Working Paper

Preventing and identifying Scientific Fraud in Tree Science Research, with specific reference to World Agroforestry Centre (ICRAF)

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World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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ICRAF operates a 'Zero-tolerance' policy on the manipulation of financial and scientific data. Here we focus on the misrepresentation of scientific data, or 'Scientific Fraud'. The purpose of this paper is mainly to protect the innocent by helping everyone understand what can happen and how it can be avoided.

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Introduction

Science is often said to bar dishonesty and bad research with a triple safety net. The first is peer review, in which experts advise funders about what research to finance. The second is the referee system, which has journals ask reviewers to judge if manuscripts merit publication. The last is replication, whereby independent scientists see if the work holds up.

Even the most prestigious scientific journals, with the most rigorous systems of peer review, have had the unpleasant experience of having to withdraw publications on 'new' findings, that were based on falsified or dubious data. For example, the journal *Science* (Volume 289, 18 August 2000) retracted a paper previously published by the journal after it was found that one of the authors had falsified data. The significance of this is discussed in a thoughtful piece by Donald Kennedy in the same issue (p1137). He makes the point that every case of this type damages the reputation not only of the people and institutes involved, but, in the eyes of our public patrons, science and scientists generally. The Science case is not unique. A laboratory in Europe has recently had to retract hundreds of papers and around the world there are numerous cases being investigated.

Within ICRAF, and in many of our partner institutes, there seem to be two contradictory experiences. On the one hand there is the view that scientific fraud - the deliberate use of false data with intention to mislead – does not happen in serious scientific institutes. Apart from a few well-publicized cases (cigarette damage, Piltdown Man, stem cells, perhaps cold fusion), basic scientific ethics would prevent anyone from deliberately fabricating evidence. On the other hand many scientists have had personal experiences in which they discovered or strongly suspected that data had been falsified. However, if these cases are not openly discussed, the correct reaction of the institute is not understood and there is no discussion of the reasons for fraud occurring nor putting in place mechanisms and systems to reduce likelihood of future fraud.

The aim of this discussion paper is to change this situation by promoting discussion of the topic of fraud in science in ICRAF. The objectives are:

- to alert scientists to the possibility of fraud.
- to suggest reasons why it happens.
- to suggest steps to avoid it.
- to make sure everyone is aware of ICRAF's policy on fraud and action to take if it is discovered.

In this paper we are focusing on deliberate attempts to falsify or misrepresent data. Other science practices that many consider fraudulent or unethical are discussed elsewhere. Note that some of these may be a surprise to many. In a recent example, claiming that papers had been submitted for publication before they actually had been was judged fraudulent and led to research funding being terminated.

This paper is not a comprehensive review of scientific fraud. If you want to read more a good starting point would be the bibliography at:
http://www.chem.vt.edu/chem-ed/ethics/index.html

A very interesting discussion list is SCIFRAUD. For information send an email to LISTSERV@LISTSERV.ALBANY.EDU with the message: info SCIFRAUD

A broad article with definitions and cases can also be found at http://en.wikipedia.org/wiki/Scientific_misconduct

What is Fraud?

Practices that are indisputably fraudulent are easy to identify, and can occur at many steps of the research process. Raw data can be falsified in the field or laboratory as they are collected, or can even be made up beforehand 'under a mango tree'. Data can be further falsified as results are processed or presented in tables and graphs. Fraud can occur not just by falsification of the numbers but by deliberately changing the protocol, arbitrarily eliminating non-supporting data or misrepresenting the processes used. By strict definition some even define fraud as showing only a very small part of a photograph in a powerpoint so that additional information is not visible.

The limits to what is fraudulent are difficult to define. For example, analysing and reporting only part of the data collected, or deliberately omitting individual observations from analysis, may be good practice or may be a deliberate attempt to deceive. The distinction probably lies in the reasons why data have been filtered and the openness with which the methods are described. Similarly ambiguous is the quoting of results that are generated by a vague estimation process rather than by a well defined data collection activity. It is acceptable, and useful, to use such 'guestimates' in many situations but fraudulent to present them in a way that implies they come from a verifiable, objective or repeatable research process. Omitting to investigate suspected bias and/or report it is fraudulent. An example is the so-called "road-side" bias where interviews or crop sampling is conducted close to access roads for logistical reasons, but this has not been explained.

Another practice that is sometimes regarded as fraudulent is that of 'honorary authorship'. This is the inclusion as authors of a publication people who did not make a direct contribution to the research reported, but are listed for political reasons. This and other ethical issues concerning publication and ownership of data are discussed in other policy documents.

Why does it happen?

In an insightful article, Goodstein (http://www.its.caltech.edu/~dg/conduct_art.html) identifies 3 common characteristics of scientists who commit fraud:

1. They are under career pressure. There is seldom a simple monetary gain involved, but they feel under some pressure to produce results.
2. They know, or think they know, how the answer will turn out if the research is completed properly. While bending the rules of science, they believe they are not perverting the knowledge base.
3. They work in a field where individual experiments are not expected to be precisely reproducible, reducing the chance of detection.

