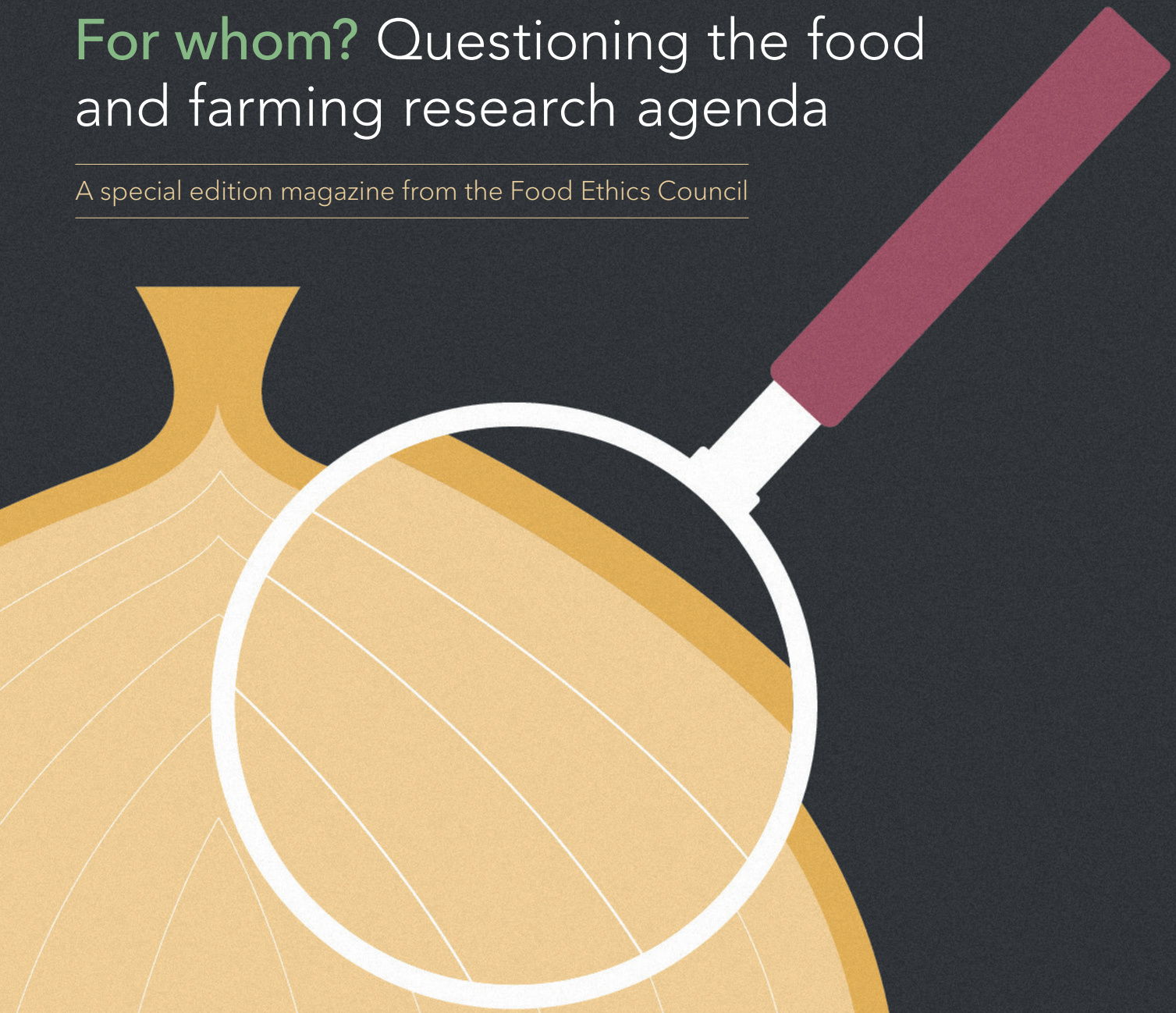
For whom? Questioning the food and farming research agenda

A special edition magazine from the Food Ethics Council



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Marion Nestle | Clara Nicholls | Helena Paul
Susanne Padel | Michel Pimbert | Jonathan Porritt
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Food Ethics Council

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This collection of articles addresses key questions about how the research agenda is set in food and farming, unmasks and challenges the dominant research paradigm, and highlights inclusive alternatives to deliver public good. In doing so, the Food Ethics Council seeks to challenge accepted opinion and spark fruitful debate about the future food and farming research agenda.

The Food Ethics Council is a charity that provides independent advice on the ethics of food and farming. Its goal is to create more conscious food systems that are fair to all people, animals and the planet.

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Publication date: January 2018

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EDITORIAL

Big questions and radical change

Dan Crossley
Executive Director, Food Ethics Council

Food is at the heart of many cultures. Food is also at the heart of many of the problems faced by society today. Research is the bridge between the problems of today and the solutions for tomorrow.

Research is about addressing questions, but many questions underpinning the food and farming research agenda are seldom asked.

For whom? By whom? Serving whom? For what? We are not the first to ask these questions, and I hope we will not be the last. If they sound like big questions, it is because they are – unashamedly. When the future of our food systems is at stake, it is important to ask big questions. It is also vital to challenge assumptions, contest the status quo, and push for ways forward that address inequity, hunger and damage to ecosystems and agricultural biodiversity.

There are many tensions surrounding food and farming research. For starters, how can we ensure the impartiality of research but at the same time ensure it has practical relevance? What should the role of corporates be? And, if corporate involvement at some level is desirable or inevitable, then how to avoid conflicts of interest? Marion Nestle explores just that issue within the realm of nutrition research.

Several of our contributors call for the research-setting process to become considerably more inclusive. The most important voices are, it seems, too often not being heard. The questions 'for whom is the research being done?' and 'who should be involved?' are more pertinent than ever.

In highlighting lessons from farmer-led research in the UK, Tom MacMillan writes that "*Farmers are in high demand... yet it is still unusual for farmers to be in the driving seat, setting the questions and getting centrally involved in research design and analysis.*" This is echoed by Ibrahima Coulibaly's powerful plea to "*Listen to farmers! Listen to farmers! Listen to farmers!*"

Contributors call for radical changes. Michel Pimbert argues that "*Nothing less than a paradigm revolution is needed to democratise food and agricultural research for the common good and the wellbeing of the planet.*" In this context, Claire Robinson asserts that "*Food and farming research has taken a wrong turn in the UK due to successive governments' obsession with genetically modified (GM) crops.*" While, Clara Nicholls and Miguel Altieri present the case that "*transitioning to an agriculture based on agroecological principles would provide rural families with significant social, economic and environmental benefits, and feed the*

"We need a high-quality research agenda which strengthens a food system that serves people, the planet and animals"

world equitably and sustainably."

In drawing out insights from the International Assessment of Agricultural Knowledge, Science & Technology for Development ('IAASTD') that took place a decade ago, Molly Anderson highlights the need for public sector research for the public good and argues the case for small-scale farmers, as being the "*largest category of people suffering from chronic undernutrition.*" In the context of small-scale 'peasant' producers who provide most people in the world with food, Pat Mooney points out "*Peasants' agroecology could be scaled up [but cannot] because of the intellectual property policies, the kinds of research orientations and the many ways the private sector has all the facetime with politicians.*" Suman Sahai, writing from India, summarises the challenge as "*the real problem however, is the traditional patriarchal approach to determining what's good for agriculture and farmers.*"

Indeed, we asked our 'big question' about 'How can food and farming research deliver for the long-term public good?'. Much debate remains on the detail of the 'how', but that it should deliver for the long-term public good is surely not up for debate. We hear from a range of contributors on this, including Jonathon Porritt, shadow food and farming minister David Drew MP, Helen Browning and Liza Draper, to name but a few.

Professor Tim Lang rightly says that "*in the UK, our food research agenda is currently paralysed by the enormity of Brexit*", which may increase the pressure, as Helen Paul warns, for "*the UK … to export its industrial research platforms to other regions, especially Africa.*" There is also talk of the need to 'take back control' from Liz Hosken, but this time not in a UK Brexit context. Liz writes of the power of community-led research and the need to build "*'affectionate alliances' with communities in a process of taking back control of their knowledge, practices and decision making…*"

Many will feel that progress in the past decade has been frustratingly slow. However, as last year's IPES-Food report "*From Uniformity to Diversity: A paradigm shift from industrial agriculture to diversified agroecological systems*" shows, yet again solutions are available; much research by its nature is long-term – but not all. Long-term in the wrong direction is no good to anyone. We need a high-quality research agenda which strengthens a food system that serves people, the planet and animals – and that helps deliver 'good food, for everyone, forever' (to borrow a phrase from Colin Tudge).

Professor Ben Mepham, our founder, articulates the need for research policy to be revised to address the priorities for food supply, namely that they should be "*sustainable, universal nutrition, by means that mitigate environmental degradation; and respect for the rights of humans and nonhumans while remaining sensitive to the diversity of cultural norms.*"

There are three things we would like to see. Firstly, we want **transparency** in the research-setting process, so that everyone can see how it is funded and who is involved. Secondly, we want **inclusivity** in how the research agendas are set – with citizens put at the heart of this, including biodiversity-enhancing farmers, who have perhaps most to offer, most to gain and most to lose. And thirdly, we want a framework introduced to ensure that **all research delivers for the long-term public good and that it contributes to fair, healthy, humane and environmentally sustainable food and farming systems both in the UK and internationally**. In our 'final viewpoint', we share further thoughts on what we at the Food Ethics Council believe is needed.

No-one yet has all the answers. But we hope you agree that this publication brings together invaluable insights from history, from different geographies and from different perspectives. Together we can make an ethical food and farming research agenda a priority. And of the question 'for whom?' Surely the answer should be 'for everyone', including the children and grandchildren of the world? Hence, we as food citizens should get involved in shaping a better future for those that will inherit our legacy.

THE BIG QUESTION

How can food and farming research deliver for the long-term public good?

Melanie Welham
BBSRC Chief Executive

Meeting the demands of a rapidly growing global population will require substantial improvements in agricultural productivity, whilst agriculture must become more sustainable and resilient. Food and farming research is helping us achieve these goals, to ensure a safe and high-quality supply of food sufficient to deliver future food and nutritional security.

Research is delivering significant improvements across the agriculture and food system and providing economic and social benefits to the UK through increased productivity, improved quality and safety, increased trade and exports, and protecting the wider environment for generations to come.

Our world-class research capabilities in institutes, centres, universities and businesses are harnessing the genomics revolution in crop and livestock breeding for improvements in traits including resilience, sustainability and resistance to pests and diseases. We are developing and using new tools and digital technologies, robotics and autonomous systems, big data, machine learning and artificial intelligence to revolutionise farming practices in the UK and further afield.

To understand real-world challenges, research into sustainable agricultural systems is integrating the biology of crops and farmed animals with farm management and the wider environment. This requires balancing production (including optimising potential trade-offs) with maintaining the natural capital on which agriculture and other ecosystem services depend.

Food and farming research is of key economic and social importance to the UK and globally. As the UK's largest public sector funder of agriculture and food security research, BBSRC takes its responsibility for future generations seriously. Our community is harnessing the step changes in understanding the biology of crops and farmed animals and combining this with novel innovations and new technologies to help address the global food and farming challenges.

Toby Hodgkin, Annelie Bernhart and Dunja Mijatovic
Platform for Agrobiodiversity Research

If food and farming research is to deliver for the public good, it must ensure that such research takes adequate account of agrobiodiversity – the diversity of crops, animals, fish and other species that are part of all production systems.

Agrobiodiversity is necessary to secure the long-term sustainability of food production systems, achieve food security, and embed the principals of food sovereignty in food systems. Research on improved use and availability of, as well as access to, agrobiodiversity will be fundamental to achieving these objectives.

Agrobiodiversity must be included in debates on the nature and content of food and farming research. This means making sure that the farmers and communities who are developers and custodians of that diversity are fully engaged in the research setting process. It also means ensuring that the research agendas recognise and respond to their roles and needs, and takes full account of their importance for the continuing maintenance and use of that diversity.

Farmers and communities that maintain agrobiodiversity include indigenous peoples and farmers in marginal environments who are often excluded from the research setting processes and whose cultural and production practices are often undervalued, if not denigrated. These include shifting cultivators and pastoral peoples around the world.

Their inclusion in any research setting process and in the development of research priorities is therefore an essential part of the development of an ethical research agenda that delivers for the long-term public good. This will require transdisciplinary research approaches that take account of different world views and traditional knowledge.

David Drew MP

Shadow Farming Minister

I have always cared about the relationship between environmental sustainability and food security. With 52% of the food we eat coming from the UK, more research is needed to find ways of ensuring that our food supplies are secure, particularly in the face of issues such as Brexit and its implications for the agricultural workforce.

We live in a time of technological revolution, and food production and farming are no exception. Through research we can make use of new technologies such as automatic milking, robotic farming and hydroponics, which can be labour saving, environmentally sustainable and secure.

However, we must also give thought to reversing the massive rise in intensive factory farming and mega-farms. As well as concerns about animal welfare, these also have negative implications for public health. For example, almost three quarters of factory-farmed pork and chicken sold in UK supermarkets has been found to be contaminated with antibiotic-resistant bacteria such as E. coli.

We could also carry out more research into our eating habits. For example, can we realistically sustain our insatiable appetite for meat? If we want to continue delivering food for the long term, a diet with less meat would reduce the need for intensive farming.

Finally, we would do well to ask how we use the food we generate. Our country throws away more than seven million tonnes of edible food each year. With a steadily growing population we need to find more efficient and environmentally friendly ways of using the food and farms we already have before expanding in an unsustainable way.

Helen Browning

Organic farmer and member of the Food Ethics Council

As a farmer, it seems everyone wants to sell you stuff that they tell you – often with little evidence – will magically increase your yields by tonnes. This was one reason why I began to farm organically. I wanted to see what I could achieve using my own resources, such as rotations, good manure management and excellent husbandry

At first it felt like a research project. I had ideas that seemed worth investigating, and questions that I wanted to answer. But support for this kind of work, which I knew would have many environmental – and potentially financial – benefits was in short supply.

There was some interest in organic methods, but it was mainly focused on policy differences rather than performance improvements. Practical work was conducted on research units rather than working farms, leading to delayed and hard-to-find results. Sometimes, as industry began to co-fund R&D, inconvenient results were smothered, with commercial partners delaying publication until they'd taken advantage of the funding. This despite public finance bearing the lion's share of the cost.

That's why I've long been keen to see two things. In applied research, I want the farmer/end user to be in the driving seat, ideally being funded to do the trials themselves, with support from scientists, as in the Soil Association's Innovative Farmers network (part of the Duchy Future Farming Programme).

For 'blue skies' research, the public should be involved in determining the work to be done. Otherwise, our new technologies will carry high levels of sunk cost that drive the need for them to succeed commercially – even though they may have little relevance to the public interest. This conflict wastes everyone's time, energy and money, when R&D could be used for the betterment of society.

Claire Robinson

Editor, GMWatch

Food and farming research has taken a wrong turn in the UK due to successive governments' obsession with genetically modified (GM) crops. Our research institutes and scientists have misused public money to align the research agenda with the interests of GM corporations. This has come at the expense of public interest research into areas of practical benefit, such as crop rotation, non-toxic pest management, and building healthy soil – which in turn make healthy crops and healthy people.

Even GMO promoter Achim Dobermann, head of the UK's Rothamsted Research, has **finally admitted** that GM crop technology is not a "major solution for agriculture". We've known for years that GM simply isn't up to the task of producing more or better food – including the new gene editing techniques, which Dobermann claims "will change the whole picture" of farming. In reality, new GM poses the **same risks** as old GM and will lead us down another blind alley.

Dobermann's institute has swallowed **millions of pounds** of public funding since it jumped on the GM bandwagon. Yet this arm of its work has produced nothing of benefit to farmers or the public. It's ironic that the UK government and scientific establishment are trying to impose this failed system, which only benefits GM seed and chemical companies, on other nations. It's time to focus on participatory research that involves farmers and the public in a transparent way from the outset.

We already produce **enough food** for 14 billion people. Over **400 world experts agree** that non-GM breeding, integrated pest management and agroecology can meet our present and future food needs in a sustainable way. Scientists should look at how they can serve these objectives while retaining the support of the public that pays their wages.

Professor Ralph Early

Harper Adams University and member of the Food Ethics Council

It is often said that the food system is broken. Globally, obesity and diet-related disease are increasing[1]. Nutrient levels of fruits and vegetables have declined over the last 50 to 100 years[2]. The University of Sheffield reported in 2014 that British soils may support only 100 more harvests. Industrial farming has created many negative externalities: biodiversity loss; the eutrophication of water courses with phosphorus and nitrogen; the development of antibiotic resistant bacteria in animal production; and the loss of insect pollinators linked to neonicotinoids.

We now understand that current methods of food production present many challenges to sustainability[3]. To meet them, the food system must change. Research is required which places people and diet-related health at the heart of farming and food industry practices, and targets the restoration and enhancement of ecosystem services.

The dilemma is that many of the food system's failings are caused by intensive, high-input agriculture driven by corporate-funded research intended to secure greater profits; but not necessarily to benefit human health and food system sustainability. Solutions enabling long-term sustainability and healthy people may offer reduced profits for corporations. If so, who will fund the research?

The answer is to embed food and farming research strongly within national food policy. Governments must recognise their moral duty to fund such research for the long-term public good.

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2 Davis, D.R. (2009) Declining fruit and vegetable nutrient composition: What is the evidence? Horticultural Science, 44, 15-19.

3 Pretty, J. (2014) Agriculture and food systems: our current challenge. In, Rosin, C., Stock, P. and Campbell, H. (Eds.) Food Systems Failure. London: Routledge.

Pat Mooney

Former Executive Director of ETC Group

We need research to start delivering public goods again. A few decades ago, the role of public research was fairly clear. It was directed to the interests of farmers and consumers. That's faded away so that most has become more a subsidy to the private sector than a benefit to citizens or producers. There's agreement that research is important but without a blessing from the private sector, the research does not happen in the public sector.

We see that globally in the CGIAR. Their research institutes are increasingly being asked to pay their own way. That means they are taking out Intellectual Property Rights, Patents and Plant Breeders Rights on what had been the public goods in their genebanks and licensing their research to companies. The reason for doing this is not so much to make profits but that they get 'credits', from international donors, for being 'valuable' to the private sector. What had been public goods are being taken away from smallholder producers.

There are many research challenges that could be addressed, from ambient temperature seed storage to improvements in small-scale farm machinery, but these are ignored and young scientists are being pushed in the direction of addressing the needs of the companies.

There is a need to recognise that the only way to get through the next decades with climate change is through a highly decentralised, highly creative approach that links together high-tech, which covers lab research, and wide-tech research being done by grassroots organisations and peasant movements around the world. The two could be complementary if there were mutual respect and good communications and if the barriers to expanding, for example, agroecology, could be removed. Peasants' agroecology could be scaled up if they could stand up. They are not being allowed to stand up because of the intellectual property policies, the kinds of research orientations and the many ways the private sector has all the facetime with politicians while peasants have almost none.

Jonathon Porritt

Founder Director, Forum for the Future

There's an intergenerational problem in setting a 'fit for purpose' R&D agenda for food and farming in the UK. How can research bodies do justice to today's short-term commercial pressures, without letting those pressures overwhelm the need for a longer-term examination of what will 'make for success' in 20 to 30 years' time?

That may sound like hyperbolic rhetoric. But ask yourself: with at least 80% of today's R&D invested in conventional intensive farming, how much of that spend has realistically factored in the dramatic impacts of accelerating climate change – not just here in the UK, but in those countries on which we currently depend for significant imports of food and raw materials? How much of it has factored in the inevitability that we will not be able to use man-made nitrogen and phosphorus-based fertilisers in the ludicrously irresponsible way that we do today?

