning, were shipwrecked *en route* elsewhere or fled famine in Europe, I grew up in

a privileged, albeit middle-class family in apartheid South Africa. Here the injustices of suffering and repression around me etched a desire to make a difference in my country and the continent of Africa. While I cannot, for one minute, assume to understand what it is like to walk in the shoes of many fellow South Africans, I can help profile their plight and propose potential policy interventions to address their daily suffering and struggles.

But where do you start with policy research or efforts to show policy impact? Many of the most pressing research questions in today's society are complex and complicated. Untangling them requires moving beyond your narrow, discipline-focussed science training and including researchers from other disciplines. The skills of the research team leader and the willingness of the team to move beyond the comfort of their own discipline to work in a genuinely integrative manner will determine whether a multidisciplinary or transdisciplinary approach is adopted.

There are challenges and limitations associated with both approaches. However, transdisciplinary approaches are often more messy, non-linear and inclusive of those who are not traditionally seen as part of a research team. The need for such methods raises several interesting questions around the ethical conduct of science. Participating in such work requires a re-look at our typical knowledge production systems and paying attention to issues in the ethical conduct of science that perhaps do not surface in traditional science fields but overlap with ethics in law, social sciences and economics. Let me provide a few examples from my own experience as a food security policy analyst.

5. *Ethics, human rights and the right to food*

Food security policy exists at the confluence of human rights agendas, the right to food and the need for the ethical conduct of science. Food security embedded in three fundamental human rights:

- The 1948 Universal Declaration of Human Rights
- The 1966 International Covenant on Economic, Social and Cultural Rights
- The 2013 UN General Assembly Resolution 67/174 on the Right to Food, supported by the 2005 Voluntary Guidelines on the Right to Food.

The Universal Declaration of Human Rights and the Nuremberg Code of 1948 both commit to preserving the dignity of the person. In the Universal Declaration on the Right to Food (UN General Assembly, 2013), article 11.2, the fundamental right of everyone to be free from hunger and a commitment by State Parties to take "individually and through international cooperation and measures, including specific programmes" to ensure this right. In terms of this article, the State's Parties are obliged to ensure adequate (access to) food and freedom from hunger. In General Comment No. 12 (paragraph 15), the obligations of governments are to:

- Respect existing access to adequate food and requires that Parties do not adopt measures that could prevent such access – either do no harm or work for good
- Protect access to adequate food
- Fulfill (facilitate) access to and use of resources and means to ensure sustainable livelihoods (of which food security is an outcome).
- Fulfill (provide) that right directly whenever an individual or group is unable to enjoy the right to adequate food (UN General Assembly, 2013).

Most national development plans seek to ensure food security for all people. Yet, many governments are struggling to identify the measures necessary to achieve these goals. This is more so in Africa, where food insecurity is fragile. The costs and risks associated with inappropriate policy choice are high, threatening to throw millions into desperation.

Food is both a means for peace and a mechanism for manipulation – threatening to topple governments or win votes for power. Research in this domain carries an enormous burden – political, economic, social and cultural environments are deeply interlinked and fragile. Yet governments have to take and implement policy choices. Given the complexity of contemporary policy issues, how do politicians decide on what decisions to take? While probably not appropriate to say, most decisions are taken without evidence-based science – largely because we are not good at packaging our work and getting it onto the table of politicians and we seldom engage anyway.

To change this we need relationship and trust. But do we lose our independence in building this trust, swaying to political objectives, when perhaps the research evidence suggests acting differently? Do we need to be more responsible when dealing with policy research? Do we have the knowledge necessary to guide policy? Is our work timely, salient and relevant? Do we shrink away in fear form policy engagement or boldly state what we know?

These questions necessitate much more thought and discussion around the ethics of science conduct. We become conscious of the need for independent research but also the need for consensus. Individuals cannot play the policy advisory role alone. None of us is capable of covering the entire scope of knowledge necessary to identify, probe and reach the best-fit scenario for complex policy decisions such as is necessary in food security policy. We have to draw on the existing body of knowledge. But, how do we handle conflicting evidence in the scientific literature and discourse? How do we act if scientific literature and discourse is biased, miscalculated or misguided?

While systematic reviews and Delphi Techniques can find common themes and commonalities; neither individuals nor machines can identify appropriate policy options and guide decision-makers through the myriad of possibilities in scientific literature, advice and recommendations. Such applications sharpen our prospects of predicting possible future outcomes of a particular course of action (take climate change as an example) but based on patterns from our past. But, will the future economy, society, environment behave in the same way as in the past?

Policy contexts are location-specific, requiring tailoring to local economic, social and cultural situations. Blueprints cannot be rolled out. Yet, in advising on policy options, who do I speak for? Do I speak for specific populations? Do I talk about them or with them? Am I qualified to speak for the destitute and hungry or can I only responsibly speak about them? In the latter case, do I know enough about the context on the ground to speak for these people?

Policy research requires multiple disciplines to engage. There are serious ethical considerations to advising on elements of science that you are not qualified to pronounce on. For example, can an economist speak with authority about nutritional matters? We need to tread cautiously, recognising the boundaries of our knowledge and the necessity to bring in experts in specific fields.

