THIS WEEK

EDITORIALS

PEER REVIEW Nature journals encourage more scrutiny of code **p.142**

WORLD VIEW How golden tickets help science find new jewels **p.143**

GALAXIES Distant black hole tore apart star in a flash **p.144**

A brighter farming future

A massive, decade-long experiment involving millions of Chinese farmers demonstrates an evidence-based approach to sustainability.

In 1958, China under Mao Zedong embarked on a nationwide political project to increase agricultural productivity by collectivizing small farms across the country and forcing them to share agricultural tools. It was a disaster and contributed to a famine in which tens of millions died.

Now science has succeeded where ideology failed. A huge, decade-long experiment involving millions of farmers reports its results this week. Writing in *Nature*, scientists in China describe how they identified and passed on evidence-based techniques to make smallholder farming in the country more efficient (Z. Cui *et al. Nature* http://dx.doi.org/10.1038/nature25785; 2018). No sharing of agricultural tools was required; just the gathering and pooling of scientific data on local conditions and agricultural needs.

Running from 2005 to 2015, the project first assessed how factors including irrigation, plant density and sowing depth affected agricultural productivity. It used the information to guide and spread best practice across several regions: for example, recommending that rice in southern China be sown in 20 holes densely packed in a square metre, rather than the much lower densities farmers were accustomed to using.

The results speak for themselves: maize (corn), rice and wheat output grew by some 11% over that decade, whereas the use of damaging and expensive fertilizers decreased by between 15% and 18%, depending on the crop. Farmers spent less money on their land and earned more from it — and they continue to do so.

The results offer hope in the search for a more sustainable future on a crowded planet. After all, some 2.5 billion smallholders together farm 60% of the world's arable land. Beyond that, the project provides many lessons. First, that a scientific approach can increase agricultural productivity and cut damage to the environment. Second, that such success requires investment in what economists call the intangibles — the creation of networks to spread information and give scientists access to essential data. The scale of the research network created is impressive: 1,200 scientists, 65,000 local officials, 140,000 industry representatives and 21 million farmers across 37.7 million hectares.

Maintaining the people in those networks — in this case, the technicians and bureaucrats in local government offices — is a must. The study shows how these posts can produce benefit, both economic and environmental, far beyond what they cost. Unfortunately, in many countries, such jobs and the networks that depend on them are being cut back, often, paradoxically, in the name of efficiency.

The third lesson is that the same methods could, in principle, be used to boost agricultural efficiency elsewhere. But that will not be easy. China has well-developed regional infrastructure and relatively efficient central control, both of which allowed this project to operate on such a large scale. India and Africa — two regions that could benefit from a similar approach — do not. That makes it difficult, although not impossible, to translate the study and the results beyond China.

Fourth, the programme must be monitored and updated. Its recommendations were fine-tuned to the needs of farmers in specific regions, but these can change, especially as the climate alters. To consolidate their success, the farmers and scientists involved should continue to adapt the recommended methods.

China must now build on this project. Some 200 million smallholdings are not yet plugged into the information networks set up and so are not applying the recommendations. There is scope for easy wins here. For example, researchers could piggyback on existing but separate networks. One is the Science and Technology Backyard platforms, which operate in 21 provinces and cover a wide range of crops. They bring agricultural scientists to live in villages, and use demonstrations to show farmers better techniques. Such projects could ensure that farmers continue to learn. They could also be expanded to investigate the best use of other agricultural options, such as pest management and the use of legumes as alternatives to fertilizers.

> ***"There is a thrill in finding that expectations hold up over so grand a scale."***

Perhaps the most important lesson is that better use of existing technology can help to produce more food in a sustainable way. None of the recommendations given to China's farmers would have surprised agronomists. Still, the scientists involved deserve great credit for having the vision and the wherewithal to make the project happen.

There is a thrill in finding that expectations hold up over so grand a scale. And, ultimately, it was that scale that made the difference. It allowed the project to go where even the best smaller studies (and Mao Zedong) could not: persuading often intractable rural farmers to change their practices, and so improve efficiency and productivity. ■

Learn to tell tales

Ocean researchers are among those inspired by science fiction to tell diverse tales of the future.

Among the many things that SpaceX likes to do differently is name its hardware. Last month, chief executive Elon Musk announced that the company's latest droneship (the floating ocean platforms designed to receive reusable rocket launch boosters) will be known as A Shortfall of Gravitas. It will join existing barges Just Read the Instructions and Of Course I Still Love You.

The names will be familiar to readers of the Scottish author Iain M. Banks (who died in 2013) as based on spacecraft from his Culture series of science-fiction novels. And Banks is about to get an even wider audience: tech entrepreneur Jeff Bezos is also a fan, and his firm

Amazon has announced plans to film the first of the Culture books.

The path from science fiction to science fact has been well explored, especially in areas such as space and technology, with inventions from satellites to iPads first imagined in stories. But can the influence go further? What if it is not the concepts described by science fiction that could have the most impact, but the act of storytelling — the creation of scientific narratives — itself?