Have research councils and academics got to grips with the fact that fossil fuels can no longer underpin our wholly spurious notions of agricultural productivity, where we use somewhere between 12 and 20 energy calories to produce one calorie's-worth of food? And what of the soil? Reputable soil scientists here in the UK tell us we have no more than 100 harvests before it's game-over for any serious farming enterprise in much of the UK. Do the maths.

These are big questions. Unfortunately, today's beguiling but utterly hollow terminology about 'climate-smart agriculture' or (even more cynically) 'sustainable intensification' tells us all we need to know about the delusions of those who set today's agenda for the future of food and farming in the UK.

Challenging the status quo

Managing conflicts in nutrition research: a historical perspective

History shows that pooling money into an 'independent' research fund doesn't work. **Marion Nestle** charts failed attempts and corporate take-overs over the years.

Whenever I talk about the conflicts of interest induced by food-industry funding of nutrition research, the first suggestion I invariably hear for solving the problem is to pool contributions into a common research fund administered by an independent third party. In theory, this method should protect researchers from feelings of obligation to any one donor company, and prevent the well-established unconscious, unintentional, and unrecognised tendencies to produce study results favourable to the funder.[1,2] But history is instructive; it demonstrates that the idea works better in theory than practice.

In 1942, Dr. Karl Compton, president of the Massachusetts Institute of Technology, announced that he had agreed to head the board of trustees of a newly formed Nutrition Foundation, established through donations from fifteen leading food manufacturers, including Campbell's Soup, General Foods, Quaker Oats and United Fruit. The foundation's purpose was to create a strong and independent programme to support basic nutrition research to improve the food, diet, and health of the American public, and applied food science research to help food companies with technical problems and product development. By "strong," Compton meant adequately funded. The initial food industry members would commit $10,000 a year to the foundation for five years. By 1947, 54 food, beverage and supplement companies were making annual contributions of $500 or more.

"Independent" meant separation of the funding from the science. The foundation appointed a scientific advisory committee to review applications and award grants, but its decisions had to be approved by the board of trustees. Because the board included food industry representatives, this requirement allowed the board to control the research agenda, even though its approval process appeared pro forma.

In his 1979 history of the foundation, Dr. Charles Glen King, who headed the scientific advisory committee, said "*the work of this committee and its rapport with the trustees were of such a quality that no grant recommendation to the board of trustees was denied or restricted in any way during my 21 years of experience as Director or President.*"[3]

However, this statement also raises questions about independence. If members wanted to remain on the committee, and if the foundation wanted donations to continue, everyone would need to meet the trustees' and donors' spoken or unspoken expectations. Gifts create obligations.

Dr. King repeatedly emphasises the independence of the scientific committee. "*It is a great satisfaction to report the fact that in no instance during 21 years of service did a member of this committee or the Board of Trustees suggest undertaking any grant or other activity that would work selfishly in the particular interest of his own organisation or against any other worthy organisation.*"

Despite these protestations, some nutrition scientists must have been dubious about the claims of independence. King quotes an unnamed member of a nutrition society: "*Of course you will have to scratch the back of your member companies occasionally and do little favours according to their interest!*" King insisted that the foundation was not run that way. Its charter specified that "*no founder or sustaining member of The Nutrition Foundation, Inc., shall refer to his membership in this corporation in his advertisement of his products; or make any other commercial reference to said membership.*" King's history quotes a speech given to the foundation's trustees in 1972 by its then-president, William Darby: "*The Nutrition Foundation… will not become a lobbying agency and must remain scientifically detached in debates affecting any particular segment of the food industry.*"

But scepticism should have been in order. Grant recipients thanked the foundation for funding in their published papers, and the foundation made sure that donors got something in return. It established an industry advisory committee to keep member companies apprised of the foundation's work, giving them early information about study results, and providing them with informal access to leading nutrition scientists. There also were tax advantages.

Because the foundation's funding model required repeated commitments from participating companies, it created ongoing pressures to please. Such pressures became more pronounced when the foundation expanded its activities beyond awarding research grants. The foundation published its own journal, *Nutrition Reviews* (which still exists), but gradually took on additional missions. It helped establish similar foundations in other countries, gave awards, published books, funded conferences and entered

into partnerships with other nutrition organisations. Its financial needs expanded accordingly.

Pressures to please might explain why reporters viewed foundation officials as spokesmen for the food industry on matters of nutrition and health. Examples include:

1962: Charles Glen King told a reporter that Rachel Carson's just-published book, *Silent Spring*, was "*bordering on hysteria*." The article identified King as the head of a "research-sponsoring organisation largely supported by the food industry."

1967: Horace L. Sipple, then executive director of the foundation, suggested that mothers could fix their families "*hot dogs and malted milks or even pizza for breakfast. It's better than nothing at all,*" he said."

1974: The foundation's president, William Darby, denounced academics concerned about the hazards of agricultural chemicals for their "McCarthyite" attack on the pesticide industry.

1982: Dr. Darby, identified by a reporter as president of a foundation "*whose trustees include top officers of corporations in the food field such as Oscar Mayer, Coca-Cola, General Foods, Swanson and Nabisco,*" said of recently published dietary guidelines, *"I don't think we should look at food-stuffs as being dangerous things…If we cut down on animal products such as lean red meats we remove one of our best sources of protein, B vitamins and iron."*

But times were changing. Government research funding, which had increased rapidly after the end of World War II, now targeted cancer, heart disease, and other chronic conditions rather than vitamins. Most large food companies closed their basic research units and shifted resources to product development and marketing. Through mergers and acquisitions, the food industry consolidated. All of this left fewer companies to contribute to the foundation's work, and its financial situation deteriorated.

In 1985, the foundation merged into the International Life Sciences Institute (ILSI), a group organised in 1978 by Coca-Cola and other food companies to promote research, but for a specific purpose: to demonstrate the safety of caffeine, food additives, and other chemical substances in foods. Although ILSI now supports research on a much broader range of topics, continues to publish *Nutrition Reviews*, and describes itself as "a nonprofit, worldwide organisation whose mission is to provide science that improves human health and well-being and safeguards the environment," it is widely recognised as a front group for the food industry. The moral: it takes more than pooling funds from food companies to maintain research independence.

"Anything short of a mandatory levy is a compromise that allows industry funding to bias the research, induces conflicts of interest, and leads to erosion of trust in nutrition science."

A more recent example of pooled funds is the nonprofit Foundation for the National Institutes of Health (FNIH), authorised by Congress to collect funds from private donors to support research and education.[4] In 2016, the FNIH distributed more than $55 million dollars, mostly for research partnerships. This money comes from hundreds of donors, ranging from grateful patients to large corporations, listed by the size of their contributions: $250 to more than $2,500,000. Here too, lines blur. FNIH actively seeks donors for specific projects and permits donors to specify areas for research.

This earmarking was evident form a front-page story in the *New York Times* about how five alcoholic-beverage companies had pledged $67.7 million to the FNIH for a study to determine whether one drink a day prevents heart attacks. This may sound like science but the funders, the size of their donation, and the research question raised red flags. I'm quoted in the article: "*Research shows that industry-sponsored research almost invariably favours the interests of the industry sponsor, even when investigators believe they are immune from such influence." But the director of NIH's alcohol institute NIH assured the reporter, "the trial will be immune from industry influence."*[5]

I can think of only one possibility that might actually work: an industry-wide research funding programme paid for by a tax or levy. Contributions would be mandatory, not voluntary, thereby eliminating the need to please donors.[6] This idea, in theory, would require all food, beverage, and supplement companies with sales over some set level to pay a fee in proportion to revenues, perhaps along the lines of the USDA's industry "checkoff" programmes. A government agency or foundation could collect the funds and administer them in much the same way as such institutions currently administer grants. A system like this has its own sources of bias, but these would not be commercially driven.

But in practice? I score its political feasibility at zero. Food companies do not like taxes and invariably oppose them, and the U.S. tax code or Congress are unlikely to permit something like this. But anything short of a mandatory levy is a compromise that allows industry funding to bias the research, induces conflicts of interest, and leads to erosion of trust in nutrition science.

Marion Nestle is professor of nutrition, food studies, and public health, New York University and author of several books about food politics. She blogs almost daily at www.foodpolitics.com and tweets @marionnestle. This article is based on material in her forthcoming "Unsavory Truth: How Food Companies Skew the Science of What We Eat." Basic Books, 2018.

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2 Krimsky S. (2004) Science in the Private Interest: Has the Lure of Profits Corrupted Medical Research. Rowman and Littlefield

3 King CG. (1976) A Good Idea: The History of the Nutrition Foundation. The Nutrition Foundation. The quotations from this report appear, in order, on pages 10, 11, 25, 163, and 118.

4 Zachwieja J, Hentges E, Hill J O, et al. (2013) Public-private partnerships: The evolving role of industry funding in nutrition research. Adv Nutr. 2013;4(5):570-2

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Agroecological research in EC programmes

The European Commission's commitment to the organic sector is becoming stronger, with CSOs holding it to account. **Les Levidow** traces recent developments.

The European Commission (EC) has a history of funding research on organic production and certification issues, but it was marginal to the main priority on biotechnology within the EC's agri-food research programmes from the 1980s onwards.

However, there have been new opportunities for organics research since 2005, when the European Commission rebranded biotech as Life Sciences for a new agenda: The Knowledge-Based Bio-Economy (KBBE).[1]

The KBBE vision extended the post-2000 Lisbon agenda, which has sought greater R&D investment in a knowledge-based economy to make Europe 'the globally most competitive knowledge-based economy by 2010'. In practice, the term 'competitive' emphasised proprietary knowledge which could be inserted into global value chains.

The EC's dominant agenda for a bioeconomy envisages that natural resources provide renewable biomass which can be converted into industrial products via a diversified biorefinery. This approach horizontally integrates value chains across industrial sectors.[2] It is a capital-intensive agenda that has been driven by European Technology Platforms, and which links multinational companies, sectoral lobby organisations and research institutes.

The KBBE vision has shaped EC research priorities since Framework Programme 7 (between 2007 and 2013). It was broadly defined as 'the sustainable, eco-efficient transformation of renewable biological resources into health, food, energy and other industrial products'.

Organic research organisations seized the opportunity this afforded by forming a stakeholder network to advocate organics and agroecosystems research for an alternative 'knowledge-based bioeconomy'.[3] They built broad stakeholder support, including relevant commercial actors across the agro-food value chain and environmental NGOs. Eventually they published a *Vision for an Organic Food and Farming Research Agenda to 2025*[4], with the aim of setting up a Technology Platform Organics.

This was followed by a *Strategic Research Agenda*, which linked the term 'innovation' with public goods, efficiency, farmers' knowledge, learning and competitive advantage. It elaborated the concept of 'eco-functional intensification', i.e. 'more efficient use of natural resources, improved nutrient recycling techniques and agroecological methods for enhancing diversity and the health of soils, crops and livestock'.[4,5] This vision advocated horizontal integration between agriculture and energy production, partly from waste materials, as a means to shorten agricultural cycles and as a substitute for external inputs: 'Diversified land use can open up new possibilities for combining food production with biomass production and on-farm production of renewable energy from livestock manure, small biotopes, perennial crops and semi-natural non-cultivated areas.'[5]

Indirect support for this agenda came from changes in research policy. The EC's Food, Agriculture, Fisheries and Biotechnology (FAFB) research programme hosted expert foresight studies exploring wider knowledges for agricultural innovation. The exercises were commissioned by the EU's Standing Committee on Agricultural Research (SCAR), with support from some national agencies promoting farmers' knowledge of natural resources. According to the first expert report, farmers often develop modest innovations, which are dismissed or ignored.[6] A more fundamental problem is that research agendas have become more distant from producers' knowledge, instead favouring specialist laboratory knowledge for agricultural inputs and processing methods.[6]

As ways forward, the expert group advocated agroecological approaches, *in situ* genetic diversity, farmers' knowledge, etc.[7] It also advocated new kinds of Agricultural Knowledge and Innovation Systems (AKIS) beyond the formal research system: 'The AKISs that have been developed outside the mainstream, to support organic, fair trade, and agroecological systems, are identified … as meriting greatly increased public and private investment'.[7] Agroecological approaches should be given priority: 'Approaches that promise building blocks towards low-input high-output systems, integrate historical knowledge and agroecological principles that use nature's capacity and model nature's system flows, should receive the highest priority for funding'.[8] The report linked agroecology with a sufficiency perspective, a counterpoint to the dominant productivist agenda.

These expert reports gave greater force to Technology Platform Organics' agenda and its specific proposals for research themes. Framework Programme 7 eventually gave greater prominence to agroecological themes, though 'agroecology' remains implicit; only 'organic' relevance is explicit in the texts. Drawing on proposals from TP Organics, FP7 calls included the following production methods: ecological services based on eco-functional intensification, enhancing soil management and

recycling organic waste via mixed farming, replacing chemical or copper pesticides with bio-control agents, enhancing on-farm production of renewable energy, etc. – generally as substitutes for external inputs.

Some research topics have sought to facilitate knowledge-bases necessary for embedding agroecological methods within wider institutions, e.g. through community-supported agriculture, agricultural extension services, food retailers and territorial labels. Knowledge for and about closer producer-consumer relations was the focus of a new topic, 'Short chain delivery of food for urban-peri-urban areas' (food localisation). Another topic emphasises 'sustainable solutions for water management and nutrient recycling' as a task for institutional interactions, e.g. in 'the relation between peri-urban pressures and the participation of farmers and other stakeholders in rural development measures'.

Despite modest success in influencing the KBBE programme, the European Commission's senior officials continued to exclusively promote the Life Sciences vision of a bioeconomy. This dominated documents for a 2011 public consultation which was meant to inform future research priorities for a European bioeconomy. In responding to the public consultation, TP Organics criticised the Commission for favouring 'specific new technologies (such as genetic modification) and capital-intensive "innovation" at the expense of agriculture'. Its intervention proposed agroecological methods and agro-food relocalisation for a different bioeconomy: government should value agricultural knowledges which have already been developed over many decades, especially in co-producing agriculture with public goods.

In all those ways, the intervention strategy has sought an explicit place for an agroecological vision in EU policy documents and long-term resources for stakeholder knowledge networks. Given the central role of 'innovation' in EU policy, agroecology was promoted as an innovative practice integrating and enhancing farmers' knowledge.[9] The successor to Framework Programme 7, Horizon 2020 (2014-20), featured the concept 'ecological intensification'; it has included greater funds for research themes relevant to agroecological practices.

Alongside specific themes, TP Organics has also advocated multi-stakeholder involvement in research: 'Stakeholders along the whole food chain … [should be] … able to participate in this development and civil society must be closely involved in technology development and innovation'.[5] This basic idea has been incorporated into the EC's research agenda as the 'multi-actor approach', whereby research proposals should demonstrate how they will involve all relevant actors in the research process. Farmers' and civil society organisations (CSOs) have been eligible for funds in the EU's research programmes since Horizon 2020.

A multi-actor approach likewise informs the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-Agri). Its agenda encompasses all types of innovation, including capital-intensive Life Sciences and farmers' knowledge of natural resources. It 'pursues the "interactive innovation model" which focuses on forming partnerships: using bottom-up approaches and linking farmers, advisors, researchers, businesses, and other actors in Operational Groups that engage in practical projects'.[10] Those Groups have facilitated farmers' joint knowledge-production with experts, including agroecological methods, resulting partly from proposals from TP Organics (2017).[11]

Beyond the agri-food sector, EU-wide CSOs have attempted to broaden the EC's research agenda to encompass diverse alternatives, especially in the run-up to FP7.[12] CSOs are currently attempting to influence the post-2020 priorities.[13] CSOs have also promoted agroecological practices for transforming the European agro-food system.[14] Such initiatives offer an opportunity for UK groups to clarify and promote their own research priorities.

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UK agricultural research: a different approach is urgently needed

Helena Paul argues that the dominant assumptions in UK agricultural research need to be challenged, opening it up to a wide range of voices and disciplines.

Currently the power in UK agricultural research lies firmly with the UK science establishment and its seven research councils. [1] These will soon, along with Innovate UK and Research England, be consolidated into 'UK Research and Innovation'.[2] They fund institutions such as Rothamsted Research and the Open Plant Synthetic Biology Research Centre and look to business for additional money.

The focus of UK agricultural research has barely shifted in twenty years and remains firmly fixed on growth and innovation, especially in genomics and industrial agriculture, mainly through large farms, corporate agribusiness and the industrial food sector. The UK also aims to export its industrial research platforms to other regions, especially Africa.

Decisions on agricultural research are made by a small group whose composition and interests have also changed little in two decades. Scientists and companies may lack sufficient detachment to assess their projects dispassionately, yet there are few alternative viewpoints and little genuine debate. Instead, policy is narrowly focused on science and technology for industrial production. It largely excludes advocates of different approaches to agriculture such as agroecology and organic; and ethical and societal considerations. Beyond occasional public engagement exercises where alternative views and suggestions are marginalised, the public is also largely excluded.

The UK science establishment – a brief outline

The government funds major parts of the UK science establishment, with a strong emphasis on working with business. Of the seven UK Research Councils, the most obviously involved in agricultural research are the Biotechnology and Biological Sciences Research Council (BBSRC)[3] and the Natural Environment Research Council (NERC).[4] These are funded (a total of around £1 billion in 2016) through the science budget of the government's Department for Business, Energy and Industrial Strategy.

In turn, BBSRC provides funding to seven institutes; the Earlham Institute, John Innes, Institute of Biological, Environmental and Rural Sciences (IBERS), Quadram Institute, Pirbright Institute, the Roslin Institute and Rothamsted Research. Together they make up the National Institutes of Bioscience.[5]

Rothamsted Research, founded in 1843, is one of the oldest agricultural research stations in the world, funded by the Lawes Agricultural Trust and BBSRC, with Syngenta, NERC and SARIC (see below) as 'partners and funders'.[6] The Lawes and Rothamsted boards currently include a number of advocates of the genetic engineering/synthetic biology approach to agriculture.

There are also six Research and Technology Clubs that are "*supported jointly by BBSRC, other funding bodies and consortia of companies*".[7] They include the Crop Improvement Research Club (CIRC), established in 2012. CIRC members include Innovate UK, BASF, Syngenta and Monsanto.[8] The Sustainable Agriculture Research & Innovation Club (SARIC) is a joint NERC and BBSRC initiative.[9] Members include Syngenta, Monsanto and Bayer.

BBSRC also gives grants to more than thirty UK Universities. OpenPlant Synthetic Biology Research Centre is a joint initiative between the University of Cambridge, John Innes Centre and the Earlham Institute, funded by the BBSRC and EPSRC as part of the UK Synthetic Biology for Growth programme.[10]

This brief look at the composition of UK agricultural research suggests that the situation described by Genewatch back in 2010 has not really changed: A small number of advisors, often with close links to a narrow range of commercial interests, are highly influential in setting the research agenda for the biosciences. These people and institutions reappear repeatedly on multiple committees and task forces.[11]

The first and second wave of GM crops

Genetic engineering has been offered for the past twenty years as a solution to research questions that have also changed very little. We are now seeing the promotion of genome editing and gene drives, as new plant breeding techniques (NPBT). Some claim that these

are more precise, cheaper, easier to use and can solve many problems – including those caused by the first wave of GM crops. Suggested applications include rendering herbicide resistant weeds vulnerable to pesticides again.