All these can apply at ICRAF so we should consider ICRAF scientists at (relatively) high risk of temptation. We have identified two additional risk factors that are more applicable to the technicians and staff assisting scientists:

4. Lack of motivation.
5. Unreasonable requests or workloads imposed by supervisors (including fear of non-delivery).

Lack of motivation is often caused by lack of understanding of the reasons for, and importance of, the work being carried out. It is easy to see why staff who have carried out similar measurements or interviews hundreds of times without knowing the objectives of the research are tempted to make shortcuts. Further, if they get the impression that no one is actually using the data collected, it may be easy to take the decision to fake it.

Example 1

The technician told the researcher that the trees he wanted to use for the experiments on Pollination Effectiveness were not currently flowering in the field, but the researcher asked her/him to go back and try once more, as (s)he needed to finish the experiment before the grant would run out. The technician came back with pollen, and the experiment was done, concluding that Pollination Effectiveness was very low. Results were submitted to a journal, but internal reviewers became suspicious. The technician finally admitted that short cuts had been used to satisfy the urges of the respected researcher, and maize rather than tree pollen had been provided.

Recently in ICRAF there has also been discussion of the workloads and pressure that senior staff are subjected to. The possibility that this can also lead to fraud must not be discounted. Use of quantitative targets for work, such as the numbers of farmers that ICRAF intends to reach in the medium term, certainly helps scientists to focus, perhaps improving efficiency. However it has also led to the use of vague and over-optimistic estimation procedures. The boundary between that and fraud is not clear, but the discredit that such practices can bring to a centre are equally damaging.

Example 2

A project had set a target of 40,000 farmers using a new technology by the end of Year 3. At Year 1 there were 10,000 counted, with 20,000 at the end of Year 2. Year 3 data did not look so promising. But the Project Coordinator knew there had been lots of activity in Year 3, so 'guessed' there must be 40,000 and reported that to donors.

Example 3

Analysis of recent data showed some interesting trends, but the statisticians advised that further data would be needed before firm conclusions could be drawn. The researcher was convinced that (s)he knew the answer anyway, but applied for funding to collect these data. Some things went wrong at home and there were more urgent needs for the money than extensive field trips that would lead to data that (s)he believed were quite predictable anyway. So – the data set was enlarged rapidly and money saved for other uses. Unfortunately the statistician became suspicious…

It is clear that pressure to produce results filters throughout the institute, with scientists making unreasonable requests of field staff. The time pressure everyone feels can mean that senior staff do not spend sufficient time in the field or laboratory, and get out of touch with the requirements of a task. Eventually this leads to work schedules that can not possibly be met, resulting in a strong incentive to take short cuts.

Example 4

A senior scientist was writing up results of an important trial with collaborators. The results were contrary to expectations and suggested much earlier work had been a waste of time. The work had been given a high profile and now it looked as if expectations of important stakeholders would not be realised. The data looked much more promising if numbers in some key tables were switched around, so (s)he did this, even though there was no indication that data had in fact got mixed up.

Checking the data

A determined fraudster who understands the nature of data from their type of research can always make up numbers that look real. Luckily many people are not this able and fake data can be spotted, but only if looked for. Any supervisor should look at data collected by staff, scrutinizing both raw field (or lab) results and processed or summarised observations. It is important that this is done very soon after data collection so that it is possible to follow up on anything that looks wrong.

Things to look for in raw data include:

- Observations which seem at odds with the protocol.
- Observations which are internally inconsistent.
- Observations which are less variable than expected.
- 'Observations' which have a fixed ratio with other data and might have been calculated rather than measured.

The actual data recording process can also be checked, going back to raw data recording sheets and samples. Look out for:

- Field or lab record sheets that are spotless.
- Poorly or ambiguously labelled data sheets.
- Unexpectedly complete datasets (where at least a few missing values would be expected).
- Excessive data recorded in a single day or recording period.
- Missing data sheets but present result tables.

It is also necessary to carry out a check of the processed data, including tables of means and variances, relationships between different quantities etc. The points to look for are:

- Results that are less variable than expected.
- Inconsistencies when the same data appear in different tables, graphs or reports.
- Results that contradict known processes.

Of course there may be many reasons why data may look 'odd', from simple mistakes made with no intention to mislead, to the protocol being changed for good reason, or our preconceptions of what the data should look like being wrong - in fact that is when we really learn something in science! Fraud is actually the least likely explanation for the 'odd' data, but whatever the reason it is important for a supervisor to note that there is something that needs follow-up, and to do that thoroughly and sensitively.

Preventing the problem from arising

While the checks on data outlined above may help detect fraudulent data, we have to aim at preventing it in the first place, thereby avoiding all the costs that fraud incurs. This is a rule of any quality management. In this case there are several simple steps that can certainly reduce the risk.

Every supervisor has a responsibility to motivate staff by making sure they understand the context and reasons for the work. Senior staff in ICRAF are routinely involved in discussions of strategies and impact, but to field staff the work can often seem as just another 2 weeks to be spent tramping round asking farmers the same old questions. Encouraging staff to provide feedback on the data collection process and any anomalies they notice also leads to better insights and shows interest.

