

THE GLOBAL FIX ON NITROGEN

The International Nitrogen Initiative brings together a range of stakeholders including scientists, industry and policymakers. **Naomi Lubick** discusses its foundations with **James Galloway**.

Nitrogen is essential to plant growth. But despite being the most abundant element in the atmosphere, plants are unable to use this inert form directly. They rely on microbes for its fixation – conversion into a reactive and usable form. In the early 1900s, it became easy to produce nitrogen-based fertiliser: the Haber-Bosch process revolutionised artificial nitrogen fixation, facilitating the production of millions of tons of nitrogen fertiliser.

The extensive use of such products has worked wonders for agriculture, but it has also caused a proliferation of reactive forms of nitrogen in the environment, causing soil acidification and oxygen depletion of waters. The International Nitrogen Initiative (INI) was set up to optimise the benefits of nitrogen while minimising its harmful side effects.

James Galloway, a biogeochemist and the associate dean for the sciences at the University of Virginia's College and Graduate School of Arts and Sciences, was one of the pioneers of INI along with Jan Willem Erisman, a member of IGBP's Scientific Committee, and many others. INI is currently chaired by Cheryl Palm, a senior research scientist at Columbia University's Earth Institute.

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Tell me about the beginnings of INI.

INI had its beginnings in October 2001, when we had the second international nitrogen conference in Potomac, Maryland, near Washington, DC. At the meeting, Jan Willem Erisman stood up and said that what we needed was an international organisation that would coordinate nitrogen research and investigations into integrated policy around the world. After some initial meetings and discussions with potential sponsors, the Scientific Committee on Problems of the Environment (SCOPE) and IGBP ultimately became the two sponsors of the new initiative. We started regional centres, found people to direct them and started setting up an organisation from the grassroots. It was a very exciting time and is still a very exciting organisation.

What prompted the regional model and how did that work out?

Many aspects of nitrogen are a global phenomenon, but different regions use nitrogen in different ways, leading to different releases to and impacts on the environment. We wanted to make sure that the differences among regions could be

captured. Regional components also enabled us to try to make sure that our approaches within regions were similar, so in the end you could put everything together and come up with a truly global story. Another driver for a regional approach is that some areas, notably sub-Saharan Africa, are nitrogen poor: there is simply not enough to provide food for people. Nitrogen issues in those areas are as important as, yet are quite different from, the issues in regions where there is too much nitrogen.

How did INI change the global conversation about nitrogen?

First, it connected people all over the world working on nitrogen issues and gave them a forum to discuss and share information. Through that process, we learned much more about what was happening in East Asia, South Asia, Latin America and Africa. And I suspect that people from those regions learned a lot more from the other regions that they weren't part of.

And by having this organisation, we were able to figure out how to get beyond the science and move into policy. That's been an increasing focus of INI. It's tough because nitrogen is pretty



Cutting down on food waste is one way to decrease our nitrogen footprint.

complicated. The message has to be focused, using language that non-scientists can appreciate and understand.

How did INI start to engage stakeholders outside the scientific community?

The Fertilizer Institute of the US provided support in 2001. And since 2004, the INI has had at the table the International Fertilizer Industry Association (IFA), based in Paris. They were very interested in working with the scientific community, but were also very cautious and said, “we don’t want to be perceived as the sole supporters of this organisation. We will help you with financial support, but you have to get the bulk of your support from elsewhere” – which we did.

IFA provided financial support for international meetings. We had the 5th one in India in December, and the 6th one will be in 2013 in Africa. Through IFA, we developed connections to the plant nutrition community; now, the International Plant Nutrition Institute is at the table working with us.

Now, my personal goal is getting the animal products and production industry more involved. Whether you are talking about pork chops, cheese, milk or poultry, there’s a large and growing demand globally for these animal products, and there are ways of decreasing nitrogen losses to the environment during their production. We would like to work with that industry very much.

On the policy side, INI has hosted policy workshops. Recently we had a meeting in Edinburgh associated with the European nitrogen assessment meeting, Nitrogen and Global Change: Key Findings, Future Challenges. Stakeholders were invited from various UN and government agencies to sit down

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Non-identical twins

Carbon dioxide (CO₂) and nitrogen compounds pose twin challenges to society. Both are bi-products of anthropogenic processes: CO₂ of the burning of fossil fuels and nitrogen compounds of food production and the burning of fossil fuels. But Galloway points out an important difference between the two. Whereas there is a degree of choice regarding the extent to which we burn fossil fuels to generate energy – flying is desirable but not essential – we have no alternative but to grow food for a burgeoning population. We could one day burn fewer fossil fuels and switch to other forms of energy. But releasing reactive nitrogen to the environment during food production is unavoidable. For this reason, approaches to dealing with increased CO₂ emissions and the proliferation of reactive nitrogen are different. INI must work to help producers and policymakers minimise nitrogen waste, but the approach cannot be to stop people from using nitrogen altogether.

in one room and say, well, how can we work together to produce a global nitrogen assessment that’s so desperately needed?

You had to find ways to translate the science for people who do not have a research background. Have you met with success?

I think we have. Have we had total success? Well, no, because nitrogen is still an issue. The message that we have to get across is, why nitrogen? And part of that is what’s the good news and what’s the bad news about nitrogen use by human society? And how can you improve the situation while still providing the resources that people want? We are out to work with stakeholders to maximise the beneficial uses of nitrogen, and minimise the detrimental impacts, which is the mantra of the INI.

