



Diverting a disaster: food for thought

By Jaleh Bahri-Esfahani

From a talk at Cafe Science Extra, Dundee

For newcomers to Café Science Extra, it is a free event open to the general public, where speakers from all disciplines of science are invited to informally present and discuss their ideas, on the second Wednesday of each month. I was therefore both thrilled and terrified when asked to give a talk - I'd been to a few before, but all from professional academics with years of research under their belts. So I decided that instead of talking about the specifics of my research I would take a step back to discuss the bigger picture, settling on "Diverting a Disaster: Food for Thought".

My interests weren't always in food security though. As a Microbiology undergraduate, I was more eager to learn about human health, yet over time, I came to find that researching diseases was too far removed from the patients for me, and as such, lost its meaning. So for my PhD, I chose a field that would allow my research to be much more applicable – I moved to Dundee and developed my project according to my interests, motivated by all I am learning about food security. I now work on a project that aims to use natural processes by soil fungi to improve phosphorus uptake in plants.

‘I believe that food security is a possibility... ... we need whole communities to collaborate’

It's a naïve and overused statement, but I'd like to be able to help. As food scarcity becomes one of the more pressing concerns that we face as a population, I find it increasingly daunting how much work remains to be done in this intricate area. I truly believe food security is a possibility, but not one that a single person can fix; we need whole communities to collaborate and come together, policy makers to meet with farmers, architects to design with consumers - using the benefit of science and sociology and economic understanding to make well-informed decisions to create a sustainable future. I concluded my talk with a statement along these lines, having already described the very possible disaster we (at places like the University of Dundee and the James Hutton Institute) are trying to divert.

The Disaster

As many of you may know, we are expected to become a population of 9 billion by the mid-century. This puts an enormous pressure on land use and availability, since more space will be needed for housing, economic growth, healthcare, the rubbish we create, as well as protecting "countryside value". All this, on top of meeting the demand for food.

With the demand for land so high, and the availability of good farmland continually declining, the option to expand farmlands is near non-existent. But to cover both our nutritional requirements and increasingly meat-based diets, cereal crop production needs to double by 2050. The last time global food production was altered this drastically was in the Green Revolution, where pivotal change to agriculture was based on fertilizers and high-yield plant breeds, selected to respond well to the fertilizers but not to interact well with soils. Whilst this allowed for food production to blossom, it narrowed our methods of agriculture to approaches heavily reliant on fertilizers, especially those

containing phosphate. In fact, we now use five times more fertilizer than we did in the 1950's and are approaching depletion of phosphorus resources because of our excessive usage.

To make matters more complicated, the efficiency of the phosphate fertilizers is particularly low. Up to 70 % of what we add into the soils can become immediately unavailable to plants, and remain trapped in the soil, as minerals or adhered to soil particles. Constant application of this inefficient fertilizer meant that more phosphorus was applied into the soil than the plants required. Coupled with degrading soil quality, water moving through and across these soils has brought excess phosphorus out of soils and into freshwater rivers, causing pollution to many freshwater fish supplies. Interestingly, we are in the unique situation whereby phosphorus supply to plants lends itself to two extremes. The first – where we are now, with the excess phosphorus, waste and increasing pollution; and the second – farming systems in developing countries where the cost of the fertilizer renders it out of reach for many growers.

Because of this dependence on fertilizers, we are now at the point where we suffer from what I called "the hunter-gatherer phenomenon". Thousands of years ago, humans had to hunt to find food and survive, just as plants had to scavenge the soils for nutrients in order to live. Now whilst we've evolved and adapted to systems whereby we grow pre-hunted food in fenced-off fields, plants used for agriculture have been restricted to breeds that we chose for previously desirable attributes (aesthetics, taste and response to fertilizers), and not their ability to find or utilise nutrients. So in the same way that if you placed a group of average modern-day humans into the jungle (where there might be plenty of food, but beyond the reach of the non-hunter-gatherer human), if you placed plants we currently

'harnessing the ability of natural soil organisms to break down minerals ..'

grow into fields without fertilizers, many would not be able to survive. In effect, we have accidentally selected lazy plants, no longer able to hunt, gather or form valuable relationships with the soil.

To summarize our predicament; we have a restricted area of land with a high demand for its use, a requirement for doubling food production, downstream pollution of freshwater food stocks, and are depending on plant breeds that rely on a dwindling source of fertilizer.

Diverting the Disaster

To demonstrate how we might divert this disaster, I brought up volunteers to demonstrate the options I believe are available to us, and provided a summary sheet for attendees to keep.

The solutions ranged from theoretically simple, dependent attitudinal change in the public and policy makers (increasing public awareness, charity events to help reduce food waste), to changes in agricultural conditions (and any incentives for growers that may be required). Suggested changes included growing mixed cultures to improve soil stability, bringing in old forgotten breeds or in new modified crops to improve fertilizer efficiency and the plant-soil relationship. My own line of research is often referred to as "fertilizer enhancers", harnessing the ability of natural soil organisms to break down the minerals in the soil and make the unavailable fertilizers more accessible for plants, thereby increasing the efficiency. Further options required heavy political input and greater acceptance for change, such as using alternative fertilizers (e.g. human excreta, guano) and creating structures in factories and within councils to reduce waste and reuse what we can.

To reiterate my earlier point, the best solution cannot be from one of these alone. It will take improvement and understanding from

all areas and vast communities of people in order to safeguard a future.

As for my experience with Café Science Extra, I can honestly say that it was thoroughly enjoyable. It is both rewarding to be able to spark interest in other people, and encouraging to receive invested interest from the general public – I would recommend it as a way to reaching out, for anyone with a passion.



The author

Jaleh Bahri-Esfahani is a doctoral student at the James Hutton Institute and the University of Dundee. Her talk 'Diverting a disaster: food for thought' was given at Café Science Extra, Dundee Science Centre on 12 June 2013.

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