Thinking, shaping and governing our futures beyond evidence and models of the past

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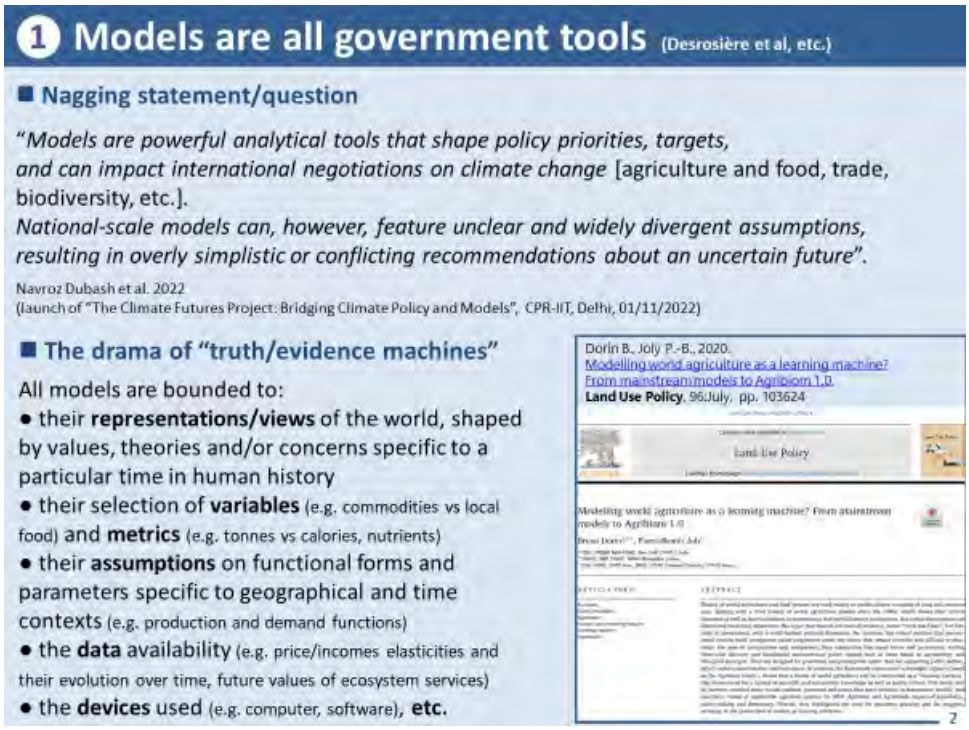
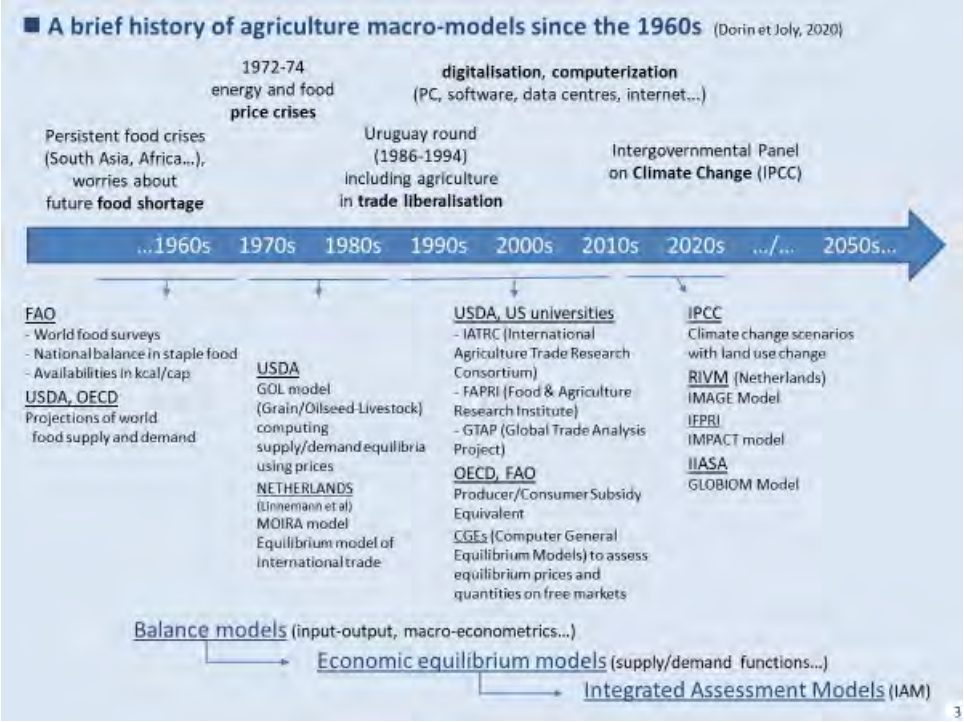