In many policy domains, the sampling techniques are not necessarily representative – they rely on accidental sampling – the participants involved in any particular event or process. These are not necessarily carefully selected and may represent significant bias. They are unlikely replicated. But this does not discredit their value and legitimacy. But does require exceptional care in documenting for reporting, analysis and in drawing conclusions that recognise these limitations.

A significant proportion of policy research is based on modelling and statistical analysis. We need to be extremely cautious with being tempted to 'make it fit', manipulating, including, excluding and extrapolating data to tell a convincing story. Often the inclusion and exclusion of variables are informed by literature – but may well also be constrained by disciplinary limitations to interpretation and practice. One example of this relates to a herd mentality in research where conclusions are drawn about elements not researched, but repeat the current trending narrative in the field.

6. *The role of consensus studies*

This is where consensus studies have an essential role to play. Consensus studies expect scientists to they make sense of the science and find a way of presenting the controversies, contradictions and convergence of evidence to guide policy decisions. Recent policy dialogues among scientists have adopted consensus study approaches. These approaches adopt multidisciplinary approaches, bringing top-rated scientists from a variety of disciplines around the table to contribute best practice examples, share experiences and lessons learnt against the background of solid critique of existing research.

Such dialogues include heated debates from scientists of different persuasions, with contradicting findings, different contextual backgrounds and different disciplinary traditions to face the challenge the science community has created for policymakers. They bring to the table literature that may have limited circulation because it is published in languages other than English. This work brings considerable insight from a range of locally-relevant contexts and diverse orientations.

I have participated in three such efforts – the founding panel of the Committee on World Food Security's High-Level Panel of Experts on Food Security and Nutrition (HLPE), the Inter-Academy Partnership (IAP) project on Food and Nutrition Security and Agriculture and the Malabo Montpellier Panel. All three involve the identification of pressing policy issues, the synthesis of literature and rigorous debate to identify the controversies, contradictions and convergence of opinions, best practice options and lessons learnt. None have been easy engagements, but have changed my perspective on many issues and heightened my awareness of the complexity of policy research and on providing carefully considered policy advice.

The HLPE is the science-policy interface of the UN Committee on World Food Security (CFS) (CFS HLPE, 2019a). The Panel was created in October 2009 as an essential element of the CFS reform. The HLPE aims to facilitate policy debates and inform policymaking by providing independent, comprehensive and evidence-based analysis and advice at the request of CFS. The CFS establishes the HLPE topics and now inform the debates at the annual conference, leading to the development of new voluntary guidelines on sustainable food systems as an example. The HLPE elaborates its studies through a scientific, transparent and inclusive process. The reports are produced by time-bound and topic-bound Project Teams, under the guidance and oversight of the HLPE Steering Committee. The Project Teams are selected by the Steering Committee following an open call for interest of experts. While being compact for evident management and coordination issues, the Project team has to embrace a variety of disciplines and background experiences (CFS HLPE, 2019b). The HLPE reports are, therefore, the result of a continuous dialogue between HLPE experts and a wide range of stakeholders (public, private or from civil society) and knowledge-holders across the world. They combining different forms of knowledge, building bridges across regions and countries, across various scientific disciplines and professional backgrounds. These reports undergo a rigorous review by the Panel, two rounds of open public comment and external review by experts. Likewise, the HLPE's study on critical and emerging issues in the area of food security and nutrition informs the work of the CFS, identifying problems, and helping members prioritise future actions and attentions on critical focal areas (CFS HLPE, 2016). By definition, emerging issues are challenging to identify. Therefore, the HLPE invites the scientific and knowledge community to provide documented inputs on the issues which are considered critical and emerging for food security and nutrition (CFS HLPE, 2016).

The IAP Food and Nutrition Security and Agriculture (FNSA) project reports included represented a global network of over 130 academies of science and medicine that sought to determine the key challenges and opportunities for science and innovation to contribute to improved food and nutrition security and agriculture (IAP, 2019). Four parallel studies were carried out, one for each region (Africa, Europe, Asia and the Pacific and the Americas), which served as a resource for a fifth study

focusing on science and policy issues that require international consideration and coordination. The report and the process of drafting the five reports recognised that addressing global food and nutrition security requires a food systems' approach that considers issues pertaining both to sustainable production and sustainable consumption, to deliver healthy and nutritious diets with a minimal environmental impact. Developing a broad evidence base and building critical mass in research and innovation (scientific, social and in policy), and mobilising these resources in advising policy is essential to build trustworthy policy guidance (Canales Holzeis et al., 2019).

The Malabo Montpellier Panel is a group of international agriculture experts who guide policy choices that accelerate progress towards food security and improved nutrition in Africa as set out in the Malabo Declaration adopted by 54 African governments in 2014 (Malabo Montpellier Panel, 2019). The Panel provides high-quality research to equip decision-makers to implement policies and programs that benefit smallholder farmers effectively. The Panel produces accessible and readable research reports for senior policymakers and key stakeholders, providing expert knowledge and guidance for policy - based on literature analysis, scientific evidence and practical experience. The Panel's emphasis on evidence-based analysis, mutual learning and exchange at the highest level of policy, positions it as a crucial actor in support of agricultural transformation and economic development in Africa. The Panel publishes technical reports and briefing papers, participates in international conferences and workshops and convenes the Malabo Montpellier Forum facilitating dialogue and knowledge sharing (Malabo Montpellier Panel, 2019).