Many advocates insist that these new techniques do not constitute GM, and therefore do not need regulation. Critics respond that the techniques may produce many unintended mutations at unexpected sites with unknown implications; and that they should not be applied and their products released into the environment without regulation or risk assessment to at least the same level as GM crops.[12]

Another obsession: the focus on wheat

There is an ongoing focus on increasing wheat yields, e.g. the Wheat Genetic Improvement Network (WGIN) (2003-18)[13] and the BBSRC funded Designing Future Wheat (DFW) programme (2017-22)[14] which involves Rothamsted Research (RRES), the John Innes Centre (JIC) and Earlham Institute (EI), with additional contributions from the National Institute of Agricultural Botany (NIAB) and several universities. A current project involves GM wheat trials at Rothamsted, funded by BBSRC. It is designed to increase the 'efficiency of photosynthesis by genetic modification'[15] rather than looking at wheat cultivation in the context of food systems, biodiverse ecosystems, altered cropping systems or agronomic research on a wider range of crops.

Justifying their position

The proponents of industrial agriculture repeat the mantra that population growth, climate change, biodiversity loss and changing food habits mean we must increase production without taking more land. We therefore need 'innovative' approaches to 'sustainable intensification', using all the latest techniques and technologies, often in combination with each other, to increase yields. This may sound reasonable, but continuously seeking to modify plants rather than increasing resilience through a systems approach to cropping systems and production is a dangerously narrow perspective on the role of agriculture.

Similar claims and promises have been made regularly by the UK science establishment for at least 20 years. However, problems have arisen in connection with all GM crops so far commercialised globally. GM drought, salt and stress-tolerant crops, promised for even longer, have not materialised.

Despite this, interests associated with GM crops and the so-called NPBTs[16] and related patents continue to have a strong influence on the direction of UK research.[17] Current Brexit plans to draw closer to the US science and corporate establishments, and to increase exports of these techniques, particularly to Africa, could increase that influence.[18]

Neglected approaches to agriculture

These assumptions are not likely to be challenged, because the approach to the topic lacks diversity. The UK agricultural establishment fails to look beyond a technical approach with its constant emphasis on innovation[19] and narrowly defined yields. It makes no real effort to bridge the widening gap between its own increasingly technocratic approach and broader agroecological perspectives such as organic agriculture, permaculture, biodynamic, that see agriculture as part of an interactive set of biodiverse ecological systems. The soil food web is critical to the quality, health and productivity of crops, along with pollinators, beneficial predators and different crops and varieties. These are just a few elements of the dynamic biological diversity that underpins food production and should be central to research efforts.

Public consultations: perfunctory and lacking transparency

Major funding goes into marketing the products of the industrial food system. But there is little real public debate about agriculture in the UK, and some of what does exist is hard to access. In 2012, for example, the government called for evidence on 'Shaping a UK Strategy for Agri-Tech'.[20] The results were only released in 2015 through a Freedom of Information request. The documents remain redacted. The response to the request acknowledges a public interest in knowing who said what, but notes that under the Freedom of Information Act, section 43(2): "*…there is a public interest in ensuring that the commercial interests of external businesses are not damaged or undermined by disclosure of information which is not common knowledge and which could adversely impact on future business of these stakeholders.*"

In 2014, Rothamsted Research held four workshops with members of the public and stakeholders[21] on how it should engage with industry. The report quotes an insightful comment from a participant: "*Rothamsted seem confused – is it for commercial interest or is it for public benefit?*" It also includes some ideas from the public about how they could be more involved in decision-making – but with a telling final sentence: "*However, there was not sufficient time at the workshops to explore these ideas and methods further with participants.*" These examples show how far we are from a genuine, inclusive debate on the future of agriculture in the UK.

BBSRC highlights its public engagement activities[22] guided by the BioScience for Society Strategy Advisory Panel.[23] In 2014 it held a six-hour dialogue with 19 selected members of the public on BBSRC's emerging Food, Nutrition and Health Strategic Framework.[24] The report reveals that the public had questions about how BBSRC governs its work with industry, challenges industry interests and maintains independence from government. However, no discussion of these issues is recorded.

Conclusions

To challenge the assumptions underlying current UK agricultural research, it needs to be opened up to a much wider range of voices and disciplines, and information should be more accessible, with BBSRC strategy advisory panel papers openly available online.

The science should be much broader and embrace ecological systems approaches to the issues. There are clear societal concerns about values, ethics, corporate influence and the framing of the issues to be addressed. Practices such as organic, biodynamic, and agroecology must drive research.

Farmers, especially small farmers, produce high quality food for citizens and, through biodiverse ecological production

systems, provide additional public goods such as clean water and healthy soils, adding to the resilience required for future food production. They should be central to discussions, not marginalised or excluded from the debate about UK agriculture and its importance to society.

Genuine public consultation should be an evolving, ongoing and integral process, and corporate power in the food system must be challenged. All this is vital, or UK agricultural research will continue to be dominated by a few narrow interests. The importance of agriculture goes way beyond narrow issues of yields, or even production, and there are many key issues to research, from the way we use our land to the nature of our food systems, especially in the context of climate change and biodiversity loss.[25,26]

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Research strategy for food and farming

Steve Tones, AHDB Horticulture's Strategy Director

The food and farming industry is large, complicated and fragmented. It consists of tens of thousands of farmers and growers who produce our crops and livestock. There are also many consultants, distributors, engineers, government departments and agencies, levy bodies, lobbyists, manufacturers, marketing organisations, processors, researchers, retailers and suppliers who help put the safe and nutritious food we enjoy on our tables.

The structural and technological complexity of the industry requires an overarching government research strategy to deliver a secure future for the sector, and for the food on our plates. ADHB's Feeding the future[1] (2013) and Inspiring success[2] (2017), both recognise the need to re-focus agri-food research and associated knowledge exchange on industry innovation. Ultimately, such focus will drive up productivity, increase competitiveness, build resilience and restore the UK to its former position as a global leader in agri-technology.

The big challenge lies in setting out how this might be achieved by the many providers of research and knowledge exchange involved. The key is in the way the various private and public funding streams available are directed and aligned; not just with each other and with the strategic outcomes, but in the synergies that can be created by bringing together organisations and people with the same purpose.

The proof of the pudding will be in the eating. Decades of fragmentation may take more than a few years to overcome. But a worthy start has been made and a clear common goal agreed, which can now be carried forward into the government's Industrial Strategy.

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What good food research could do

Professor Tim Lang considers why history matters for UK food-related research and argues for more 'good food research' that is independent, public and interdisciplinary.

The UK has a long and rich tradition of outstanding food-related research. Almost as soon as industrialisation began at the cusp of the 18th and 19th centuries, people began to see the chance to apply its fruits to farming and food. This took at least two research directions. One was to use chemistry to unpick what made things grow. Another was to use it off the land to 'industrialise' food. One focussed on life itself and the other on labour.

One of the first food transnationals to incorporate research was the Anglo-German-Uruguayan-Argentine meat extract behemoth which produced Bovril and later Oxo, applying the science pioneered by Justus von Liebig at Giessen.[1] As food chains became longer, the opportunities for fraud emerged, applying both crude and sometimes sophisticated science. This distortion of research is beautifully summarised in the classic account by Ingeborg Paulus in 1973,[2] and again more recently and very readably by Bee Wilson[3].

A long fight ensued throughout the 19th century to clean up British food. Although an early chemist (Frederick Accum) first exposed adulteration in 1820,[4] it was not until *The Lancet*'s founding editor, Thomas Wakley MP, created an arms-length Lancet Analytic and Sanitary Commission run by Arthur Hill Hassall, that the clean-up really began. The grand-sounding Commission (actually tiny!) gave its exposés to *The Times* and *The Lancet*, with Wakley trumpeting in the Commons. This was an early example of brilliant UK food campaigning with a small number of people wearing multiple hats! They were effective in winning legal change but, arguably, the right of the British people to have decent, safe good quality food wasn't finally settled until various amendments to the 1865 Act were strengthened decades later.[5] But the battle over food quality and the role of research had begun in earnest.

> "In the UK, our food research agenda is currently paralysed by the enormity of Brexit"

Why does this history matter? Because here we are in the early 21st century, with ample evidence that the food system has serious flaws again and the role of research is implicated. So much R&D works for the food system rather than unpicking its impact. Some consequences are intended by researcher – such as the systematic mining of the environment or deliberate 'ultra-processing' of mass foods – and some are unintended. I don't think anyone sets out deliberately to spread childhood obesity or to break the NHS by externalising vast healthcare costs from ever cheaper food. Yet the food system nevertheless is locked into a self-defeating illogicality, with researchers compromised too often.

We should not be surprised. Research does not operate in a vacuum. It is framed by intentions, both tacit and overt. That's why there are such ethical issues over research funding and over working with industry. Over the last 40 years, much food research has been heavily incorporated into tweaking rather than reviewing food system performance. But the tensions are becoming clearer. And food companies are acutely aware they face disaster for instance if they fail to rein back their impact on climate change. No wonder, older more critical traditions of science and research have re-emerged, questioning what is meant by a 'good food' system. So often they emerge within civil society, rather than academic science. But, remembering Wakley, Hassall and The Lancet, it was ever thus.

What do we need ahead? More public and independent research. And more interdisciplinary pursuit of 'big picture solutions'. Why? Because the data show conclusively that dietary change is now the biggest source of premature death and (perhaps more ominously) healthcare costs.[6] [7] The data also make clear that the food system needs to change pretty dramatically from its current intensification and over-production (particularly of animals), and

that the ecosystems on which Darwinian ecological diversity depends are being most actively destroyed by what ought to be a means of subsistence – food.

No discipline or perspective has the answer to this systemic challenge. It requires more collaborative, less self-serving research. Universities have not helped with their football league approach to the Research Excellence Framework ('REF').

I'm not all gloomy, however. Some great research comes out, clearly in and for the public interest, while ticking the REF boxes. The policy pick-up, however, is weak. There's a failure of politics at present with regard to food. Vast data and studies point to the need to restructure the food system, but too little happens.

Here in the UK, our food research agenda is currently paralysed by the enormity of Brexit.[8] Yet this is precisely the moment where we should stop and ask fundamental questions about what sort of food research is most needed to put the UK (and other rich nations) onto a more sustainable track, and to shift food culture amongst the general public more rapidly than has ever happened other than in wartime. This requires interdisciplinary research, and more social science, not just the Life Sciences' pursuit of ever more microscopic dynamics, fascinating though those may be.

Helping deliver sustainable diets from sustainable food systems surely ought to be the framework for all food research.

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How to unlock the contribution of agroecology in farming?

Susanne Padel and Nic Lampkin, Organic Research Centre

Food and farming research can deliver public good by focusing on agroecology[1,2] But how can farmers make use of agroecology in practice and what can research can do to support them?

Two studies we undertook for the Land Use Policy Group provide insights. The first[2] demonstrated clear potential contribution and called for better information and knowledge exchange systems on agroecological practices, building on tacit farmer knowledge and active farmer participation, alongside an agroecological focus in training, education, research and innovation.

The second[3] concluded that farmers want clarity on long-term indicators that consider the finances and resource use to help them future-proof their farms (e.g. investment in soil fertility). Farmers need accepted definitions, measurements and indicators of the state of resources and sustainability[4,5] so they can benchmark their activities.

Research must be clearer on the evidence for practices that farmers can implement. It must provide reliable indicators for monitoring that consider resource use and long-term financial implications and risks. Our Agricology project tries to address the need. It is a collaboration between many organisations to provide information on Practical, Sustainable Farming Regardless of Labels.

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Agriculture research in India: what is and what should be

Agriculture research in India is still dominated by the Green Revolution's philosophy and goals, argues **Suman Sahai**. Increasing production of the major staple crops continues to claim centre stage and the bulk of the agriculture research budget.

The annual budget of the Indian Council of Agricultural Research (ICAR), India's leading agency for agricultural research is not insubstantial: for the year 2014-15 it was Rs 61.45 billion.[1] Of this, the bulk (about 20%) was devoted to crop sciences, 11% to animal science and eight percent to horticulture. Strategic and frontier application research on the other hand, got less than two percent. This reflects a lack of focus on research to prepare for the current and future challenges facing farming and farmers. This is surprising given that India is already confronting climate change in real time and feeling its brunt every year in unseasonal rains, deficient monsoons and unpredictable droughts and floods, leading to shortfalls in total food output. Although natural resource management (e.g. for soil and water) got approximately 12% of the budget in 2014-15, the approaches are conventional, for instance using chemical fertilisers to 'improve' soil health.

The real problem however is the traditional patriarchal approach to determining what's good for agriculture and farmers. Decision-making is top down, with almost no consultation with farmers and other stakeholders on their needs, the problems they need solved or their options for diversification. Formulae are worked up in scientific institutions to solve this or the other problem or achieve this or the other goal. Underlying all this planning is the sole commitment to increasing production.

On the other hand, farming has undergone dramatic changes on the ground, like the widespread feminisation of agriculture. Faced with declining returns from farming, men migrate to cities for better opportunities. Yet this enormous shift finds no resonance in setting research priorities even though it's recognised that women farm differently. Then there is the withdrawal of the agriculture extension service that linked farmers to scientists, which means there is now no communication between the two. Previously, the extension service would pick up problems in the field, such as when a successful variety was failing or a new pest had appeared. This feedback informed research which then sought a solution. This is no longer the case.

The adoption of Genetically Modified (GM) technology is a good example of how research agendas are moving further away from farm needs. Critics have often said that GM crops were a "solution looking for a problem". Farmers were never consulted about the need for GM crops, nor were the pros and cons discussed with them. Some fifteen years after Bt cotton was adopted, farmers are still not fully aware of what this technology really does. The mandatory insect refuges are still not being planted and the number of pesticide sprays have not always come down. As for the research itself, regulatory violations are commonplace.[2]

Although exact figures are not available for the money channelled to GM research, there are indications that it takes a substantial amount of the research funds. According to the Department of Science and Technology, a number of public sector research institutes, 51 universities, 118 research institutions and 64 agri- based industries were engaged in research on more than twenty GM crops.[3]

Transparency in research, especially on GMOs, is a serious challenge as both public and private sector institutions are reluctant to provide information. In 2006 Gene Campaign requested the biosafety data generated on Bt brinjal, under the Right to Information Act.[4] The Government refused, saying the data was 'Confidential Business Information'. Gene Campaign had to seek the intervention of the Supreme Court, arguing that information with a bearing on public health could not be considered 'confidential'. The Court then instructed the Government to make such data available in the public domain.

Defining research programmes for coping with climate change demonstrates yet again that the research establishment works on its own, without consulting stakeholders. The National Mission for Sustainable Agriculture (NMSA) is one of eight Missions set up by the Government's National Action Plan on Climate Change (NAPCC) in 2008.[5] NMSA's Research and Action Plan provides no information on the methodology adopted for identifying the priority areas for research, nor does it mention the persons involved in developing the agenda. The document reiterates positions taken decades ago. For instance, on rainfed farming, the NMSA's sole approach is watershed development, a position that the

Government took about 70 years ago when it adopted the National Watershed Development Programme for Rainfed Areas (NWDPRA).[6]

The NMSA looks to biotechnology to address the multiple problems of climate change, even though India's sole GM crop is Bt cotton and its research is restricted to insect resistance via the Bt route, and to herbicide tolerance. Curiously, genetic diversity, widely recognised to be an effective tool in global efforts to counter climate change[7], receives scant attention. Yet India is a powerhouse of agrobiodiversity and could provide real solutions to coping with drought, submergence, salinity, temperature rise and new pest profiles.

Stakeholder inputs can bring new ideas, new approaches and out of the box thinking informed by practical field experience. But the Indian research establishment continues to turn its back on this advantage. Likewise, it fails to take seriously or build on agriculture-related research conducted informally by farmers and civil society groups.

Stakeholders continue to use diverse platforms to speak up about what they would like agricultural research to address. Below are the recommendations that emerged from two national consultations organised by Gene Campaign on identifying current research needs and improving farming. In a 2010 national conference on 'Ensuring Food Security in a Changing Climate'[8], priority areas for climate adaptation research emerged from consultations with a range of experts and practitioners from 22 States.

Specific recommendations

A knowledge-intensive, not input-intensive approach should be adopted to develop sustainable farming systems. Traditional knowledge about farming and coping with adverse weather should be incorporated into research programmes to address the uncertainties of climate change, build resilience and reduce emissions.

A special research focus is needed for rain fed areas and a diversified model including crops, livestock, fisheries, poultry and agro forestry should be developed to minimise risk.

A Centre for Climate Risk Research, Management and Extension must be set up in each of the 128 agro-ecological zones. The Centre should prepare computer simulation models of weather probabilities and develop farming system approaches to minimise the adverse impact of unfavourable weather and maximise the benefits of a good monsoon. Field research stations must house dynamic research and training programmes on building soil health, pest management, water conservation and the equitable and efficient use of natural resources.

Genetic evaluation of traditional varieties and animal breeds must be undertaken to identify valuable traits for future breeding, including tolerance to higher temperatures, drought and salinity; as well as feed conversion efficiency and disease resistance in animals.

Participatory and formal plant breeding must be promoted to develop climate resilient crops that are temperature, drought and salinity tolerant.

In crops, genotypes with a higher per-day-yield potential must be selected, to counter the yield loss from heat induced reduction over the growing period.

Developing balanced ration, feed and fodder regimes are required that will increase milk yield of indigenous cattle and reduce methane emissions.

In another national consultation to celebrate its 20th anniversary in 2013, Gene Campaign brought together scientists, civil society groups, farmers, policy makers and media professionals to discuss what was needed to make farming profitable and farmers prosperous. These deliberations yielded a wealth of suggestions[9], some of which are flagged below:

Farming's goal cannot now be the maximisation of yield (as in the Green Revolution model of high yield at all cost). Minimising risk is crucial in today's era of climate turbulence. Minimising damage to the natural resource base is key.

Map local resources and crop and animal genetic diversity; develop local resource based farming systems.

Develop region specific sustainable farming systems to exploit the genetic potential of existing varieties rather than breed new ones.

Develop gender appropriate farm equipment and instruments for use by women, given the widespread feminisation of agriculture. Most farm equipment is designed for men, which physically smaller women find hard to use.

Move away from exclusive subsidies to chemical fertilisers. Create financial structures to subsidise farmer initiatives that improve soil health using different composts and organic matter.

Develop early warning systems for timely detection of new pests, which climate change is bringing in to new areas. Data on pest types should be compiled and shared with farmers, along with training on the best approach to control specific pests. An Integrated Pest Management programme incorporating traditional community knowledge of pest detection and control should be developed.

Focus research on developing true breeding seeds rather than hybrids. Private seed companies and public-private research collaborations tend to develop hybrids which serve as an intellectual property instrument without necessarily benefitting the farmer.

There was consensus that an effective extension system must be restored, including both education and responsive research to fix field problems.

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Inclusive alternatives

Democratising food and agricultural research

Nothing less than a paradigm revolution is needed to democratise food and agricultural research for the common good and the wellbeing of the planet, argues **Michel Pimbert**.

Expanding grassroots innovation and self-managed research

Historically, knowledge about food and farming has been produced by people without any professional university training. Well before scientific institutions and agricultural research stations existed, farmers and livestock keepers generated a huge diversity of locally adapted crop varieties and livestock breeds by working with nature. Even today, farmers and ordinary citizens are engaged in the production of knowledge on a significant scale outside universities and research institutes.

Self-organising grassroots research and innovation plays an increasingly important role in larger social movements working for food sovereignty, agroecology and biocultural diversity. Farmers, indigenous peoples, pastoralists and other citizens engaged in grassroots research and innovation rarely work alone. They are usually members of a collective of peers, an affinity group, or an association.

Self-organised peasant-led research and innovation processes are typically part of horizontal socio-cultural networks that usually span large geographical areas (Box 1).