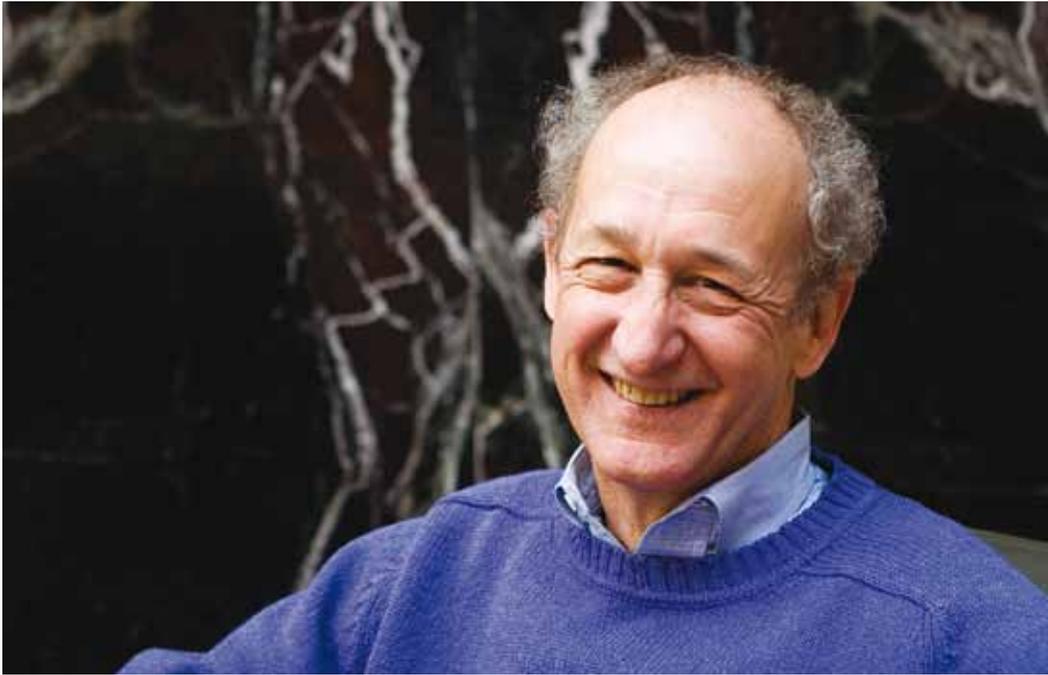
What are some of the main problems that you would tackle?

I will break it down into two systems: First, the energy-production system and burning

of fossil fuels. Just like carbon dioxide is a waste product [of combustion to make energy], nitrogen oxides are a waste product. They can be captured, they can be controlled. Many countries are doing a good job of that already; it could be better. Other countries are just beginning. But that’s like handling any other waste stream: we know the science, we know the engineering, we have the policy instruments. It’s a matter of political and social will.

The second major system is food production. We estimate that of all the nitrogen that’s used to produce food, only about 15-20 percent actually enters a person’s mouth. The rest is lost to the environment during the food-production process.

One of the things that my colleagues and I have developed is the N-Print Project (N-print.org). Featured right on the front page of the website for the INI, you can go in there and enter the amount and types of food you eat, the kind of car you drive, what kind of house you live in, and actually see how much nitrogen is lost to the



James Galloway was one of the pioneers of the International Nitrogen Initiative.

environment due to a person's energy and food lifestyle – and then the user can ask questions. What if I decreased my meat consumption? Instead of having it five times a week, what if I had it once a week? Then right on the screen it shows you how your nitrogen footprint diminishes.

What surprises people most when they look at their footprint?

Let me recast your question another way: what are the really obvious things that people could do to decrease their nitrogen footprint? There are two very simple unambiguous things they can do.

One is cutting down on food wastage. In the US, of the food that is purchased in the grocery store or purchased by a restaurant for serving customers, 30-40 percent is wasted. It is not consumed by people. By merely cutting down on food waste, you decrease the amount of nitrogen needed to grow food. That's relatively easy to do because nobody really likes to waste food.

The other is tougher. In the

US, the average amount of nitrogen consumed each year by a person is about 5 kilograms of nitrogen per person per year – and that's in the milk we drink, the meat and soybeans we eat, it's the protein we take in, expressed in terms of nitrogen. Animal protein is more nitrogen-intensive in its production as a food commodity than plant protein. The US Department of Agriculture says that on average, an adult only needs 3 kilograms of nitrogen per year. If people in the United States stop overconsuming protein, that would decrease by about a factor of two the amount of nitrogen lost to the environment in the US.

Then you get to the other sources: using fertiliser on lawns, etc. While they have some local impacts, when you are talking about looking at a total system, it's food waste and the type and amount of protein consumed that are the two big ones.

What are points that INI could focus on in the future?

As to scientific research, the INI has a real opportunity to play a role in Asia. There you are going

to have an increasing amount of nitrogen lost to the environment due to increasing populations and increased consumption of protein, especially animal products, on a per capita basis and increased consumption of energy on a per capita basis. The INI has a story to tell, and through its East Asian and its South Asian centres, it has a platform to tell that story. And this story should be told not just to scientists working there, but also to a broader audience of stakeholders, including policymakers.

There is currently an IGBP synthesis on nitrogen and climate that is being led by Jan Willem Erisman to help society better understand the relationships. Nitrogen has both direct and indirect contributions to climate change. The direct contributions are increased emissions of N_2O (nitrous oxide) to the atmosphere. The indirect contributions include increased concentrations of O_3 (ozone). Both N_2O and O_3 are greenhouse gases and contribute to atmospheric warming. Another indirect contribution is the increased loading of nitrogen-containing aerosols, which have the potential to scatter solar radiation and will act as a cooling agent.

On the policy side, the INI is right now an independent organisation associated with SCOPE and IGBP. In my personal view, the more the official connection to recognised international bodies, the more its potential impact. The Food and Agricultural Organization (FAO) is an obvious one because of the food aspects. But the challenge of nitrogen is that it needs to be more than one or two organisations. Because it's not just food, the environment or energy. It's everything. ■

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