How to feed the world in 2050?

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How to encourage sustainable farming

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ABSTRACT

Two main dimensions – technology and policy – are explored to answer the main question in the title. Interconnections among land scarcity, food security and the ecological footprint of farming introduce what we call the intensification dilemma. Asking "how to get enough food for more than 9 billion by 2050 while avoiding the additional biodiversity loss and carbon emissions that would result from expanding farmland?" leads us to search the answer in some form of intensification, that is: more per-hectare output. Past input-based intensification has actually saved significant land for nature, but at the cost of increasingly inefficient input use, and thus excessive pollution load (nitrates or GGE) or resource depletion (water, energy, biodiversity).

Getting out of this dilemma seems to require a deep technological change, driving us away from input-based intensification while keeping its sunny side (rising per-hectare output). We call it "sustainable intensification". A more descriptive (but certainly less sexier) name for this is non-input based intensification, which basically means getting more output per hectare of land while also getting more output per unit of any other input (e.g. more crop per drop). Is it possible? It seems never to have completely been achieved in the past. In the past, we have succeeded in increasing per hectare output while reducing per-Kg-of-fertilizer or per-MJ-of-energy output. Prices said fertilizer or energy were less scarce than land, and we have chosen accordingly. Today they are all getting dramatically scarcer and some even more expensive.

In this presentation, two possible avenues for sustainable intensification are explored: (1) more targeted, precise and efficient input use (through e.g. information technology and remote sensing) and (2) redesigned agro-ecosystems where internal ecosystem processes efficiently substitute for industrial inputs (through better ecological knowledge). The public-good nature of ecological knowledge is used here to explain why the latter avenue is so under-developed when compared to the former. Some form of realignment of research-policy incentives would be required if research priorities such as this are to be promoted.

But addressing the intensification dilemma (as well as related and broader issues) requires more than deep technological change. Basic behaviours of people need also to be massively changed. Food waste needs to be reduced, diets changed… Even changing farming systems involve more than technological research and development – it requires changing farmers' choices and behaviours. Altering behaviours is

the realm of policy. Three possible policy models are explored here for comparative purposes. Changing diets, e.g. reducing meat consumption, is taken as an example, only because it is “technologically” simpler (while politically not so simple) and allows us to focus on policy as opposed to technology.

Policy can lead people to reduce meat consumption by: (1) not acting and leaving the relevant adjustments for the market mechanism, as meat gets more expensive as a result of inefficiently using scarcer and thus more expensive cereals; (2) resorting to ethics, common sense or enlightened self-interested (health concerns related to food); or (3) domesticating market mechanisms to incentivise diet changes (e.g. negative incentives for cereals or other human food diverted to feed). This comparison is used to argue that a research agenda directed towards sustainable farming and food systems requires policy, economic and other social sciences so much as the hard sciences.