These decentralised and distributed forms of people-led research and innovation sharply contrast with the organisation and practice of mainstream science and technological research and

Box 1: **Examples of self-managed research and grassroots innovation networks constructing knowledge for food, agriculture and well being**

The *Campesino a Campesino* (CAC) movements in Central America and Cuba

Campesino a Campesino (Farmer to Farmer) is a grassroots movement that originated in the early 1970s in Guatemala and spread through Mexico, Nicaragua and Cuba. Using their own farms as classrooms, the peasant farmers rely on principles of popular education and peer-to-peer learning to build local capacity, autonomy, and empowerment. The CAC process has generated effective site-specific agroecological solutions and empowering forms of non-hierarchical communication for social change throughout Central America and the Caribbean.

The Peasant Seeds Network in France

In 2003, the Réseau Semences Paysannes was created in France by the Confederation Paysanne, the National Coordination of Defenders of Farm Seeds, and several organic farmers' associations. The Réseau Semences Paysannes comprises over 70 member organisations. Members of the network engage in participatory and evolutionary plant breeding and they facilitate grassroots research and innovations in agroecology.

URGENCI and community supported agriculture

URGENCI, the international network for Community Supported Agriculture (CSA), emphasises the need to consider citizen-consumers as key subjects in peer-to-peer learning on agroecology and food sovereignty. Popular education about the realities of farming and the entire food system is at the heart of the CSA movement and its knowledge creation processes.

L'Atelier Paysan in France and Farm Hack in the USA

These communities of farmers and mechanics use internet platforms to share knowledge about farm tools and machinery they design and build on their farms or in community workshops. These grassroots communities of innovators and self-managed research develop and share open-source tools for resilient agriculture. They also assemble offline in face-to-face meetings, workshops, and hands-on build events. Lastly, these grassroots networks are inclusive of different types of knowledge holders and comprise not only farmers but also people with a common interest: engineers, designers, architects, tinkerers, and programmers.

development (R&D). They work from the bottom up and tend to be organised on the basis of a more horizontal and egalitarian logic.

They often rely on forms of critical education to build the capabilities and confidence of wo/men participants in grassroots networks. Farmers and other citizens are part of non-hierarchical 'peer-to-peer' collectives which typically seek to go beyond the concepts, categories, criteria and epistemology of dominant knowledge in the sciences and humanities. Focussed on problem-solving, the knowledge and innovations they develop can either be conceptual, methodological, technical and/or institutional.

Some horizontal networks for autonomous knowledge-creation distance themselves from the state and rely on self-mobilisation and self-financing. But most peoples' networks promoting the democratisation of food and agricultural research often consciously adopt a dual power approach to transform existing knowledge, policies and practices. For example, farmers, pastoralists and indigenous peoples engage with scientists in participatory research on the basis of clearly negotiated roles, rights and responsibilities, while also maintaining a decentralised network of safe spaces for more autonomous and plural ways of knowing (for example, experiential, local, tacit, feminine, phenomenological).

> "Nothing less than a paradigm revolution is needed to democratise food and agricultural research for the common good and the wellbeing of the planet."

This dual approach reflects an awareness of the partial and incomplete nature of all knowledge systems. Self-managed research and grassroots innovation networks also help democratise the politics and production of knowledge by exerting countervailing power. Reversals from normal practices ensure that peasants – rather than scientists alone – determine research priorities and oversee a power-equalising process of knowledge creation in farmers' fields and the entire R&D cycle.

The Raita Teerpu: a citizens' jury on the priorities of agricultural research, State of Karnataka, India. (Photo: Pastapur Yesu)

Deepening democracy and social inclusion in the construction of knowledge for food and agriculture depends on further strengthening grassroots research and innovation networks. This can be done by supporting several mutually reinforcing transformative processes including: education for critical consciousness and place-based learning; horizontal peer to peer learning for the production of collective knowledge; building extended peer communities to validate and protect collective knowledge; and strengthening local organisations to scale out grassroots research and innovation to more people and places.

Democratising and transforming public research

Many farmers and people 'out there' recognise the liberating potential of modern science and technology. A simplistic rejection of all research and science will not do. Instead, the challenge is how to transform existing research systems (e.g. universities and research centres) so that they can embrace more inclusive ways of knowing and focus on priorities decided by citizens through inclusive processes of *direct* democracy. Some of the transformations required in the governance, culture, organisation and professional practice of public research are briefly highlighted below.

Putting citizens at the heart of decision making in research

Existing governance and funding bodies for R&D can be reformed and opened up to wider citizen participation by including more gender-balanced representation of peasant farmers, indigenous peoples, pastoralists, fisherfolk, farm workers, artisanal food processors, and citizen-consumers. However, this more equitable representation of citizens in structures that govern research (e.g. boards, funding bodies, expert committees) must be complemented by more transformative and direct forms of democracy that create space for the voice and agency of hitherto excluded people.

In practice, a range of methodological approaches and processes can be used to facilitate direct participation of farmers and citizen-consumers in different stages of the R&D cycle. Several institutional and methodological innovations can be used to enable the direct participation of farmers and citizens in the upstream definition of research priorities; the framing of national policies for scientific

research and development; decisions on research funding and budget allocations and in risk and sustainability assessments. Examples of these methods for deliberative and inclusive processes (DIPs) include citizens' juries and scenario workshops that link hitherto excluded voices in policymaking and agenda setting.

Embracing transdisciplinarity and methodological pluralism in research

Transdisciplinary ways of knowing emphasise the importance of methodological pluralism to integrate different traditions of knowledge and multiple sources of evidence. Novel methodological mixes are needed to dismantle boundaries between disciplines, disrupt knowledge hierarchies, foster respectful intercultural dialogues between the knowledge systems of scientists and farmers, and co-produce knowledge with different social actors. Moreover, this co-creation of knowledge by scientists and peasant farmers should increasingly be part of a participatory process driven by a transformative logic of changing society – rather than just interpreting it.

Transdisciplinary co-inquiry is a challenge for university departments that have historically been engaged in relatively specialised education and research. Building internal capacity to 'walk the talk' of transdisciplinarity first requires recruiting more staff familiar with its theory and practice. Second, the uptake and spread of transdisciplinarity in universities and research centres also requires a large-scale effort to re-orient, re-skill, and train currently employed researchers and teaching staff. Much of this educational effort in universities and research institutes should focus on working with peoples' knowledge and reversing enduring systemic biases against the knowledge of women, indigenous peoples, under-represented ethnic groups, and other disadvantaged groups.

Professional reversals and organisational transformation

Given its emphasis on peoples' knowledge, transdisciplinary co-inquiry calls for power reversals and new roles for research, donors and development professionals. In essence, people – their knowledge, and the diverse environments that sustain them – become central, instead of university research centres, government departments, scientific peer groups and the narrow 'research excellence' metrics used to evaluate academic papers and their impacts. A significant shift to a new professionalism and participatory praxis for transdisciplinarity also requires profound transformations in the governance, culture, operational procedures, staff training, and reward structures of research organisations and funding agencies.

Protecting public research from privatisation and corporate control

The casualisation of the academic workforce is increasingly widespread and seriously undermines the quality of university education and research. After spending years earning their doctorates more than half (53%) of the academics teaching or doing research in British universities have to manage on some form of insecure, non-permanent contract. Lack of job security militates against the changes in attitudes and behaviours needed for transdisciplinary co-inquiry. It promotes conformity to established research traditions and their cognitive routines. Similarly, it is difficult to see how universities can re-invent and transform themselves for participatory and transdisciplinary ways of knowing when so many academic staff experience job insecurity, stress, low morale, lack of recognition, and low pay. As both the products and victims of the capitalist division of labour, academic workers will probably need to engage in joint action with citizens and social movements to reverse these debilitating trends.

Insulating research from corporate abuse and capture is also a top priority. The Union of Concerned Scientists in the USA has identified key areas where governments can act more to protect science against undue corporate influence and corruption, including protecting scientists from censorship, retaliation and intimidation; reforming the regulatory process; and strengthening monitoring and enforcement. Significantly increased government funding for public research is also necessary to reverse the privatisation and corporate capture of higher education and research.

Reclaiming universities as a commons for knowledge democracy

Ensuring that the cultural, intellectual and other resources of universities are accessible to all members of society – and are held in common, rather than privately controlled or owned – is key for an inclusive knowledge democracy. Inspiring stories of peoples' struggles to regain control over the commons and the production of knowledge can offer new models for the governance, re-structuring, organisation, and practices of agricultural research.

Power-equalising processes are central in the two complementary pathways described here for democratising food and agricultural research. These transformative processes include respecting and valuing all knowledge systems (cognitive justice), reversals from normal professional practice, deep organisational change, the strengthening of horizontal networks of local organisations, as well as institutional and methodological innovations that can enable citizens' direct democratic control over research priorities and its governance.

Deeper-seated political and economic changes are also necessary throughout society, including policies that can reverse the ongoing economic genocide of farmers as well as provide the 'free time' and 'material security' which food producers and other citizens need to fully engage in participatory democracy and the construction of knowledge.

This paper is a summary of the last book chapter in Pimbert, M.P (2017) Food Sovereignty, Agroecology and Biocultural Diversity. Constructing and Contesting Knowledge. Routledge, London.

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Learning from farmer-led research

Tom MacMillan wants to see more agricultural research led by farmers. Why isn't it the norm, and what can be done to redress the balance?

Farmers are in high demand. They are the subjects of farm business surveys, and host variety and product trials, as well as being customers or end-users of countless research results. Yet it is unusual for farmers to be in the driving seat, setting the questions and getting centrally involved in research design and analysis. Farmer-led research of this sort is the exception, but it has huge untapped potential.

Why farmer-led?

Why have farmers at the centre? First, for accountability. Much public research is done in the name of farmers, with grant applications setting out the potential business benefits, without so much as asking a farmer what they think. There is a growing focus on funding projects with 'impact' and including partners outside research institutions, but the scrutiny of claims that projects will have an impact is relatively weak and those partners are rarely farmers.

Second, to boost innovation. Practical innovation by farmers has been central to the development of modern agriculture and continues to play a vital role in the development of key practices and systems such as minimum tillage. Some farmers do their own R&D – reviewing the literature, trialling new approaches, piloting – if usually without the level of rigour and resources that scientists can bring to bear. Social scientists and policy makers have developed 'systems' models of innovation that recognise the process is non-linear, disruptive and path-dependent, rather than a straight line from 'Eureka' to the field. Research funding has yet to catch up, with most farmers feeling remote from the 'applied' research projects that are supposedly designed with them in mind.

Even by the least imaginative measures, policies to drive agricultural innovation are struggling. Yields of some key crops like wheat have plateaued despite being a key focus for public and private investment.[1] The fact that yields in trials have continued to rise suggests the research is irrelevant to what farmers are doing on the ground.

Third, there's more to farming than yield, and innovation is not one line along which we just travel slower or faster. Having farmers at the centre changes the aims and focus of research. Much applied agricultural research investment – public as well as private – is premised on the hope of a commercial return to the investor. So, a lot goes into things farmers will ultimately buy, such as new breeds and varieties, medicines, pesticides, fertilisers, machinery and software.

By contrast, all else being equal, the ideal solutions for farmers are free of charge, available year after year, and adaptable. The public return on these kinds of R&D investment is indirect, through the agricultural economy and ecosystem services. But it is potentially more valuable and more sustainable than investing in new stuff to sell to farmers.

International and UK experience

The recognition that farmers are innovators has informed a number of approaches to supporting agricultural innovation in international development. One of the best-known methods is the Farmer Field School (FFS). More than 10 million farmers have taken part in FFSs across Asia, Africa and Latin America.[2]

The UN Food and Agricultural Organisation set up the first FFS in 1989, in Indonesia. Extension staff were working with very poor smallholders who could not afford inputs such as pesticides. They helped farmer groups to identify pests and predators, study their lifecycles, and develop practical strategies to manage the pests' natural enemies. This was innovative integrated pest management, and hands-on, basic research, born out of necessity.

Although a 2014 meta-analysis of 71 FFS evaluations found that farmers' experiences varied widely, in targeted initiatives participants gained knowledge, changed practices and consequently netted higher yields and incomes.[3]

A growing number of UK initiatives support participatory and peer-to-peer approaches to farmer learning. However, their focus has generally been on the exchange of existing knowledge and best practice (e.g. through benchmarking) rather than deliberately supporting experimentation or helping farmers develop novel approaches.

Some UK initiatives have directly supported farmer R&D and innovation, including: 'stable schools' that helped peer groups of dairy farmers to reduce antibiotic use; projects by producer organisations, especially in horticulture; and sector-specific innovation networks run by institutes or advisory businesses, such as NIAB-TAG and Kingshay. They have generally been sector- or topic-specific and, in some cases, the results are restricted to the farmers and growers involved.

A new wave of initiatives is expanding the scope and scale of farmer-led research in the UK. The most extensive is the Innovative Farmers network that we coordinate at the Soil Association. Others include Rothamsted's FarmInn programme, the network of 'satellite

farms' being developed by the Agricultural Engineering Precision Innovation (Agri-EPI) Centre, and the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-Agri).

Emerging evidence from UK initiatives

The EIP-Agri deliberately supports innovation by farmers, providing a mechanism for governments to fund 'operational groups' through the Rural Development Programme.

Defra and the Scottish and Welsh governments opted to implement the EIP-Agri. The initiative has experienced teething problems across the EU, including bureaucratic application processes, confusing eligibility conditions, requiring one party in a group to carry the financial risk and expecting groups to front costs, all of which have hindered progress. An EU-wide evaluation of the EIP-Agri praises it as a pioneering initiative but highlights that there is still much to learn in effectively implementing this kind of practical innovation support.[4]

Innovative Farmers has been in action longer than the EIP-Agri. It is part of the Duchy Future Farming Programme, principally funded by the Prince of Wales's Charitable Foundation. It is coordinated by the Soil Association, with LEAF, Innovation for Agriculture, the Organic Research Centre and Waitrose. Sponsors include the BBSRC, AHDB, Anglia Farmers, Buccleuch, Produce World Group, Riverford and Robin Appel.

It is a not-for-profit network that gives farmers and growers research support and funding on their own terms. At the heart of the initiative are farmer groups running 'field labs'. The network provides facilitation, administrative support, collaboration tools, research support and micro-grants.

Since the pilot phase began in 2012, around 1,000 farmers have taken part in field labs on over 50 topics, and over 5,000 farmers have taken part in the programme's wider knowledge exchange (KE).

The field labs are getting results. Findings range from how to reduce antibiotic use in dairy to ways farmers can improve soil health and reduce pesticides. This is already changing farming practices. The latest independent evaluation by the Countryside & Communities Research Institute found that nine out of 10 farmers involved would recommend it to others and half had made or planned changes to their farming system.

The findings are shared through a web portal (www.innovativefarmers.org), farm walks, webinars and conferences. The network also reaches wider through the farming press, a key source of technical and business information for farmers throughout the industry. Innovative Farmers' reach last year of 1.9 million meant that, on average, every UK farmer would have heard about the field labs about half a dozen times.

Development opportunities

As the UK prepares to leave the EU, farming is set to enter a period of transformation driven by changes in trade, markets, labour and support payments. To weather this change, and make the best of it, farmers will need to innovate. Opportunities to support them in this through farmer-led R&D include:

Advancements in data collection and analysis. Developing research designs and analytical techniques that suit farmer-led R&D is an important methodological challenge for scientists. One example is the Agronõmics project led by ADAS, which is developing new statistical approaches to detect small treatment effects in real-world situations.

Targeting farmer-led projects with research funding. Only a small fraction of the UK's public agricultural R&D investment – perhaps as little as 1% – supports practical projects led by farmers. Significantly increased, it could transform farming. For example, allocating £35 million per year (10% of agricultural R&D investment) would support around 500 substantial farmer-led projects at any time. Because much of this investment would ultimately go to researchers to take part in projects developed by farmers, there would be little net effect on public funding for research institutions.

Rewarding researchers for practical research. Researchers currently depend primarily on their publication record for career advancement, notwithstanding the growing attention to 'research impact'. Measures that could help recognise, celebrate and reward scientists who support farmers effectively include: an awards scheme with prize funding for researchers working on farmer-led projects (similar to wider innovation awards run by the research councils); training to help researchers work effectively with farmer groups; and involving farmers and other practitioners more in reviewing research grant applications.

Investing in innovation support services. Experience shows that farmer-led innovation projects benefit from professional support. This can include: facilitation and project management; research advice to design and analyse trials or other types of research; and communication to ensure the learning is shared widely. Innovative Farmers is an example of an innovation support service. The EIP-Agri has a facility to develop 'innovation support services' to provide such support, which is being implemented in Wales and Scotland, but not yet in England.

Connecting farmer innovation projects better into KE networks. AHDB is leading efforts to coordinate the UK's KE landscape, so farmers find it easier to obtain the solutions and advice they need. Innovation support services such as Innovative Farmers need to link effectively into this KE activity.

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Listen to farmers: an interview with Ibrahima Coulibaly, President of CNOP-Mali.

In conversation with **Patrick Mulvany** in September 2017, in the Nyéléni Centre, Mali, Ibrahima Coulibaly discusses the crucial role of smaller-scale farmers in agricultural research.

Why is agricultural research important?
Agricultural research is important. It was so in the past, it is today, and it can be tomorrow, but under one condition: Research always has to come from a need; specifically a need from the farmer[1].

Agricultural research that stems from artificial needs or is imagined by researchers will always miss the real needs of farmers. The real question should be "can we have research that is useful?" Yes we can, and that is agricultural research that works for the needs of farmers.

How would a useful agricultural research agenda be developed?
To develop the agenda, it is important to have mechanisms for inclusive participation of researchers, farmers, and governments (via policies). They all need to talk to each other, and most importantly, they need to understand each other. How the problems faced by farmers are taken up by researchers, and how the results are then shared back to farmers, and government, ensuring that the greatest number possible of farmers can have access to that knowledge; in that lies the question.

And what is the role of the researcher?
The role of the researcher is first and foremost to listen, particularly to the needs of farmers. And to do research and produce results based on these farmers' needs. It is worthless to do lots of research that will then sit in drawers of research institutions. Results that are not immediately transposable to smallholder farmers are not useful to them.

Should smaller-scale farmers be setting priorities for the research agenda?
Exactly! Participatory approaches have been tested across the world where smaller-scale farmers have gathered and defined what their research needs are. Today more than ever, when we talk a lot about agroecology, it is becoming a necessity because nowadays there are real needs for research. For example: protection of cultures. There are lots of basic needs that have yet to be met. There is also a lot of local knowledge that needs to be tested by research, e.g. fertilisers – there are so many options that have yet to be formally researched, such as Foliar Fertilisers. They get minimal research in today's agenda. There is so much scope to diversify research, but it isn't tapped into. And smaller-scale farmers don't have the time to do the research. They can't be both farmers and [formal] researchers. Research can have its role in agroecology but only if the agenda is set by farmers.

You said that farmers have the knowledge about seeds and soils, fertility, about agroecology. What stops the researcher from taking that knowledge and stealing that knowledge?
This is a difficult question. The knowledge that smaller-scale farmers share is with an understanding that it should not be privatised. Knowledge is a common good. The risk that researchers use that knowledge for their own gain is always there. It is important to find solutions to avoid going down that path. I was just talking with my colleagues from Togo, who have an agroecological farm, and we said: We smaller-scale farmers need to document/record our experiences – this way, no one can steal them, because there would be a farmers' publication that shows the source of the knowledge.

Do you think that researchers understand 'Farmers' Rights' – or 'Free, Prior and Informed Consent' under the Biodiversity Convention? Do they understand their legal obligation to protect the knowledge and ensure the knowledge is not stolen?
I don't think researchers understand this,

at least currently. Only a few are sensitive to these questions and concerns. There is a need to educate researchers and explain that the world has changed, and that they too have to change with it. If they don't, they'll become dinosaurs, and disappear. If they are not able to transition towards working with smaller-scale farmers today, farmers will have to live without researchers.