That's the goal of something called science-fiction prototyping. Developed by Brian David Johnson at computer company Intel a decade or so ago to help the firm's engineers anticipate future demand, the approach takes scientific facts and spins them into the future to explore the societal scenarios that could emerge. Advocates say an emphasis on exploring how humans might react to technological change creates a "focused, tailored and creative way to think about possible futures around a particular issue" (A. Merrie *et al. Futures* **95,** 22–32; 2018). It differs from other forms of scenario planning, they argue, because the emphasis is placed as much on the narrative used to explore the results as on the results themselves, and because the goal is not to reach a predetermined outcome. The method has been used by researchers at the University of Essex, UK, and King Abdulaziz University in Jeddah, Saudi Arabia, to create and test a virtual-reality-based distance-learning tool originally imagined for the year 2048 that they call the BReal Lab (go.nature.com/2fhz9za).

Sustainability scientist Andrew Merrie at Stockholm University and his colleagues have taken this principle and applied it to a topical environmental concern: the fate of the world's oceans. The project paints four scenarios for 2050–70, each of which builds on current trends in oceans governance and the fishing industry, as well as ongoing development of marine science and technology. More-uncertain outcomes — the possible collapse of ice sheets and the formation of deep-sea dead zones as a result of onshore pollution — play out differently for better and worse.

One scenario, called Oceans Back from the Brink, describes a public talk given in 2070 about how an artificial-intelligence system released all forms of confidential data, which prompted the collapse of existing corporate structures and renewed conservation efforts. Another, Rime of the Last Fisherman — Dispatches from a Dying Ocean, imagines a less-than happy ending, with decaying oceans, a geoengineering experiment gone badly wrong and onshore disaster.

"Narrative has an important role in the communication of science."

The paper in *Futures* is accompanied by striking illustrations on the project's website (go.nature.com/2orkrux).

Narrative has an important role in the communication of science, but can it also help in the pursuit of research? Purists may baulk, but stories already feature heavily, from the promised potential of work pitched in grant applications to the case studies of impact that funders increasingly ask for when projects finish. Climate-change science has long relied on emissions scenarios that diverge according to how future societies might behave. These rely not on extrapolation of current trends, but on imagined differences in, for example, whether nations come to cooperate or opt to pursue their own agendas. And climate-change policies are being planned on the basis of stories of future technology — carbon capture and negative-emissions equipment included — that many argue are pure fiction and will never materialize.

Some of the scenarios painted — in both the fictional tales of the future ocean and the high-emissions scenarios of climate modellers — are something that society, scientists included, should be desperate to avoid. To do so, data and evidence remain the priority. But in a world where both are so easily trumped by a seductive (and false) counter-narrative, perhaps more researchers should also learn to tell tales as they look ahead. ■

Code check

Researchers who rely on bespoke software are encouraged to submit the programs for scrutiny.

Computer code written by scientists forms the basis of an increasing number of studies across many fields — and an increasing number of papers that report the results. So, more papers should include these executable algorithms in the peer-review process. From this week, Nature journal editors handling papers in which code is central to the main claims or is the main novelty of the work will, on a case-by-case basis, ask reviewers to check how well the code works, and report back.

The move builds on growing demand in recent years for authors to publish the details of bespoke software used to process and analyse data. And it aims to make studies that use such code more reliable. Computational science — like other disciplines — is grappling with reproducibility problems, partly because researchers find it difficult to reproduce results based on custom-built algorithms or software.

This policy is the latest stage in the evolution of our editorial processes, which aims to keep up with technological change across the research community. All Nature journals, for example, already require that authors make materials, data, code and associated protocols promptly available to readers on request, without undue qualifications. In 2014, the Nature journals adopted a "code availability" policy to ensure that all studies using custom code deemed central to the conclusions include a statement indicating whether and how the code can be accessed, and explain any restrictions to access.

Some journals have for years gone a step further and ensured that the new code or software is checked by peer reviewers and published along with the paper. When relevant, *Nature Methods*, *Nature Biotechnology* and, most recently, journals including *Nature* and *Nature Neuroscience* encourage authors to provide the source code, installation guide and a sample data set, and to make this code available to reviewers for checking.

To assist authors, reviewers and editors, we have updated our guidelines to authors (go.nature.com/2d2i80d) and have developed a code and software submission checklist (go.nature.com/2h9ouaj) to help authors compile and present code for peer review. We also strongly encourage researchers to take advantage of repositories such as GitHub, which allow code to be shared for submission and publication.

According to the guidelines, authors must disclose any restrictions on a program's accessibility when they submit a paper. *Nature* understands that in some cases — such as commercial applications — authors may not be able to make all details fully available. Together, editors and reviewers will decide how the code or mathematical algorithm must be presented and released to allow the paper to be published.

Occasionally, other exceptions will be made — for example, when custom code or software needs supercomputers, specialized hardware or very lengthy running times that make it unfeasible for reviewers to run the necessary checks. We also recognize that preparing code in a form that is useful to others, or sharing it, is still not common in some areas of science.

Nevertheless, we expect that most authors and reviewers will see value in the practice. Last year, *Nature Methods* and *Nature Biotechnology* between them published 47 articles that hinged on new code or software. Of these, approximately 85% included the source code for review.

As with other scientific fields, the impact of computational tools is determined by their uptake. Open implementation increases the likelihood that other researchers can use and build on techniques. So, although many researchers already embrace the idea of releasing their code on publication, we hope this initiative will encourage more to do so. ■