[*] Few weeks ago, my Indian colleagues and friend Navroz, co-author of the last 6th IPCC assessment report that was published this year, had these question and statement about numeric models.
"*Models are powerful analytical tools that shape policy priorities, targets, and can impact international negotiations on climate change* [agriculture and food, trade, biodiversity, etc.].
National-scale models can, however, feature unclear and widely divergent assumptions, resulting in overly simplistic or conflicting recommendations about an uncertain future"

[*] I had more or less the same questions 30 years ago, when I started working not on climate change but on food and agricultural issues. Today, I will present you some reflections about food and agricultural models that should well introduce the following complementary presentation "What is foresight?" made by my Cirad's colleague Jean-Michel.

These reflections are mostly drawn from a paper co-published in 2020 with Pierre-Benoit Joly, a former economist now well-known in the academic field "Science and Technology Studies" – or "STS" – that emerged in France and worldwide less than 20 years back. In this paper, we follow the inspiration of the French statistician Alain Desrosières and other STS scholars who posit that economic models are hybrid, i.e. both "tools of evidence", hence "truth machine", and "tools of government".

We reviewed models of world agriculture since the 1960s to show that all these numerical models were jailed in at least five different ways, no matter how large their data content or how powerful their mathematics.
● First, they are bounded to their representations/views of the world, shaped by values, theories and/or concerns specific to a particular time in human history
● second, to their selection of variables and metrics
● third, to their assumptions on functional forms and parameters specific to geographical and time contexts
● fourth, to the data availability, both for the past and the future
● and, fifth, to the devices used.



[*] I cannot go into technical details like in our paper. I can only show you a snapshot our brief history of agriculture macro-models since the 1960s, from what we called “balance models” to the current Integrated Assessment Models or “IAM” combining economics and biophysics.

Some events mentioned at the top had some influence on models’ architecture, on their selection of variables and metrics, on what they made important and not, on what they made visible and invisible.

For example, free market has become very important since the 1980s to support economic growth everywhere, but employment and distribution of wealth were neglected as well as the worrying erosion of natural resources, as if technical progress, comparative advantage and trickle-down theories would take care of everything. We know today that this is far from the case. But can we challenge the mathematical beauty of economic models full of assumptions and parameters on human behaviors, utilities, technologies, prices and so on, moreover when they are imagined and calibrated with the Western industrialized world as you can also notice from my slide where main modelling organizations are mentioned?

[*] Yes, they are fascinating models, full of equations, data and theories, but is this a sufficient condition not to wonder about the future they draw for us? In this second section of my presentation, I will try to feature two of their blinders that I detailed in others papers, with the most recent ones mentioned at the top right of the slide.

These two blinders are on each eye of all the conventional models I mentioned, and for me, they prevent these "truth" or "evidence machines" from seeing and drawing agroecological futures.

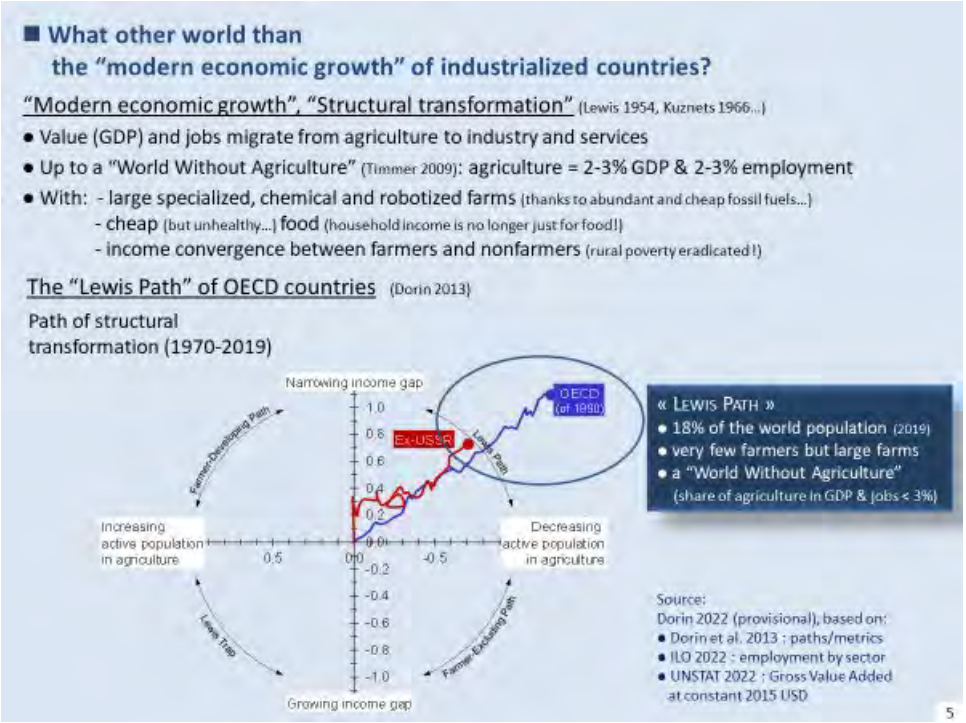
[*] The first blinder is what I called the "industrial sociotechnical regime", using the concept of "sociotechnical regime" of Shot and Geels who defined it as a "*set of aligned rules that dominates amongst scientists, government, firms and users that together form a community for how to produce, use and regulate specific products and processes*".