La Via Campesina and others have said very critical things about the international agricultural research programmes promoted by the CGIAR and similar organisations, and about corporate-led agricultural research, which dominates the North and Africa. What are your views on that?
Those who claim that they work for farmers but are actually just promoting chemical agriculture and the interest of multinationals who only work on conventional agriculture are not worth it. If researchers don't understand that, they won't have a future. Researchers need to go beyond those multinationals' needs and think about the planet. Environmental degradation, human health impacts, etc.. They need to work for these issues, not for multinationals.

But multinationals have commercial interests for their profits and they are encouraged by governments in the North; they are pushing GMOs in Africa. The programmes of AGRA and many other institutions across Africa are forcing this chemical-dependent genetically-modified agriculture on the smaller-scale farmers. What actions should Via Campesina, ROPPA, and other social movements take, or are taking, to try and stop this type of research?
Here in Mali, we have done a great 'mobilisation' to stop GMOs from entering the country. It has been one of the most important mobilisations ever organised in West Africa. It is thanks to this that GMOs haven't made it to Mali. This shows that it is possible to stop them. We don't want GMOs to come and disrupt local farming production and our traditional farming systems. Researchers have to understand that GMOs aren't the answer. Following the corporate agendas isn't the solution. They may be promoted by big research councils, by funding bodies, multinationals, powerful countries, but, in the end, GMOs have no place in smaller-scale farming and don't answer the needs of farmers. We don't want it, not now, not ever, in our fields.

In Nyéléni 2007: forum for food sovereignty, there was a very clear declaration against GMOs. Ten years on we are in the same wonderful venue which you constructed for the forum – the Nyéléni Centre – and we are again reasserting the same things.
True, but there has been progress nevertheless. In 2007 we were at a very low point, because Burkina Faso had introduced GM cotton, which created a lot of problems for farmers. Today, there is no denying that GMOs have impoverished farmers and brought nothing positive to the government of Burkina Faso either. It is sad that 10 years were wasted to reach this conclusion. What we say is that although it was painful for farmers, it is a great lesson for other African countries. GMOs are an illusion, they don't answer any real developmental need in Africa.

> "Agricultural research that stems from artificial needs or is imagined by researchers will always miss the real needs of farmers."

In 2007, we didn't only talk about the importance of seeds, but also all agricultural biodiversity, and how this forms part of the environment and ecology that underpins production.
Yes, I think we planted a seed that germinated very well, by resisting. [Farmers'] seeds are important, more so than the more engineered/certified versions of governments. Today, AGRA, Bill Gates Foundation, are forcing African governments to put in place policies for [the adoption of] what they call 'improved seeds'. These policies benefit the organisations, not the farmers. We cannot lose the power of farmers' seeds. This is why we are cataloguing them, and making sure that they are preserved and maintained year after year, so that our future can rely on these varieties, and not the GMOs.

And livestock as well?
Of course, it also includes livestock species; chicken, sheep, goats, cows as well. All traditional breeds.

And soils, bees?
Yes all of this. It is the entire environment that we preserve. 'Régéneration naturelle assistée' is a method used by farmers to regenerate biodiversity on-farm.

Over the past 10 years, the industry and researchers have developed GM 2.0 (e.g. synthetic biology). It includes all sorts of technologies such as gene editing and gene drives, which the industry calls 'new science' rather than GMOs. Do you/ Via Campesina/ROPPA/ have views on industry's development of this?
We will never venture there. It has no interest for us at all. What matters to farmers is 'what seeds do I have, and which ones can I keep for the following year?' It isn't complicated. We have developed fertiliser techniques that we can control, that don't require us to go on the market dominated by large multinationals, with artificial fertilisers and pesticides. We want an agriculture that is manageable, and controllable by us the farmers, that makes us live healthily and is sustainable for our children's generation.

Your message for researchers – from those who produce most of the food for most of the people in the world and who would realise food sovereignty – is…?
Listen to farmers! Listen to farmers! Listen to farmers!

CNOP-Mali is a member of Via Campesina. Ibrahima Coulibaly is also President of ROPPA: Le Réseau des organisations paysannes et de producteurs de l'Afrique de l'Ouest (Network of Peasant Organizations and Agricultural Producers in West Africa). Patrick Mulvany is an agriculturalist and a member of the Food Ethics Council.

1 Paysan/ne i.e. a man or woman smaller-scale farmer

Food and farming research for the public good

The global food system is literally killing us, writes **Molly D. Anderson**. Here's what we need to do to fix it.

At least 815 million people across the world suffer from chronic severe undernutrition[1] because they cannot access sufficient food. Approximately one in five deaths globally is due to eating poor diets.[2,3]

Agriculture and other food system practices are huge contributors to environmental degradation. Considered as a whole, the food system emits up to 57% of greenhouse gases.[4] Agriculture uses about 70% of the global freshwater supply[5], and about one third of arable soil has been acutely degraded by agricultural practices.[6,7]

Can research mitigate these social and environmental costs?

To imagine and design a better research system, one must understand how research has contributed to the system we have now. In the International Assessment of Agricultural Knowledge, Science & Technology for Development (IAASTD), over 400 scientists from 52 countries painstakingly investigated the outcomes of investment in science, knowledge and technology since the middle of the 20th century, to determine where future investments should be directed in order to achieve sustainable development.

As we unravelled past investment patterns, we found that 'business as usual' (i.e. increasing investment in industrial agriculture in developing and industrialised countries) clearly could not produce healthy food sustainably into the future. The IAASTD documented decades of negative social, environmental and health consequences due to the spread of industrialised food systems. Too much of past investment had focused on single sectors of the food system (e.g. agricultural production) or single goals (e.g. maximising productivity), rather than considering systemic trade-offs and the multifunctionality of food systems.

Private sector funding of agricultural research has grown rapidly, while public sector research has correspondingly become increasingly less prevalent (particularly in the United States, once a leader in agricultural research). Between 2008 and 2013, for example, real (inflation-adjusted) public food and agricultural research and development in the US fell by about 20% while real private research and development increased by 64%.[8] The interests of the private sector are quite naturally in goods and services that will return profits to companies, including strong protection of intellectual property rights; there is little appetite for research that is simply good for people and the planet.

The kind of development the world needs has more recently been articulated in 17 Sustainable Development Goals (SDGs) and their 169 targets, including SDG 2 which aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Whether the world reaches this goal will be determined by many actors, but whose voices should dominate discourse, and who should set research priorities? The stakes are high: ecological integrity, public health and decent livelihoods for marginalised people on one hand, versus greater profits for and control by the private sector on the other. Research funded through public sources must support the former, and governments must set limits on the ways in which the latter further enhances political power through campaign contributions and lobbying at the national and international scales.

IAASTD authors found that some kinds of research, including participatory research with farmers and women's organisations, furthered sustainable development. Research on agroecology, crop diversification and their implementation helped achieve better environmental quality and health outcomes.

Small-scale farmers are the largest category of people suffering from chronic undernutrition. The tools and knowledge that they need are low- or no-cost, focused on minimising waste, recycling all useable materials for nutrients or energy, restoring or enhancing soil fertility, and growing the greatest amount of nutritious food sustainably on small parcels of land. Such practices are the essence of agroecology, but promise very little profit to those purveying farm inputs and marketing agricultural products across the world. That is why public sector research for the public good must lead in this area. Likewise, research into developing local and national markets where small-scale farmers can sell extra produce needs to happen, to counterbalance extensive research on international trade.

Research for the public good would pay greater attention to low-income consumers and those whose health has been severely compromised by poor diets, such as colonised indigenous

peoples. At present, these groups are targeted as potential markets for the junk food that has already saturated markets in the Global North.[9] Research could help illuminate how to encourage consumption of traditional healthy foods, and innovative ways to distribute food, such as those piloted in sharing and solidarity economies or through right-to-food policies that provide healthy food at minimal cost.

The focus must be on the expressed needs of marginalised people. They have not benefitted from the global food system. Rather, they have suffered under the practices of a few elite players who have become fabulously rich by extracting wealth from the relatively powerless people and countries whose plights continue to worsen. Their lands and waters have been grabbed by speculators or wealthier governments for their own benefit, evicting users who lack secure tenure rights. Their agricultural future is threatened by industries that are allowed to pollute the atmosphere and cause climate change, which exacerbates conflict within and between countries and has led to famine conditions in several countries in 2017.[10]

"To imagine and design a better research system, one must understand how research has contributed to the system we have now."

Focusing research on improving the health and well-being of marginalised people, or on producing food while enhancing soil fertility, sequestering carbon and maintaining biodiversity, will benefit all people by helping to create food systems that serve the public good. It puts those who have been largely excluded from the benefits of food system research and development centre stage, redressing wholescale human rights violations. And it helps reverse several decades of environmental degradation and deleterious health impacts related to diet. This is the opposite of Green Revolution research, which allowed relatively wealthy farmers who were able to adopt Green Revolution seeds and technologies to become more prosperous.

Specific policy levers will depend on country context. In countries where the private sector has overrun public sector research, increased funding for public competitive research on topics that directly benefit agroecosystem quality and human well-being is essential. This may require extensive revision of existing programmes. Opening up the laws for licensing and patents of the products of private sector research to allow wider access may also be needed, to ensure that public corporations actually provide public goods. Research on climate change mitigation is needed to avoid global breakdowns of food systems, from the provision of essential ecosystem services to crop production under conditions of severe stress. Research on mitigating food systems' contributions to any of the 'planetary boundaries' identified by the research group at the Stockholm Resilience Centre will additionally help to keep food systems sustainable.

Every country and region requires a process for gathering and synthesising broad citizen input into research priorities. Advisory groups dominated by industry voices are not adequate to this task. The 'people's food policy' plans that many countries have developed (e.g. Canada, Australia) give rise to immediate research needs for how the will of the people can be implemented most effectively, at the lowest cost, whilst providing good jobs to citizens.

While we know from the IAASTD and many subsequent reports that 'business as usual' will not suffice, the path forward into a sustainable and equitable food system is not yet clear. Research is needed to compare different transformational strategies that are being piloted, to examine their results on the ground.

At the international level, an institution that focuses on agroecological research, with the imprimatur and funding levels of the largest CGIAR institutes, is long overdue. Communication and outreach to poor farmers, including peer-to-peer sharing of practices about what is already known, is vital to the success of such an endeavour. International UN agencies must continue to monitor and document the status of world health and the environment. This monitoring should include input from those whose livelihoods are being destroyed by environmental degradation, in addition to the technical teams which are usually tasked with data gathering.

Through renewed attention to the social contract between governments and their citizens, a new 'Social Contract for Science'[11] and integration of knowledge from the public into science, publicly funded research can help point the way toward a sustainable future for all.

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An interdisciplinary and participatory approach to setting research priorities in Brazil

The new Brazilian Research Network on Food and Nutrition Sovereignty and Security offers a positive alternative to the old established ways of doing food and agriculture research, argues **Renato S. Maluf**.

The Brazilian Research Network on Food and Nutrition Sovereignty and Security promotes academic research on food, nutrition and agriculture. It takes an interdisciplinary perspective that focuses on public policies, dialogue with organisations and social movements, and recognises different ways of producing knowledge.

These perspectives have guided the development of the Research Network since 2012. Its official constitution was approved during the third National Meeting of Research, held between November 8th and 10th 2017, which brought together hundreds of researchers on the campus of the Federal University of Paraná, in Curitiba (PR), Brazil.

The Network emerged in part due to the construction of what could be called the 'socio-political field' of food and nutrition sovereignty and security (FNSS) in Brazil initiated in the late 1980s. This era saw the country's re-democratisation, bringing together social organisations, public managers and academics with significant repercussions for public policies from 2003 onwards[1]. The process led to an understanding that new approaches to research were needed. The dominant paradigm of disciplinary research was not able to adequately contemplate multidimensional issues including hunger and malnutrition, the right to adequate and healthy food, diversified family-based agriculture, and the adoption of agroecological principles.

There has been an increasing number of research groups working on the subject of FNSS and the human right to food (RtF) in universities and research institutions throughout the country. This has happened in parallel with hunger and food becoming priorities on Brazil's public agenda in the 2000s. The National Council for Food and Nutrition Security (CONSEA)[2] has emboldened researchers to adopt multidisciplinary approaches to FNSS and RtF, and at the same laid bare the lack of opportunity for dialogue between researchers that adopt this perspective, and the lack of institutional support (e.g. from development agencies) capable of harbouring such approaches.

The Research Network on Food and Nutrition Sovereignty and Security was developed by a group of researchers who wanted to practice citizen science that produced academic knowledge, whilst at the same time valuing other forms of knowledge production. They wanted to prioritise dialogues that fitted with the agendas of social organisations and public policies, without compromising their own academic autonomy. Their other aim was to construct adequate research methods without compromising academic rigour.

This research concept is expressed in the six principles that guide the Network's performance, namely:

1. Interdisciplinary and multi-professional academic knowledge, respecting diverse forms of knowledge generation and methodological diversity.
2. Citizen research committed to overcoming hunger and promoting food and nutrition sovereignty and security.
3. Independence and autonomy from governments, political parties, national and international organisations and private interests.
4. Permanent commitment to reducing inequalities and promoting gender, ethno-racial and generational equity.
5. Supporting food quality, and adequate and healthy food in terms that respect socio-environmental circumstances and cultures.
6. Generating knowledge that contributes to public policies and to positioning at national and international levels free from conflicts of interest.

Likewise, the Network's action guidelines aim to promote, among other things: (a) cooperation between national and international researchers; (b) methodological diversity; (c) multi-, inter- and trans-disciplinary characteristics of the production of knowledge; (d) knowledge for new forms of teaching and extension; (e) knowledge exchange with organisations, movements and social groups; (f) professional, institutional, regional, gender, generational, cultural and ethnic-racial diversity; (g) strategies for disseminating scientific production and knowledge in the academic field and the society; (h) interaction between knowledge, policy and action; and (i) action, funding and partnerships free of conflicts of interest.

Much has already been achieved with the approach proposed here, which

constitutes a solid base for the Network. This can be seen in the volume and quality of academic papers, analysis of socio-economic and political dynamics, diagnoses of underlying public policies and actions, and construction of indicator matrices.

"… [the research] 'establishment' promotes standards of food production, distribution and consumption that contribute to Brazil's high levels of social inequality, environmental damage and neglect of cultural and genetic heritage, as well as the reproduction of global trends towards poor diets."

More than 300 research projects from all regions of the country were debated during the recent Third National Meeting. The long list of issues being addressed included: the various forms of family-based and diversified agriculture and their interaction with access to equally diverse healthy food; meanings and requirements for the adoption of the agroecological approach; sustainable food provisioning; determinants of overweight and obesity; nutritional deficiencies and their relationship with access restrictions and consumption habits; food and nutrition education; and intersectoral and participatory public policies.

This new Network is in direct contradiction to the research establishment that reflects the old disciplinary tradition. This 'establishment' promotes standards of food production, distribution and consumption that contribute to Brazil's high levels of social inequality, environmental damage and neglect of cultural and genetic heritage, as well as the reproduction of global trends towards poor diets. Based on scientific legitimacy conferred by the traditional academic community, the old disciplinary tradition is given priority support by governments, the private sector and international organisations. This interaction can sometimes involve conflicts of interest, posing crucial questions related to public-private relations in initiatives with social impact.

The Network is undoubtedly a promising initiative that will strengthen a field of research that demands visibility and legitimacy both in academia and in society as a whole. It promotes a form of citizen science that is committed to eradicating hunger and promoting adequate and healthy food, to challenging inequality and valuing diverse and sustainable patterns of production and consumption. It is an approach that must be constantly reaffirmed through open debate and cooperation between those who practice it and those to whom it is addressed.

To be sure, there are conceptual and methodological challenges, many of which are recorded in the annals of meetings promoted by the Network. The curricular structures of undergraduate and, particularly, graduate education need to provide reflection and research activity which promote the characteristics and contents highlighted here. One way this could be achieved is to address the lack of adequate institutional support from the development and funding agencies that host interdisciplinary projects or those based on ethnic-cultural diversity and knowledge.

Academia has been affected by the destabilising parliamentary coup of 2016. As well as experiencing budget cuts and regulatory backsliding, it is suffering direct and violent attacks on freedom of thought and expression. This means that, alongside the expected roles of the Brazilian Research Network on Food and Nutrition Sovereignty and Security, it will need to join with other resistance instruments that are being erected throughout the country.

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2 CONSEA is an advisory body of the Presidency of the Republic of Brazil to propose and monitor public policies related to food and nutrition security and the right to adequate and healthy food.

Community led food and agricultural research: reflecting on experiences from Africa

Agricultural research requires a profound paradigm change if it is to face the multiple crises caused by arrogant notions of human superiority. **Liz Hosken** considers how community-led research can serve to transform the whole food and farming system.

In one of the Ugandan community dialogues that I took part in in, we asked a participant how they understood the idea of research. They replied, "*it's when people come with notebooks and ask questions to help them count and measure things – it can be plants or soils or seeds.*" For these communities, research is something that 'educated' people do. As to what was done with the information the researchers gathered, they were not sure.

It has not always been like this. The enormous diversity of cultural foods we enjoy today were developed by communities – largely by women farmers – through careful observation and selection, since the dawn of agriculture. Their ecological literacy enabled them to domesticate crops from the wild and further develop and enhance the traits they were seeking, from taste to resilience, from aroma to how easily they could be stored, to feed the family and for cultural ceremonies.

As Dr Melaku Worede, who set up Africa's first Gene Bank in Ethiopia, says, "*the rich genetic diversity that we see across the planet did not occur by chance. Farmers have played a key role in creating and maintaining this diversity by domesticating and breeding plants to adapt to the conditions under which they were farming. They breed within the context of the varying landscapes and seasons, and with a multiple of characteristics and criteria to meet the needs of the family and community. Traditional farmers know what they are doing.*"

Since the Second World War, the push for 'economic recovery' has systematically undermined farmers by the commercialisation of what was held in the commons for millennia – knowledge, skills, seeds and farming practices – shared within and between communities and generations. As farmers nurtured new traits in their seeds, they shared and exchanged them alongside the knowledge that is inextricably embedded in the cultivation of seed diversity and farming practices. This was a joyful practice that further enhanced the diversity of seeds, crops, knowledge and cultural food systems that were highly adapted to local ecological and climatic conditions.

The current situation in Africa

Across the planet, farming communities have been demoralised and fragmented by ongoing pressures to 'modernise' from the aggressive agro-chemical industry and their allies. The Food Sovereignty Movement, La Via Campesina, emerged more than two decades ago to build solidarity amongst farmers in resisting this pressure. In Africa our priority is to enable the bio-cultural systems to weave back together again wherever possible.

The deskilling of communities through the corporate enclosure of the knowledge and skills that are traditionally held communally, is undermining their seed and food diversity, confidence, and the control and resilience of their farming systems.

In another community gathering in Uganda in early 2017 Praxcida, a small-scale farmer, explained that government extension agents tell them that their traditional seeds are primitive and that they need to use modern hybrids and chemical inputs so that they can produce more to sell to the market. She said hesitantly, "*we prefer our traditional crops because they taste so much better, and with the changes in climate we find those of us who still have traditional varieties harvest more food. The cassava which the government gave us, for example, rots in the soil before we can eat it. Yet many of us give in to the government and have lost our traditional seeds.*"

By the end of this community dialogue the farmers agreed that even if the government continued to give them 'foreign seeds' as they call them, and chemical inputs, they now had the confidence not to use them. They agreed that the chemical inputs were killing the soil and "*making it thirsty*". They

committed to continue meeting regularly to recover and share their traditional varieties and to bulk them up so they could share them with others.

This is the story of communities across Africa, although not many have the support to regain confidence in themselves.