Feedback to all levels of staff is important for sustaining a high level of motivation. Lack of feedback during data collection easily leads to the impression that it does not really matter what data is provided to the researcher. Immediate feedback requires the active involvement of the scientists at the time of data collection. If the scientist is seen in the field taking an active interest in both the data collection process and the results, field staff may be convinced of its value. Feedback also requires speedy data processing. It is not unusual that data are being processed months or years after they were collected. This not only means data collectors get the impression that it is unimportant, but also that any queries that arise when data are eventually analysed can not be followed up. Junior staff are rarely informed about the outcome of their work (articles, presentations, new projects, etc.) further reinforcing the impression that it doesn't really matter what data they provide to the scientists.

Example 5

An unusually careful researcher was collecting data in a large farm survey, using a large team of enumerators. As part of the quality control process, he revisited a sample of farms from which data had reportedly been collected. He found that some of those farms had not actually been visited by enumerators.

Quality checks are notoriously difficult in off-station work, such as in on-farm experiments and social surveys. A pre-condition for detecting fraud is that the scientist in charge understands the practicalities of the work involved. For instance, if the scientist knows from experience that it takes an hour to carry out one interview then s/he will know that something is wrong if an assistant hands in twenty questionnaires daily. In some cases enumerators have been paid according to the number of completed questionnaires returned, with an obvious incentive to fake data. Performance-based salary systems should never be applied without sufficient checks in place.

Supervisors also need to be familiar with field operations to make sure they are not making unrealistic requests. A few days with a field team gives a supervisor invaluable insight into what works well, what may be error prone, and what it is reasonable to require staff to do. In other research areas very senior staff often maintain a research activity of their own so that they spend time in the field or lab, keeping track of who and what works well.

Feedback of compiled results, their implications, and the way they will be used is also important. Eventually field staff should see copies of annual reports and other publications. However draft reports, or feedback on the way the work has been received elsewhere, also help.

The same ideas apply when thinking of senior scientists and removing any motivation they have to practise fraud. ICRAF has to provide a working environment that encourages innovation, efficiency and impact without undue pressures building up. It has to ensure that results that fail to match expectations or do not confirm early optimistic predictions are valued as highly as those that promise large impact, as long as the work has been well conducted. It has to cultivate an institutional culture and reputation for integrity and responsibility, as well as for innovation and a challenging vision. If management structures are working well and everybody is communicating with supervisors then problems should be resolved long before anyone feels pushed to make up results.

Consequences of fraud and action to take

In principle, science is 'self correcting' - false results will, eventually, be found to be so and be replaced with correct information. This will take time, and in the interim there could be grave consequences of false information being passed to clients, and a substantial waste of time and money. Once fraud is exposed the effect on the credibility of the institute, partners and all individuals involved is obvious.

For these reasons, ICRAF's policy towards individuals found to be deliberately falsifying results is clear and strict. Although scientific fraud is not explicitly mentioned currently in the Personnel Policy Manual (a case of assuming it won't happen?) it is covered under the grounds for disciplinary action as:

- Gross negligence.
- Fraud or dishonesty involving ICRAF.
- Actions that bring ICRAF into disrepute.

The result is that those found guilty of fraud can expect to be summarily dismissed. In addition ICRAF may press criminal charges of fraud if appropriate.

The supervisors of those practicing fraud also bear some responsibility. It seems to be widely believed that 'I cannot be held responsible for something I don't know about'. However if it has been possible for the fraud to occur because supervision has been lax, then the supervisor is guilty of negligence. For example, a supervisor who never looks at raw data generated or never observes field data collection activities may not be using appropriate levels of supervision and so is, to some extent, also responsible for the fraud.

What to do if you suspect fraud

If you find a case of suspected fraud within ICRAF then the following steps should be taken:

1. Preserve the evidence that you feel substantiates the fraud.
2. Inform the direct supervisor of the suspicion, together with the relevant program leader, regional coordinator and director.
3. The supervisor then has to organise an investigation that establishes whether fraud has been committed and the extent to which fraudulent information has been used and published.
4. The report from this investigation is given to the Director General who will follow normal disciplinary processes as appropriate. Note that the Personnel Policy Manual includes a provision for staff to be suspended during an investigation.
5. The supervisor has to carry out comprehensive removal of fraudulent information from databases and reports. If fraudulent information has been published then the paper must be retracted. If significant fraudulent information has been included in reports to donors then they have to be informed.

All staff accused of fraud however are innocent until proven guilty. Whistleblowers or data scrutineers also have to be highly valued by all staff as they help us sharpen our practice and maintain our reputation.

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The World Agroforestry Centre is an autonomous, non-profit research organization whose vision is a rural transformation in the developing world where smallholder households strategically increase their use of trees in agricultural landscapes to improve their food security, nutrition, income, health, shelter, energy resources and environmental sustainability. The Centre generates science-base knowledge about the diverse role that trees play in agricultural landscapes, and uses its research to advance policies and practices that benefit the poor and the environment.

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