Through such processes, the existing literature is synthesised and clear policy advice is arrived at through consensus involving at least several disciplinary experts, but sometimes with extensive public input and usually with an external review. In terms of the HLPE, rigorous processes have been developed and documented (CFS HLPE, 2019b).

7. *Conclusion*

In conclusion, each discipline has its own ethical considerations, but increasingly we are pressured into showing that our work has policy relevance, has influenced policy and led to tangible change. While many of us would love to claim this, there are a number of ethical elements to bear in mind.

I wonder if the research system is not expecting too much of us. Should this criterion apply to all research? Is the requirement not creating expectations that lead to unethical practices? Herd mentality in conclusions misleading and misguiding policymakers? Where is the moderation? The seasoned reasoning in such approaches? The moral compass guiding ethical behaviour?

The responsibilities for policy influence are exceptionally high. The risks of public policy experiments and misinformation can have significant consequences for achieving the very goals at the centre of the SDG – to leave no one behind in development.

The fourth industrial revolution brings about more and more data, increases our capacity to analyses large data sets and machine learning tells us more about how we act. However, when it comes to policy support, there can be no substitute for the sound and ethical conduct of independent science across multiple domains and the need for reaching consensus on complex societal public policy matters.

The expectations of the millennium generation will also test us in future. They are more tech-savvy, able to multitask and prefer to work in teams. But they are also more sceptical about the future.

In thinking about the ethical conduct of science, we need to think carefully about the expectations for policy influence and the mechanisms that can manage ethical values, behaviours and advice. These may well not fall into the classical misconduct categories of fabrication, falsification and plagiarism,

but are deeper and possibly more widespread ethical responsibilities towards society and our future well-being.

8. *References*

Canales Holzeis, C. et al., 2019. Food systems for delivering nutritious and sustainable diets: perspectives from the global network of science academies. *Global Food Security Submission,* p. GFS_2018_166_R1.

Carpi, A. & Egger, A., 2019. *The culture of science: Scientific ethics.* [Online]
Available at: https://www.visionlearning.com/en/library/Process-of-Science/49/Scientific-Ethics/161
[Accessed 17 November 2019].

CFS HLPE, 2016. *Critical and Emerging Issues.* [Online]
Available at: http://www.fao.org/cfs/cfs-hlpe/critical-and-emerging-issues/en/
[Accessed 25 November 2019].

CFS HLPE, 2019b. *High Level Panel of experts e-Consultations.* [Online]
Available at: http://www.fao.org/fsnforum/cfs-hlpe/hlpe-consultation-process
[Accessed 25 November 2019].

CFS HLPE, 2019. *HLPE - High Level Panel of Experts on Food Secuirty and Nutrition.* [Online]
Available at: http://www.fao.org/cfs/cfs-hlpe/en/
[Accessed 25 November 2019].

de Groote, I. et al., 2016. New genetic and morphological evidence suggests a single hoaxer created 'Piltdown man'. 3(160328).

Eisner, R. & Vasgird, D., n.d. *Responsible Conduct of Reseasrch: Research misconduct,* s.l.: Columbia Center for New Media Teaching & Learning (CCNMTL) in collaboration with the Columbia University Office for Responsible Conduct of Research.

IAP, 2019. *Food and Nutrition Security and Agriculture.* [Online]
Available at: http://www.interacademies.org/37646/Food-and-Nutrition-Security-and-Agriculture
[Accessed 25 November 2019].

Kennedy, D., 2002. More Questions About Research Misconduct. *Science,* 297(5578), p. 13.

Malabo Montpellier Panel, 2019. *About the Panel.* [Online]
Available at: https://www.mamopanel.org/about/
[Accessed 25 November 2019].

Martinson, B., Anderson, M. & de Vries, R., 2005. Scientists behaving badly. *Nature,* 435(9), pp. 737-739.

McKie, R., 2012. *Piltdown Man: British archaeology's greatest hoax,* s.l.: The Guardian.

National Academies of Sciences, Engineering, and Medicine, n.d. *Proceedings,* s.l.: National Academies of Sciences, Engineering, and Medicine chronicle.

National Academy of Science, 1992. *Panel on Scientific Responsibility and the Conduct of Research,* Washington DC: National Academy of Science.

Niemi, P., 2016. Six Challenges for Ethical Conduct in Science. *Sci Eng Ethics,* Volume 22, pp. 1007-1025.

Radford, T., 2016. *Forensic examination reveals identity of Piltdown hoax prime suspect,* s.l.: s.n.

UN General Assembly, 2013. *The right to food ,* s.l.: UN General Assembly.

World Economic Forum, 2018. *Code of Ethics: Young Scientists,* Geneva: World Economic Forum.