Research for what and by whom?

In Kenya, Teresa is also a small-scale farmer. She remembers the diversity of crops she grew up eating, but now most people plant the crops promoted by the government, and they depend mainly on maize. After a series of community dialogues reflecting on why and how things had changed, Teresa, together with other women in the community, began to recover their traditional crops through talking to the elders who remembered them. Sometimes they had to go deep into the rural areas to find an elder woman who they heard might have a particular variety of sorghum or millet that had all but disappeared.

Theresa says: "*As we began to rediscover these seeds, I started to experiment by growing our indigenous crops such as green grams, cowpeas, millet and sorghum in one field, and in another plot, some distance away, I planted the government seeds. I watched carefully … I harvested four bags of government green grams and six bags of our indigenous green grams. I found indigenous crops do better when there is less rain, and government crops need pesticides, which don't help to produce more, but cost more. And indigenous green grams taste so much better and are easier to store and sell.*"

There are two issues here. Firstly, the corporate appropriation of the inherently collective farming practice of cultivating a diversity of crops, is stripping farmers and agriculture of the very conditions to deal with climate disruption. This is an ongoing battle to reclaim control of the farming system.

The other issue is the conception of 'research' born in the context of reductive thinking and industrialisation. Today, in order to be accepted as valid, research has to meet certain standards established by academia, and has to be done within a certain timeframe, because of funding or an objective that has to be achieved such as an academic qualification. In our experience these conditions make it hard for research not to be extractive – getting information from farmers within a certain period as defined by the research objective or the project funding. Even when the aim is to be participative, it is hard to get away from these constraints.

Unravelling research

As Dr Melaku says, "*farmers have acute knowledge and capacity to observe and work within the complex dynamic of soils, seeds, wild biodiversity and climate.*" He insists that those working with farmers need to take the lead from farmers, and may be able to 'top up or add a bit' to build on the farmers' priorities. This requires an ongoing collaboration with farmers. It is a process, not a time bound project.

> "[the way forward]… is through building 'affectionate alliances' with communities in a process of taking back control of their knowledge, practices and decision making"

Ethio-Organic Seed Action (EOSA) in Ethiopia, led by Dr Regassa Feyissa who has been inspired by Dr Melaku's work, trains 'technical' people, mainly geneticists and agronomists, to do research in this way. Their joint objective, agreed with the farmers, is to enhance diversity in order to increase productivity and climate change resilience. This is the opposite approach to industrial agriculture, which strips diversity from the field in a drive to extract endlessly from the soil and the farmers for corporate profit.

In the case of Praxcida's and Teresa's communities, it is the women who lead the research in exploring what diversity they used to have. These women find the people with a 'lost' seed variety, and learn from them about the variety. They go on to multiply the seeds and share them with others. They control the process, and those accompanying them respond to the farmers' priorities, providing encouragement and tips where appropriate. This too is an ongoing process as it takes time for the farmers to regain confidence in their traditional knowledge, seed diversity and farming practices, and to resist the pressure from government and other external forces.

This means that the purpose of research, if it is to truly serve the transformation of the food and farming system, is not singular but manifold. In this way, it can regenerate ecosystems, farming systems and community cohesion to deal with climate disruption and the pressures to adopt 'foreign seeds' and inputs. Crucially, it leaves a resilient legacy for the next generation.

Community-led Research

There are some basic guiding principles which have evolved over the years in accompanying communities in their research to revive their traditional knowledge and practices. These include:

Recognising that indigenous knowledge systems are holistic and include a dynamic relationship between the world of humans, Nature and spirit (the ancestral domain). A healthy farming system depends on a healthy ecosystem. Through observing the practice of seasonal ceremonies using seeds and other sacred materials at sacred natural sites, the connection between the three domains is maintained. Seed and food is produced for the family to eat, for communal ceremonies which play a vital role in nurturing community cohesion and the ancestral relationship with the land.

Knowledge is understood to develop through practice and is willingly shared for others to explore for themselves. Rural communities are traditionally highly eco-literate, being able to read the dynamics between the climate, the moon cycle, the constellations and the behaviour of animals, plants, insects and birds, in indicating what seeds to plant when. This complex knowledge develops over decades of practice and cultivating a relationship with seeds, the land,

biodiversity and the wider ecosystem. Through this, communities learn the ecological laws of the land of which they are a part.

The research process takes place through restoring the traditional community practice of meeting regularly to analyse, reflect and transfer knowledge between generations. Given the breakdown of community cohesion and the loss of confidence in their traditions, these 'community dialogues' as we call them, are spaces for communities to learn from their elders and to revive their knowledge and practices. Research is understood as a practice which communities have had for generations, and is revived through the dialogues too. It is a reflective, empowering process that builds collective knowledge and understanding.

Those who accompany this community-led research process encourage and support the community to take the lead in deciding what they want to explore and revive. They can 'top up' with information so that communities can make informed decisions about issues that are foreign to them, like the story of the origin of pesticides; or augment their agro-ecological knowledge, or introduce useful tools such as eco-cultural mapping and calendars. Those practitioners who engage with communities in this way become passionate advocates because they learn so much, including how to think holistically.

Women in most farming cultures are the main custodians of seed diversity and biodiversity and traditionally play an important role in the ceremonies and governance systems. As Teresa demonstrates, women tend to have a profound relationship with seeds and farming and enjoy researching into different varieties and sharing their findings. Rural women in Africa, and elsewhere, have been severely undermined by the colonial and globalisation processes and their traditional knowledge and role is poorly understood or recognised.

Conclusion

Unmasking research as currently understood requires a profound paradigm change. It is part of the systemic transformation required of us to face the multiple crises caused by our hubristic ideas of human superiority. As we are seeing, it is not through 'counting and measuring' to extract endless amounts of 'objective' information that we will understand the complexity of the living systems of which we are a part, nor is this information changing our behaviour.

In our experience it is through building 'affectionate alliances' with communities in a process of taking back control of their knowledge, practices and decision making; linking up with others to resist corporate control; and nurturing regenerative food and farming systems. By 'de-professionalising' research it becomes part of the collaborative process of living consciously, participating with each other in observing the cycles and laws of Nature which govern our food and farming systems and building resilience in the context of climate disruption and corporate domination.

Liz Hosken co-founded The Gaia Foundation, based in the UK. During the first decade of Gaia's work Liz spent many years in the Amazon, where she was "initiated" into indigenous ways of seeing the world, which resonated with her own. Together with partners and indigenous communities, they developed a methodology for accompanying communities to revive their indigenous knowledge and practices. When Liz returned to her continent she was inspired to share these lessons and search for ways to restore Africa's rich cultural, spiritual and ecological heritage. Liz now teaches the philosophy and practice of this approach, which is rooted in experiential learning and Earth Jurisprudence.

Research for the public good

Industry-sponsored science is clouding the picture of how food systems impact health

How scientific research is structured, framed and financed has a major bearing on our understanding of the challenges facing society – and none more so than the burgeoning health risks generated by our food and farming systems, argues **IPES-Food**.

In many countries and many sectors, the commitment of governments to fund research as a public good, or even to make data and research results available as a public good, has been increasingly compromised (e.g. New, 2017). In the past few years, many governments have reduced their support to all forms of public research, including national surveys, as well as international research organisations (Dalrymple, 2008). Public sector agricultural research has been dramatically scaled back over recent decades on the back of government funding cuts to higher education institutions (King *et al.*, 2012; Muscio *et al.*, 2013).

These cutbacks have generated a void that is increasingly being filled by private interests, creating several problems. Firstly, some issues of high public interest may not attract funding from private investors. For example, the gradual privatisation of agricultural research funding has come alongside an increasing focus on those commodities for which there is a large enough market to secure a significant return on investment (Piesse and Thirtle, 2010). In this context, minor species and traditional crop varieties have been neglected (Rahman, 2009), despite their nutritional benefits.

Meanwhile, holistic analysis of food systems – and the social-ecological interactions that generate human health risks – is falling through the cracks. This is reflected in the lack of interaction between different disciplines in many agricultural colleges (O'Brien *et al.*, 2013) the lack of attention to the complex interactions between the natural environment and human society (Francis *et al.*, 2003), and the high proportion of doctoral and post-doctoral research topics in highly specialised fields of biotechnology as compared to research on agroecology (Francis, 2004).

Second, the privatisation of research has implications for the validity of the research that does emerge. While private funding can produce – and often has produced – important contributions to the evidence base, industry-funded research has in a variety of contexts and sectors been found to disproportionally favour outcomes aligned with industry interests (Bhandari *et al.*, 2004; Lexchin *et al.*, 2003; Perlis *et al.*, 2005; Scollo *et al.*, 2003). This can occur through conscious or unconscious influence on the definition of research questions (Bero, 2005; Lesser *et al.*, 2007; Scollo *et al.*, 2003), the experimental design (Djulbegovic *et al.*, 2000; Lexchin *et al.*, 2003), the implementation of statistical analyses (Lesser *et al.*, 2007), the interpretation of statistical results (Alasbali *et al.*, 2009; Golder and Loke, 2008), the extent or quality of peer review (Barnes and Bero, 1996; Scollo *et al.*, 2003), and industry-related delays, suppression, or dissuasion regarding the publication of specific results (Bero, 2005; Lexchin *et al.*, 2003; Okike *et al.*, 2008).

Influence over the framing of the research agenda and the terms of the broader scientific debate has also been identified through a range of additional practices, e.g. employing individual researchers as consultants or inviting them to sit on company boards in order to signal objectivity and legitimacy; funding professional and academic associations; publically critiquing established but "inconvenient" evidence and sowing doubt about its validity, often through the use of front groups; and using corporate social responsibility programmes as marketing campaigns (e.g. to shift the focus from obesogenic diets onto the importance of active lifestyles by sponsoring sporting events).

The empirical evidence on the influence of industry-backed studies in shaping understandings – and ultimately policy – is largest for the medical, pharmaceutical, and tobacco sectors. However, emerging research supports the hypothesis that some corporations in the agri-food industry operate in a similar fashion and have meaningfully impacted debates around nutrition (Brownell and Warner, 2009; Nestle, 2016;

The PLoS Medicine Editors, 2012). Lesser *et al.* (2007) show in a review of nutrition research on soft drinks, juice, and milk that the funding source may have a significant impact on study conclusions, with 0% of industry-backed studies reporting an unfavourable outcome (as compared to 37% of publically funded articles).

Major discrepancies have been found between the results of industry-funded and non-industry-funded studies (including systematic reviews) on the health impacts of sugar consumption and sugar-sweetened beverages (SSBs) (Bes-Rastrollo *et al.*, 2013; Vartanian *et al.*, 2007). Explicit attempts from the 1960s onwards to divert attention from sugar to fat as a heart disease risk factor were recently uncovered, and are seen to have significantly derailed decades of medical research around sugar (Kearns *et al.*, 2016; O'Connor, 2016). Popkin and Hawkes (2016, p. 175) conclude that it is only studies funded by the sugar and beverage industries that continue to cast doubt on the substantial weight gain and cardiometabolic risks from SSBs.

> "… [it is important] to redefine research for the public interest and the public good, to reassert scientific integrity, and ultimately to address the burgeoning health impacts of food systems."

Industry funding of professional associations has also been alleged to heavily influence the framing of prominent public debates (Nestle, 2013; Simon, 2013, 2015). For example, the scientific objectivity of the American Society for Nutrition (ASN) and the Academy of Nutrition and Dietetics (AND) has been called into question on the basis of strong ties to the food and beverage industry (Simon, 2013, 2015). This has major implications since the ASN is the publisher of three widely read nutrition science journals, the American Journal of Clinical Nutrition, the Journal of Nutrition, and Advances in Nutrition. Meanwhile, the 'Nutrition Fact Sheets' produced and publicised by the American Dietetic Association (ADA) have been called into question on the grounds of industry partners having paid to co-write them (Brownell and Warner, 2009).

The increasingly prominent role of private actors, and the declining role of public research, also raises questions about data availability and access. Access to data on farm-level trends, environmental conditions, disease incidence and the properties of foods is essential in order to build understanding of the various health risks in food systems. Privatisation of data production and access is already raising major issues of transparency and accountability across food systems. For example, lack of data collection by industry, or lack of access to that data, has been identified as a major obstacle to identifying the health impacts of Concentrated Animal Feeding Operations (CAFOs) on surrounding populations (National Research Council, 2015). Risk assessments for new technologies and chemicals (e.g. Endocrine Disrupting Chemicals, or EDCs) also tend to rely on data generated and controlled by major agri-business firms, while information around biotech crops is notoriously difficult to access. In 2009, 26 university crop scientists wrote to the US Environmental Protection Agency complaining that patents on engineered genes were preventing public sector scientists from researching the potential impacts of GM crops (Pollack, 2009). While most biotech companies now have agreements with universities on use of their patented technologies for research, scientists must still negotiate permission to conduct these studies from the companies themselves (Haspel, 2014; Stutz, 2010). Risk assessments for novel food additives are particularly reliant on industry data and private sector governance: under US law, it is the responsibility of manufacturers to assess whether new substances are generally regarded as safe – 'GRAS' – by scientific experts. Notification to public authorities is voluntary, with little scope for public scrutiny.

Recent advances in Big Data could pave the way for major improvements in monitoring and mitigating food systems impacts, e.g. by deploying farm-level soil data to enable more targeted use of chemical inputs. However, current trends raise concerns about how that data will be used and to whom it will be available; vertical integration is continuing apace across the agri-food sector, with a handful of firms gaining an increasingly dominant position, and company information becoming ever-more opaque (IPES-Food, 2017).

Research priorities, structures, and capacities therefore need to be fundamentally realigned with principles of public interest and public good, and the nature of the challenges we face, i.e. cross-cutting sustainability challenges and systemic risks.

The challenge is not simply to curb the production of research and data by private actors; these activities form a crucial part of the evidence base. Nor does public research represent a panacea. In a context of increasing privatisation, public-sector research has tended to echo the emphasis of private research agendas, e.g. mirroring the focus on increasing productivity for a small number of tradable crops via technological innovation (Jacobsen *et al.*, 2013). Moreover, without major reinvestment in public data gathering, private firms will continue to be best-placed to conduct monitoring of risks and outcomes across food systems.

A series of inter-connected steps are therefore required in order to reassert public interest across the board, and to counter the risks of industry-sponsored science.

Firstly, scientific integrity could be bolstered through changes in the rules governing scientific journals, e.g. around disclosure of conflicts of interest, and steps to make that information more visible. Some medical and nutrition journals have already taken significant steps in this direction. For example the American Journal of Clinical Nutrition policy (AJCN, n.d.) now requires that all clinical trials and observational studies (including nutrition trials) be registered in an appropriate public trials registry upon initiation of the study. Meanwhile, the Journal of the American Medical Association policy (JAMA) requires that statistical analyses be

independently conducted by researchers who are not employed by the funder, in addition to any statistical analyses performed by the sponsoring industry (Fontanarosa *et al.*, 2005).

Secondly, to address the problem at root, measures may also be required to reduce the reliance of researchers on private funding. The interaction between researchers and industry funding is highly complex, since in many instances researchers are required to attract private funding sources and voluntarily approach industry actors in search of grants. Such situations require at a minimum a careful analysis of potential conflicts of interest. Initiatives to fund and mandate independent scientific research and independent journalism on the health and environmental impacts of food systems are therefore needed.

Securing the necessary resources may require innovative funding models and the involvement of a range of public and private actors (e.g. philanthropists). Reflection is also required on the role of trade associations and industry-linked information portals and 'front groups'. These bodies may have greater capacity than public health agencies to communicate around food-related health risks, but also face key conflicts of interest and tend to blur the boundary between industry and education (Heiss, 2013).

Thirdly, a more fundamental reorientation of research agendas and modalities is required. Siloed approaches in science and policy make it possible for dominant actors to separate the problems from one another and to frame the debate around narrowly defined, one-dimensional solutions. Promoting more holistic and integrated approaches in science and policy alike – 'food systems thinking' – is therefore essential. Different forms of research involving a wider range of actors and sources of knowledge are also required to rebalance the playing field and challenge prevailing problem framings (e.g. industry-leaning approaches; a global North bias). For example, participatory research, which includes the people whose health is most affected by food systems, can help to overcome narrow research questions that exclude impacts on certain populations.

Encouraging a broader shift in research modalities requires different incentives across academia. It also requires assurances that studies of this type will not be relegated to inferior or anecdotal status, and will be considered side-by-side with other types of inquiry, forming a meaningful part of the evidence base for assessing food systems.

Fourthly, further investment should be made in large-scale data gathering by intergovernmental organisations. The WHO-led Initiative to Estimate the Global Burden of Foodborne Diseases offers an example of collaborative data generation and capacity-building. After a decade-long effort, this initiative was able to produce an authoritative estimate of the global foodborne disease burden in 2015, while drawing considerable stakeholder attention to this problem (WHO, 2015a). Another example of a global initiative that aims to redress the imbalance in regional data availability is the mapping of poverty and likely zoonoses hotspots by the International Livestock Research Institute (ILRI *et al.*, 2012), one of the CGIAR research centres.

Together, these steps can help to redefine research for the public interest and the public good, to reassert scientific integrity, and ultimately to address the burgeoning health impacts of food systems.

This text is based on the October 2017 report from the International Panel of Experts on Sustainable Food Systems (IPES-Food): 'Unravelling the Food–Health Nexus: Addressing practices, political economy, and power relations to build healthier food systems' (Lead author: Cecilia Rocha, Editorial lead: Nick Jacobs). Available here (including references)

Fairness and food safety: a research gap

Dr Liza Draper, Food, Nutrition and Public Health Division, University of Westminster

Food safety is generally thought of as a rather dull and technical issue. Most of us take it for granted that the foods we put into our mouths do not contain dangerous pathogens or chemical substances.

The ways in which foods are marketed and retailed in industrialised countries such as the UK, do not encourage us to look back along the food chain. This is particularly true in regard to animal foods, as this might remind us of uncomfortable truths about animal and worker welfare. It is only when a food scare, such as BSE, Horsemeat or the recent revelations about the 2 Sisters Food Group occurs, that these are exposed.

The safety of global food supplies is vital, but the current research agenda on food safety remains extremely narrow, with a focus on risk assessment and management along the food supply chain. Risks are framed primarily from a toxicological or epidemiological framework. Consideration of fairness and ethics rarely, if ever, feature.

Now, however, with concerns about sustainability and food security high on the policy and research agendas, there is an opportunity to re-frame food safety to extend beyond concerns about consumer health, and to include potential harm to others involved in the food chain to ensure that food is fair for all, including animals and workers.

Pathways for the amplification of agroecology: matching practice with discourse

The sophisticated analysis on food sovereignty is not always matched by concrete agroecological initiatives on the ground. There is an urgent need to translate agroecological principles into practical strategies to enhance production and resilience, so that they can be widely disseminated and expanded among thousands of farmers, write **Clara Nicholls** and **Miguel Altieri**.

Transitioning to an agriculture based on agroecological principles would provide rural families with significant social, economic and environmental benefits, and feed the world equitably and sustainably.[1]

Small-scale food producers farming less than 25% of all arable land provide most of the food consumed today.[2] If they applied agroecology, these farmers' contribution to global food security could be improved and replicated. Yet, very few resources, and almost no policy support, have been devoted to agroecology research and extension. It attracts less than 10% of the funding devoted to the 15 international research centres of the CGIAR.

There are many ways to overcome the barriers to widespread adoption of equitable and accessible agroecological alternatives including: funding more research and education on agroecology, creating an enabling policy and institutional environment, providing the right incentives to farmers, and creating solidarity markets. Equally important there is an urgent need to translate agroecological principles into practical strategies for soil, water and biodiversity management to enhance production and resilience.[3]

Understanding the ways successful farmers use biodiversity and the ecological underpinnings of their complex ecosystems, and then spreading extensively such principles farmer to farmer has been shown to be effective in speeding the development of productive, sustainable and resilient agroecosystems. Another avenue is for agroecologists and farmers to blend traditional and modern knowledge to create novel farm designs, well adapted to local circumstances. These lighthouse[a] farms then radiate out agroecological principles and lessons to the broader rural communities.

Herein we identify and describe a few initiatives that allowed the amplification of agroecology beyond isolated local experiences to include more farming families in larger territories.

Reviving traditional farming systems

The failure of the Green Revolution to deliver for the very poor led to new enthusiasm for traditional technologies. This spearheaded a quest in the developing world for affordable, productive, resilient and ecologically-sound technologies that enhance small farm productivity while conserving resources, promoting biodiversity, and thriving without agrochemicals.

One early project in the mid-1970s advocating this approach, pioneered by Mexico's INIREB, unveils a plan to build Aztecs' perfected chinampas – raised farming beds constructed in shallow lakes or marshes agriculture in the swampy region of Veracruz and Tabasco. A self-sustaining system that has operated for centuries, allows for the production of a wide variety of staple crops, vegetables and flowers mixed with fruit trees. Abundant aquatic life in the canals provided valuable sources of protein. Although adoption of chinampas was limited due to lack of local market outlets, the 'raised beds' are still in full operation in the swamps of Tabasco, as they ensure Chontal Indians' food security in times of scarcity.[4]

In the Andes, several local government institutions in collaboration with NGOs and farmers have restored, or built new, terraces across Peru. Terraces minimise risks in times of frost and/or drought, reduce soil loss, increase cropping options because of their microclimatic advantages and improve crop yields. Also the revival, at altitudes of nearly 4,000 m, of 'Waru-Warus' – raised beds surrounded by ditches filled with water – has not only ensured good crops, but also, warmed by the sun, the water in the ditches moderate night temperatures, reducing frost damage.[5]

a 'In this paper, 'lighthouse farms' / 'lighthouses' refer to beacons of good practice that radiate out this good practice to others.

In more arid and semiarid regions, generations of farmers have developed management options that can increase the soil's ability to store water for plant use, reduce vulnerability to drought and help halt soil erosion and degradation. Traditions of hand-dug 'Zai' pits for land rehabilitation have been successfully revived by projects in Burkina Faso and Niger. The pits act as micro catchments, holding and concentrating rainfall from the area allowing reasonable maize yields in times of drought.[6]

Campesino a Campesino ('CaC')

El Movimiento Campesino a Campesino ('CaC') is a grassroots movement in sustainable agriculture that emerged in Mexico 30 years ago and has swept across Central America and the world. CaC is a cultural phenomenon creating innovative teaching mechanisms that link campesino communities across villages using agroecology and a horizontal learning network. It uses participatory methods based on local peasant needs and encourages the spread of the rich pool of family and community agricultural knowledge that is linked to their specific historical conditions and identities. By exchanging innovations among themselves, peasants have been able to make dramatic strides in food production relative to the conventional sector, while preserving agricultural biodiversity and using much lower amounts of agrochemicals.[7]

Several hundred thousand farmer-promoters have shown that, given the chance to generate and share agroecological knowledge freely amongst themselves, smallholders are perfectly capable of adopting agroecological practices. The wide adoption of Mucuna as a cover crop in Central American hillsides by more than 50,000 families[8] - and the more than 130,000 farmers in Cuba that since 1990 adopted agroecological practices and became the main food producers of the island[9] - are a living testimony of the efficacy of this teaching mechanism.

Demonstrating agroecological transitions in practice

Since the 1980s, NGOs have promoted the integrated use of a variety of agroecological management technologies and practices. They emphasise the design of diversified model farms that demonstrate agroecological principles to the community and farmers from other regions. The half hectare agroecological modules established by the Centro de Educacion y Tecnologia (CET) in Chile, allowed a family of five to be totally self-sufficient in food without using external inputs. The Asociacion Cubana de Agricultura Organica (ACAO) in Cuba and Centro IDEAS in Peru established similar demonstration modules, helping hundreds of farmers to rebuild their farms based on strategies that promote efficiency, diversity, synergy, and resilience.[10]

Successful farms established by farmers using agroecological principles can also be used as demonstration lighthouses. El Hatico nature reserve in Colombia features efficient silvopastoral systems (SPS), which combine fodder plants, such as grasses and leguminous herbs, with shrubs and trees for feeding livestock and other complementary uses. SPS quickly recycle nutrients and improve soil fertility, nitrogen fixation and nutrient uptake from deep soil horizons. SPS create complex habitats and soil food webs that support a rich biodiversity above and below ground, and increase connectivity between forest fragments. El Hatico has become a major research and education demonstration centre that has benefitted thousands of farmers, students, scientists and others.[11]

Alternative food networks

Today agroecology is recognized by rural social movements as a transformative science that is explicitly committed to creating a just and sustainable future by reshaping power relations from farm to table. An ever-increasing diversity of actors (farmers' organisations, progressive academics, NGOs, citizens and environmentalists) are forming transnational agrarian and food justice movements, under the banner of food sovereignty, that oppose the corporate-dominated global agri-food system. Democratising access to healthy food for all is a main goal of such movements.

An emblematic example is Ecovida in southern Brazil, an initiative that builds inclusive and equitable local commercial networks. Ecovida has a decentralized structure encompassing 180 municipalities and approximately 2,400 families of farmers (around 12,000 people) organised in associations linked to 10 citizens' ecological food cooperatives.[12]

Reconfiguring agroecological territories

There are many examples of whole rural communities engaged in agroecological transition processes at the territorial level, involving the widespread use of agroecological practices, biodiversity and resource conservation schemes and territory-linked embedded food systems. The network of Globally Important Agricultural Heritage Systems[13] and some of the large settlements of the Movimento dos Trabalhadores Rurais Sem Terra ('MST') in Brazil[14] are examples of communities preserving their traditional systems to preserve, and or secure, land managed under agroecological principles.

Favourable policies

Although development of public policies in support of agroecology are extremely important, experience suggests that combinations of complementary policies are needed to incentivise the spread of agroecological initiatives. Public food procurement is perhaps the most effective policy promoting agroecology such as Brazil's National School Feeding Programme ('PNAE'), which by 2012 included the participation of 2000 municipalities and about 45 million students per day were served. Researchers found that the PNAE offers an economic incentive to small farmers to begin an agroecological transition by creating a price-differentiated market.[15]

Conclusions

It is well established that small farmers can produce much of the food needed for rural and urban communities, in the midst of climate change and without dependence on modern technologies. Such contributions could be amplified if agroecology were extended to restore and enhance the productive capacities of existing peasant systems. In order to realise such potential, successful local agroecological initiatives must be widely spread via farmer to farmer using

teaching strategies (such as the CaC model), creation of demonstration farms or centres, reviving traditional systems and reconfiguring whole territories under agroecological management, all with a focus on sharing experiences and strengthening local innovation and problem-solving capacities.

Developing equitable local and regional market opportunities would make it more economically viable for the adoption of agroecology to grow. Experience shows that policies can be supportive of the agroecological transition if they ensure that agroecological alternatives are adopted broadly, and that the resulting production finds guaranteed outlets in local or solidarity markets.

Simple practices that give quick, visible results may appeal to farmers for early adoption, which has been the basis of the CaC methodology. However, the goal is to transition farmers to more integrated systems which lower production costs and enhance farmers' autonomy. Although more complex agroecological management depends on a deeper understanding of ecological relationships, lighthouse farms can unravel the complexity by focusing on the principles that underpin such systems rather than on the practices and technologies.

Transitioning towards agroecology for a more socially just, culturally diverse, economically viable and environmentally sound agriculture will be the result of the coordinated action of emerging social movements in alliance with civil society members and researchers committed to support the goals of farmers' movements.

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Measuring farming outcomes for the public good

Steve McLean, Head of Agriculture & Fisheries, Marks & Spencer

Our priority is to develop a supply base fit for the future that drives innovative products and profitability, and allows everyone to reinvest in their communities. We don't own the farms and factories that make the products we sell in our stores, therefore our reputation for quality, innovation and sustainability is built on long-term relationships. One way we increasingly build and maintain these relationships is through collaborative data collection.

The centrepiece of this approach is to focus on 'outcome measures.' These provide us with an objective tool to quantify, monitor and manage our impact on people, animals and our shared planet, regardless of the production system, climate and location. Having developed and refined both the measures and the bespoke collection system with our friends at FAI Farms, we are now regularly collecting data at critical points in our supply chain in close partnership with our suppliers.

The data is extremely beneficial to us for benchmarking and identifying best practices as well as areas for improvement. However, more importantly, the data is providing direct feedback to the farmers and suppliers that produce our food on how they themselves can improve animal welfare, economic, social and environmental performance of their farm and operations.

A sustainable food future is the public good we are all working towards. We are beginning to see the signs of how collaborative data collection with our suppliers can help get us there.

An ethical research agenda

Setting an ethical research agenda: the role of the public sector

Ruth Segal argues that public funding should be directed towards research that works explicitly towards creating a diverse and plural research system and answers the needs of poor and food-insecure farmers.

The concept of research 'for the public good' – and of research outputs as 'public goods' – has been understood in different ways over time, interpreted to fit with competing development discourses, and has been used to justify a wide range of public research interventions which are often contradictory. To prioritise food and farming research for the public good, we need to consider what we mean by 'public good', including asking who is the public – or publics?

An ethical research agenda can be defined as one which creates research to develop a food system providing outcomes of social welfare, food security and environmental sustainability.[1] To produce these outcomes, policy and research should consider not just production goals (quantity of food) but environmental and socio-economic goals too: including access to food by all; the nutritional value of food produced; biodiversity; resilience to climate change; the cultural value of food (including the relationships between people and place); the livelihoods people can make through producing food and the quality of their jobs.

If that is an ethical food system, then research to support it needs to take multiple approaches, because the answers to those questions look different to different people, in different contexts, with different constraints.

Research: who is it for?

An ethical agricultural research agenda must move beyond technical questions about yield and production to examine political questions about access – to productive inputs and outputs, knowledge and power to decide on research agendas.

As experience from the Green Revolution onwards has shown, forms of agricultural research shape modes of production. Ten years ago, the IAASTD report argued that the global agri-food system has been shaped by those with the power to do so, and choices about priorities for research and investments have been based on a development model designed in industrialised nations, often disregarding local knowledge, culture, interests and ecosystems.[2]

IAASTD argued that a focus on production and profit, not sustainability and development goals has given rise to the social, health and environmental problems now confronting both developing and industrialised countries. Most investment in crop research and innovation has ignored locally important crops that provide vital dietary diversity, or crops that are important for women's livelihoods. Therefore, these 'orphan crops' are less economically attractive for many farmers.

The IAASTD analysis also described the huge impacts of globalisation, which has led to a shift in agricultural systems towards export production. Agricultural outputs in developing countries are now often the raw materials for a global market in processed foods. The type of product produced, where, how, who by and who for, have all been affected by the integration of agriculture into global markets. Inputs to the agriculture system, including research, are therefore becoming geared towards the incorporation of food production into global food value chains. But such globalisation processes often have a negative impact on food security for poor and marginal communities in countries of the South, and have increased inequality[3].

The expansion of markets, coupled with unequal power relations in the food system "…has resulted in the luxury tastes of the richest parts of the world being allowed to compete against the satisfaction of the basic needs of the poor."[4]

Addressing inequalities

Policy makers who champion the role of the private sector in delivering food security rarely take into account power relations within the food system. Instead, they assume that trade-based approaches to food security will enable the private sector to deliver desired food system outcomes. By this logic, if the best way of reducing poverty is to connect smallholders to global markets, then research which enables them to provide products for multinational food corporations could be seen to be 'for the public good'.

As a result, research has overwhelmingly supported market-based approaches to achieving food security, and more so as private sector R&D increases. While it is impossible to get reliable figures for private investment in agricultural R&D, evidence from sub-Saharan Africa shows private investment bias towards a limited number of commodity crops.[5]

Agribusinesses and processing companies employ agronomists to work with farmers, providing them with plant varieties that best serve their product lines, e.g. potato varieties that are best for making crisps.[6] In this way, such companies

are shaping the direction of agricultural research directly on the ground. This leaves a huge gap of investment in the crops that could make the most difference for poorer smallholders.

The dominant model of development (agricultural growth leads to economic growth, poverty reduction and a shrinking agriculture sector) underpins this approach. Against this model, civil society and farmer groups have developed radically different visions of how the food system should operate. Right to Food and food sovereignty approaches call for forms of production, e.g. agro-ecology, which consider context, scale and diversity. Proponents call for food policy to focus on goals of social justice, human rights and environmental sustainability.

What research is needed to make this a reality? The private sector makes most money from technical solutions that can be applied at scale, so there is more incentive to invest in research for commercial crops than for those grown by small-scale farmers. It is difficult to make money from poor farmers who cannot buy agricultural inputs, or are unwilling to take the risks associated with trying out new crop varieties.

Publicly-funded research should aim to meet the needs of those farmers, focusing on 'neglected' crops and crops for bio- and dietary diversity. It should be explicitly directed towards forms of research that are not receiving attention from private sector actors.

Public research, which produces knowledge and places it in the public domain, should be a public good. However, publicly-funded research is often shaped by donor priorities rather that the needs of farmers, and has not always focused on development outcomes.[7] Not all forms of knowledge are equally available, accessible or relevant to all publics. Research centres may produce new seed varieties or knowledge about better farming techniques, but farmers may need additional resources to use this knowledge, including access to the seeds, or to extension services so they can learn new approaches. Without these inputs, research is unlikely to deliver benefits to farmers. The public good outcomes from research therefore depend on policy, regulation, infrastructure and institutional support to overcome barriers to access. Policy research on overcoming these barriers is needed to support public agricultural research.

Public good outcomes also depend on the usefulness of the research to the end-user. Barriers might include not only the form in which the knowledge is available, but the relevance of the knowledge to the context in which it is to be used. Farmers are unlikely to use technologies which do not address problems they have identified. Researchers, instead of searching for a 'silver bullet' technology that can be applied at scale, should be working at farm level directly with small-scale farmers to produce research outcomes that meet their needs. Farmers must be acknowledged for their role as innovators, rather than merely as recipients of outputs from research centres. This includes appreciation of the generations of knowledge and daily research embodied in 'traditional' seed varieties.

These debates about forms of research have been ongoing for decades, since the development of 'farmer first' and other participatory and co-creation research methods in the 1980s.[8] But such approaches have remained at the margins of research agendas. As UN agencies report increasing numbers of food insecure people[9], there is a new urgency to ensure the voices of farmers are heard in research systems.

But even with better directed research, farmers will not grow crops for local food security if commodity crops provide them with a better income. Policy research is needed to identify mechanisms that enable farmers to make a living from growing healthy food sustainably. Research is needed into what incentives will enable them to make that shift, for instance from cocoa production for global markets to crops for diverse diets for local communities. This could include research into emerging rural-urban systems which support small-holder production.[10] The public sector has a key role to play in identifying these policy and other mechanisms. Its strategic focus should be on farmers in marginalised areas, who are often physically difficult to reach, and socially or politically marginalised. This includes focussing on the needs of women farmers.

Publicly-funded research should be working explicitly towards creating a diverse and plural research system. This means recognising the multiple routes to food security and different research needs for different contexts. It means supporting multiple methods for innovation in diverse contexts, and developing mechanisms to bring a wider range of voices into research processes, so farmers themselves can identify investments that will best meet their needs. It means asking who benefits from current approaches and challenging power and inequality in the current food system. It means recognising that 'good' is different for different people.

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Ethical priorities for future agrifood research

There needs to be a revolution in the way science knowledge is obtained, writes **Ben Mepham** – and ethical reasoning must be a crucial element in decision-making on science and agriculture policy.

What drives research?

Significant difficulties in making plans for research priorities lie in adequately understanding the present situation, and accurately forecasting the resulting developments. Given these imponderables, and uncertainties pervading the Brexit debate, I adopt here a radical 'visionary' approach - hoping that if the analysis proves useful, appropriate policy implications will emerge. For, while ethical deliberation clearly does not exert the clout of legislation, arguably it can exercise a significant influence by informing sound judgments.

In *Food Ethics* (1996),[1] my chapter on research policy began with this quotation from an article by the social scientist Howard Newby: "*Agricultural science has indeed transformed the practice of agriculture. Discoveries made by people in white coats ...have been transferred into farmers' fields in a bewilderingly short space of time, assisted by a wide network of institutions ... aimed at speeding up the process of technology transfer.*" Given Newby's "bewilderingly short space of time," and the dramatic acceleration of 'technology transfer' over the last 20 years, it is pertinent to enquire whether ethical analysis has assumed more, or less, significance in formulating research policy over that period.

In my chapter I suggested, with reference to farm animal welfare, that three types of question should be posed for 'rigorous' ethical auditing: i) are issues assigned a priority commensurate with their ethical significance? ii) is the research addressing appropriate questions? and iii) is the research conducted in ways that respect consumers' rights to know about the processes and products employed in food production? In brief, my conclusions suggested that in no case had these ethical issues been adequately addressed.

Over the last 20 years, the notion that 'ethics' is relevant to assessment of the activities of governmental and commercial organisations, and not just to personal standards of behaviour, has assumed a high public profile. Now, almost all organisations dealing directly with the public have established ethics committees, and codes of ethics. But this 'privatisation' of ethics led to abolition of many government committees with clearly-defined ethical remits, such as the Agriculture and Environment Biotechnology Commission (AEBC, of which I was a member) and the Farm Animal Welfare Council. Moreover, as noted by the renowned US agricultural ethicist, Paul Thompson,[2] "*while people … think of medical ethics as a field where normative assumptions and disagreements are analysed and debated, 'food ethics'… [including its agricultural dimensions] … tends to be associated with personal conduct*" e.g. concerning consumers' choices to eat foods they consider raised under 'good welfare' conditions or 'additive-free'. So, in the agri-food context, "*the norms distinguishing right from wrong are presumed obvious and noncontroversial*" because for many people it is not the role of food ethics to specify, analyse or debate normative commitments. Yet, arguably, this is precisely where ethical deliberation is necessary.

The Biotechnology and Biological Sciences Research Council (BBSRC), which funds the UK government sponsored agri-food research, describes its mission in a 'core narrative'.[3] In essence, this amounts to providing support to the bioscience base, in order to underpin the bioeconomy, and build a more prosperous nation. But wider concerns, such as global environmental sustainability (adversely affected inter alia by intensive agriculture) and malnutrition (due to inadequate and/or inappropriate food supply) are not mentioned in the BBSRC's narrative. Instead a headlong pursuit of economic growth in the face of a rapidly degraded environment, and a marked deterioration in public health, illustrates the government's reliance on out-dated theory to address new global crises.

An ethical research agenda

Much basic research in the biosciences, when conflated with biotechnology (with which it is inextricably entwined in BBSRC programmes), aims to address economic objectives. But when this focus is to the detriment of environmental, animal welfare and public health considerations, it is hardly compatible with the aim of achieving universal prosperity. What seems necessary is a much more joined-up, holistic analysis of the ethical implications of research programmes, to guide sound decision-making on research priorities – a primary aim of the now-disbanded AEBC.

In another chapter in 'Food Ethics' (Ethical analysis of food biotechnologies: an evaluative framework) I outlined a conceptual tool, the ethical matrix. Based on elements of the so-called 'common morality,' it sought to facilitate ethical deliberation on the impacts of proposed technological innovations for a range of interest groups (for example consumers, farmers, retailers, farm animals and biota in the environment). Subsequently, it has been used extensively, e.g. by the Food Ethics Council, and across the EU – which sponsored a major research grant to explore its utility. Thompson[2] is surely right that "*it is arguably most useful as a heuristic device … that facilitates multidisciplinary conversation and collaboration.*" It does not aim to prescribe ethical decisions, but to clarify views and justify individual judgements.

I believe bioethical analysis should be an essential ingredient of BBSRC's remit. But it's a telling fact that, apparently, this

claim was only once endorsed – when, in 1997, I was awarded a three-year BBSRC research grant for a project 'Bioethical analysis of technology assessment'. Focusing on two prospective dairy technologies, it involved workshops employing the ethical matrix, surveys of retailer, consumer and farmers' attitudes and desktop research. Arguably, it provided crucial evidence for the EU's ban on the use of growth hormone in dairying. However, a subsequent BBSRC Chief Executive considered that bioethics was outside the Council's remit.

The ethical matrix is only one of several ways to aid ethical assessment of scientific research policies. But structured deliberation, with input from representatives of different interests in society must surely now be a routine element of prospective technology policies. The public participatory process on the future of the Norwegian fishing industry, conducted using an ethical matrix, is a notable example of the value of this approach in forward planning.[4]

Food systems for universal, sustainable nutrition

Space limitations confine my focus to this single objective. To economise on citation of references, several key ideas are discussed in earlier publications.[5] To illustrate the attitudinal changes required to devise research policies responsive to rigorous bioethical analysis, I suggest that the following claims need to be assigned importance.

Reliance on economic growth is no longer valid

Probably, the most important claim advanced in recent years, is that future prosperity can only be achieved if decoupled from economic growth. For Tim Jackson, "*In a world of limits, frugality recalls us to our membership in a wider community: prosperity can only be conceived as a condition that includes obligations and responsibilities to others. It's a view that is almost totally antithetical to the prevailing notion of prosperity through individual gain.*"[6] But despite the evidence that "*excess nutrient loading, species loss, ocean acidification and climate change [are] already representing a serious threat to the integrity of ecological systems,*" until recently this claim was questioned by many economists. Now, for informed and thoughtful people, it's virtually a truism; for, "*to have a chance of avoiding collapse in the resource base in the (not too distant) future requires a massive technological shift, wholesale changes in patterns of consumer demand; and a huge international drive for technological transfer.*"[6] But there is little evidence of these objectives in BBSRC research policy.

Intergenerational justice is crucial

An estimated 800 million of the world's 7.3 billion people suffered from chronic undernourishment in 2014-2016. Addressing this relentlessly self-perpetuating predicament is clearly not just a matter of stop-gap measures but of inter-generational justice. Reciting the UN Declaration of Human Rights is cynical and meaningless if not supported by serious positive measures. In an inter-generational context, this ethical obligation needs to ensure: that in future the planet is sufficiently well-stocked with resources to supply everyone with adequate nutritious food; and everyone has an equitable access to this total stock. Environmental lawyer Edith Brown Weiss proposed two important principles to underpin this obligation: conservation of options (ensuring that future uses of the diversity of the natural and cultural resource base are not unduly restricted); and conservation of quality (ensuring the planetary resources we pass on are in no worse condition than those we inherited).[7]

Research aims need to be re-directed

Traditionally, the aim of science has been the acquisition and extension of knowledge. But Nicholas Maxwell's novel approach to scientific research – aim-oriented rationalism – makes attainment of personal and social wisdom its principal aims.[8] He argues that, as science can never be fully 'neutral', the aim of research ought to be to acquire wisdom rather than just to accumulate supposedly ethically neutral facts. He claims that intellectual priority needs to be given to the dual tasks of articulating our problems of living, and proposing and criticising possible solutions. Many years' experience as a scientist and reflection as a bioethicist, persuade me of the soundness of this thesis.

A revolution in the way 'scientific knowledge' is acquired and used is urgently needed. Given the enormous roles played by bioscience and biotechnology in our lives, an introduction to ethical reasoning should be provided to all secondary school children, be a prominent feature of tertiary education, and a crucial element in decision-making on science policy. Structured approaches, such as the ethical matrix, can facilitate sound judgements.

Priorities for food supply should be: sustainable, universal nutrition, by means that mitigate environmental degradation; and respect for the rights of humans and nonhumans (farmed and feral) while remaining sensitive to the diversity of cultural norms. Research policy should be revised to address these priorities – although this will entail substantial restructuring.

Ben Mepham was founder and Executive Director of the Food Ethics Council (1998-2003). Formerly a reader in physiology at Nottingham University, in 1993 he founded and directed the Centre for Applied Bioethics, and was subsequently appointed to a 'special professorship' in bioethics. Since retirement in 2005, he has held an honorary professorship at the Centre. He co-founded the European Society for Agricultural and Food Ethics, and was a member, as a bioethicist, of the UK government's Biotechnology Commission.

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Final viewpoint

Calling for a paradigm shift

Food Ethics Council viewpoint

There are enough 'hockey stick' graphs – of climate change, biodiversity loss, obesity and other negative products of the current industrial food system – to make the case for proper investment in long-term solutions and an appropriate, inclusive, ethical food and farming research agenda. Yet, the evidence has been ignored.

There is a lot known about our food and farming systems and their impact on people, animals and the planet. And there is a lot not yet known about them. While there is greater understanding of genetics of both crops and livestock, greater concern for farm animal welfare and improved awareness of how farming can have a positive impact on the environment, there is much to be deeply concerned about – the endemic exploitation, wastefulness, unsustainability, unfairness, self-interest and short-termism.

Much food and farming research is arguably supporting the current industrial food and farming systems quite satisfactorily. However, flaws in the current systems mean they are too often asking for research that delivers for private gain, rather than public good. The scientific quality of UK food and farming research is recognised to be high, but the issue is what is researched and how the use of its products are regulated.

While industrial food system research has delivered benefits for some, it also has a number of aspects that many would consider undesirable:

Failure to address fundamental ethical questions – Those driving the research and industrial innovation agendas, in both the public and private spheres, are too often operating without addressing fundamental ethical questions about the wider purpose of the research and what its social and environmental implications are. Often the only 'ethical concern' explored in research proposals is whether the research has potential for immediate harm to humans or livestock. While it is of course important to consider likely immediate harm from research, it is also important to question what impacts the research will have on our food systems and on society more broadly. The latter should be a critical factor in shaping what research is funded.

A narrow agenda – The narrow productivist mantra dominates the top line aims of research and shuts off opportunities for other enlightened food and farming research, due to a number of 'lock-ins'[1]. As Pat Mooney writes in IPES-Food's 'Too Big to Feed' (2017):

"While the volume of R&D spending in the agrifood sector may be high, the scope remains strikingly narrow. The consolidation and privatization of R&D budgets has focused innovation on a narrow range of crops, technologies and approaches, creating path dependencies that detract from research on traditional crop varieties or social innovation strategies."

Undue corporate influence – on the research agenda, and associated legal, political and other measures which prevent more progressive research happening. Private and publicly funded research is becoming more and more imbalanced, with reduced publicly-funded research increasingly serving the interests of agrochemical and seed companies that have much larger research budgets. The public R&D spend for the UK is largely restricted to the 'discovery' end and not the applied end of research, which is instead mostly left to the market. This gives control to the large multinational corporations whose views feedback the 'targets' for the innovation research. This perpetuates the R&D agenda being for the industrial food system. This is concerning given that BBSRC now has control of some of the UK's aid budget, as it may mean research is more likely to be targeted to issues that coerce smallholders into industrialised production systems and related food chains rather than in support of their biodiverse and ecological, localised food webs. There is also a widely held, elitist view that applied science is 'derivative' (i.e. not discovering anything new), hence not considered to be 'good science' and

therefore not suitable for funding by UK research council committees.

Unacceptable opaqueness – There is a lack of transparency and in some cases 'murkiness' over many different aspects of research. Without open access to information about priority setting and related discussions, it is not possible to have inclusive decision-making involving the wider public. This would include, for example, online access to all the papers for the BBSRC's Advisory Panels and/ or future UKRI Advisory Panels. That might seem inconsequential at first glance, but these documents being unavailable for public scrutiny is hugely important, as it sets the tone and begs questions about transparency and openness.

Questionable assumptions and interpretations – Much current research is based on misplaced or questionable underlying assumptions, such as the oft cited 'food production has to increase by 70% by 2050'. It is also the interpretation of these which is often problematic and led by those with vested interests. For example, one interpretation amongst agri-food businesses has been that increasing yields is the way to meet expected demand, rather than also by addressing the use of much of this 'food', food loss, food waste and changing diets.

Undue emphasis on immediacy and scientists' short-term publication requirements, at the cost of supporting longer-term approaches with greater citizen participation in agenda setting. The latter is a relatively recent phenomenon, but vital. The nature of that participation is also hugely important. 'Partnering' with other multinationals along the supply chain which often ends up only benefitting the major corporations themselves, is not 'participation' in the sense used in this magazine.

A neo-colonialist approach to research that is considered suitable to other countries and continents - Imposing an inappropriate industrial paradigm of research, including a focus on biotechnology and genomics, on the UK's overseas partners. At present there is not enough support for the real needs of smallholder farmers, particularly in the Global South. Smallholders need to be protected and to be given access to relevant research (e.g. agronomy). However, critically the research needs to be appropriate to those smallholders and farmer-led, not imported from the UK's largely industrial food and farming systems.

The good news is that there are alternatives to the 'status quo' industrial research paradigm, examples of which are in the pages of this magazine. A progressive research agenda needs:

Serious investment in transformational food, farming, health and environmental research – to benefit the world's main food producers (particularly small-scale), citizens (food eaters), animals, the environment and future generations – in both the UK's international research footprint and at home. This is even more important for the UK as it begins the process of leaving the EU and its research and innovation programmes, like Horizon 2020 and its successors.

Research that is proportionate to the scale of the challenges faced – Food and farming research must help us develop urgent responses to the 'knowns' of climate change, biodiversity loss, obesity, hunger etc. and build social and environmental resilience for the unknowns.

A paradigm shift towards agroecology and other approaches that value people, the planet and animals – and a framework and political will to shift future research in that direction.

UK's international research footprint to support farmer-led research, including farmers' informal and biodiverse seeds systems and peasant agroecology, which feed the majority of people in the world. Research to enhance smallholder farming systems should be aimed at what the smallholders want, not imposed from industrial food systems.

Radical transparency – including from key research councils (and in the future UKRI) on funding, potential conflicts of interest, agenda setting processes and underlying assumptions. There will often be an element of research bias, but as long as there is openness and the biases can be contested, then that is less of an issue.

A genuinely inclusive and open approach – including farmer-led (particularly by small-scale and biodiversity-enhancing farmers) and community-led research – and citizen science done well. As we at the Food Ethics Council wrote in our 'Just Knowledge' publication (2004): "The ethics of science and technology – the values and assumptions that get built in during research, innovation and regulation – must be opened to greater public scrutiny and challenge."

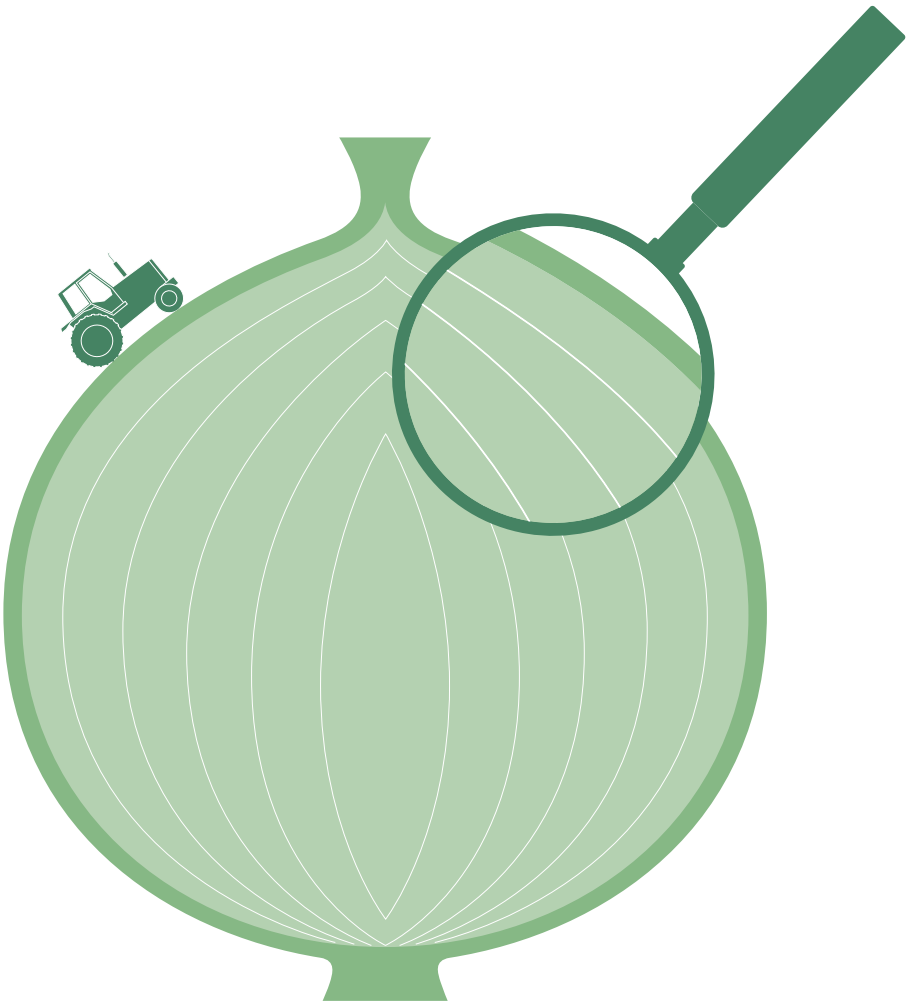
The products and intellectual content, and their derivatives, of (especially) publicly-funded food and agricultural research to be kept in the public domain. We need publicly-funded research to support smaller scale agriculture, otherwise it is always going to be the industrial food system that benefits. We also need to ensure that the world's, mainly smaller-scale, food providers have rights to the resources they require to sustain production, including being able to retain access to and control over their biodiverse seeds through international recognition of Farmers' Rights.

Proper application of the precautionary principle. It is particularly important post-Brexit that the UK has effective and appropriate levels of regulation in place, especially for technologies used in food and farming, including new biotechnologies such as synthetic biology and gene editing.

A proper way to measure effectiveness of research. Too often research 'success' is measured by the number of peer-reviewed academic papers or number of patents / IPRs granted, by growth in productivity yields alone or by securing matched corporate funding, rather than measuring how it improves wellbeing and the environment. In the food and farming context, critically measuring research effectiveness should include how a piece of research is likely to contribute to fair, healthy, sustainable and humane food and farming systems.

There are key questions that those setting and conducting research should ask of every proposed piece of research. These include:

- How could the research **accelerate the shift** to fair and sustainable food systems?
- What are the **underlying assumptions**? What lies behind or under the declared top-line aims of research such as to 'Feed the World', 'Tackle Climate Change', and so on?
- **Who** is funding the research?[2]
- **Why** is the research being funded? Who really wants the research to be done and who gets the immediate benefit, including financial benefit? And is that benefit fairly distributed?
- How can those likely to be affected by the research (e.g. farmers or citizens) **be genuinely involved** in shaping it?
- What are likely (intended and unintended) **consequences** of the research? What will it mean for (particularly small-scale) farmers, animals, environment, citizens, future generations…?
- What **options are foregone** by taking the route that the researcher selects?



It is not enough to ask these questions. Answers to the above questions need to be taken seriously, not simply treated as 'window dressing' when it comes to funding decisions on future research.

April 2018 is the start date for the UK Research and Innovation ('UKRI'). It is also the tenth anniversary of the International Assessment of Agricultural Knowledge, Science and Technology for Development's ('IAASTD') publication of its 22 'Findings'. What happens in the next decade is critical. The Brexit context provides a new opportunity to transform the way UK food and farming research is done for the public good at home and overseas. We urge all those involved in food and farming research to take responsibility for this much-needed transformation. We require an inclusive research setting process, a transparent research agenda and the application of socially and environmentally enhancing research that contributes towards food systems that provide for the needs of people, animals and the planet. Questioning for whom food and farming research is carried out is a first step towards this transformation; the next step requires ethical actions.

1 IPES-Food (2016) 'Uniformity to Diversity' publication describes "the key mechanisms locking industrial agriculture in place, regardless of its outcomes; it is these cycles that will need to be broken if a transition towards diversified, agroecological systems is to be achieved. Some of these 'lock-ins' relate to the political structures governing food systems, some concern the way agricultural markets are organized, and others represent conceptual barriers around the way questions are framed. Each represents a vicious cycle locking in industrial agriculture, as well as a potential entry point for change."

2 In many cases, the answer is the taxpayer via research council funding.

Further reading

The literature on topics covered by this publication is extensive. The following publications represent a very small selection of suggested further reading.

Clapp J. and Fuchs D. (eds) (2009) Corporate Power in Global Agrifood Governance

etcGroup (2017) Who will feed us? The Peasant Food Web vs. the Industrial Food Chain.

Food Ethics Council (2004) Just Knowledge? Governing research on food and farming

Galushko V. and Gray R. (2013) Privatization of Crop Breeding in the UK: Lessons for Other Countries, Paper prepared for presentation at the 87th Annual Conference of the Agricultural Economics Society, University of Warwick, United Kingdom, 8 - 10 April 2013

IPES-Food (2016) From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems

IPES-Food (2017) Too Big to Feed: Exploring the impacts of mega-mergers, consolidation and concentration of power in the agri-food sector (Lead author: Pat Mooney, Editorial Leads: Chantal Clément and Nick Jacobs) – particularly the chapter entitled 'IMPACT 3 - Narrowing the scope of innovation: defensive and derivative R&D'

Mills, E., Wilkinson, J., Then, C., Luig, B., Greenberg, S., Thomas, J., Chemnitz, C., Herre, R., Rehmer, C., Wenz, K., Bartz, D., Moldenhauer, H., Hirtz, S., Alliot, C., Ly, S., De Schutter, O., Frison, E., Sharma, S., Urhahn, J. & Murphy, S. (2017). Agrifood Atlas - Facts and figures about the corporations that control what we eat, jointly published by Heinrich Böll Foundation, and Rosa Luxemburg Foundation, Berlin, Germany and Friends of the Earth Europe, Brussels, Belgium

Pimbert M.P., Barry B., Berson A. & Tran-Thanh K. (2010) Democratising Agricultural Research for Food Sovereignty in West Africa. IIED, CNOP, Centre Djoliba, IRPAD, Kene Conseils, URTEL, Bamako and London.

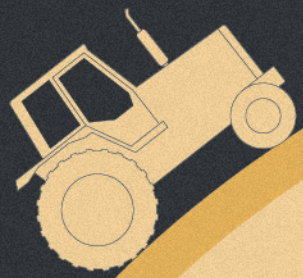
Pimbert M.P. (ed) (2017) Food Sovereignty, Agroecology and Biocultural Diversity: Constructing and contesting knowledge, Series: Routledge Studies in Food, Society and the Environment

Rosset P.M. & Altieri M.A. (2017) Agroecology: Science and Politics

Sumberg J. & Thompson J. (2012) Contested Agronomy: Agricultural Research in a Changing World, Series: Routledge, Pathways to Sustainability

UNESCO (2016) Indigenous and Local Knowledge(s) and Science(s) for Sustainable Development. Policy Brief by the Scientific Advisory Board of the UN Secretary-General (5 October 2016).

This collection of articles addresses key questions about how the research agenda is set in food and farming, unmasks and challenges the dominant research paradigm, and highlights inclusive alternatives to deliver public good. In doing so, the Food Ethics Council seeks to challenge accepted opinion and spark fruitful debate about the future food and farming research agenda.



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