This regime emerged from the astonishing advances in science like thermodynamics, chemistry, hydrology and genetics, but also in economics with Adam Smith clearly showing how task specialization could dramatically increase production and labour productivity. Over the latest centuries, this led us to the mass production of cheap essential goods and services for a growing population.

We live much more comfortably today than in the Middle Age, no doubt about it, but we tend to forget that it was done at the cost of and increasing consumption of fossil fuels and other rare natural resources in order to:
(1) first, boost the production and labour productivity with machines or robots.
(2) second, assembling the split and specialized worlds, whether products or regions.

[*] What we tend also to forget is that agriculture was put at the forefront of this process, until arriving in what Peter Timmer called “A Word Without Agriculture” where agriculture does not represent more than 3% of GDP and 3% of employment, as today in all OECD countries. This is also a world outside of nature, with “wild nature” on one side, and factories of food or biofuel on the other.

To sum up, the two intricated drivers of this world for agriculture and food are:
(1) firstly, the specialization in a few standardized mass-productions such as wheat, rice, corn or palm oil, to enable their robotization and generate economies of scale, the profit-driver of any industrial activity
(2) the use of inputs produced by conventional science & industry to increase land productivity provided you add and pay for genetic materials, chemical fertilisers, pesticides and now IT or artificial intelligence.



[*] The second important blinder is for me what we call in economics "modern economic growth" or "structural transformation" since the post-war period and "Nobel" laurates such as Arthur Lewis or Simon Kuznets.

In a nutshell:
- modern economic development means values and jobs migrating from agriculture to industry to services
- until arriving in the Timmer's "World Without Agriculture" that I mentioned earlier
- a World fed by ever-growing quantities of fossil fuels, with large specialized, chemical robotized farms, producing cheap food. Beside cheaper food that is important for human kind so that it can afford other essential goods and services, there is another important feature of this WWA: average income of farmers and non-farmers has converged. In other words, we emptied the countryside of farmers but made those who stay much larger and richer.

[*] I called "Lewis Path" this canonical path of structural transformation, and I tried to see which countries or regions of the world had really followed it since the year 1970, positioned here in the middle of the graphic. As you can see, I found only the OECD and transition countries. In 2019, these two regions represented about 18% of the world population. The big question is now: "what other paths has been followed by most of mankind over this half century, and why?"

[*] In facts, more than half of the 2019 world's population, located in Asia, had been following what I called a "Lewis Trap", where average farm size has shrunk instead of getting bigger, and where the income gap with nonfarmers has widened instead of narrowing.

[*] From these two models' blinders emerged various questions, and I have selected three to convince you that collective foresight may be a good tool to answer them.

For the first question we have already the answer: "*Is nature productivity based on division/specialization?*". Definitely not. It is rather based on complex local relations and synergies among billions living and non-living elements. And it is precisely these bio diversities and synergies that can lead to a real paradigm shift towards agroecology.

This is why I put them at the heart of my definition of agroecology, where land and labour productivities are no more based on specialization and economies of scale, but on "*a mosaic of local agroecosystems that, each in their own way, stimulate and optimize biological synergies between many plant and animal species above and below the soil, from soil fungi to cereals, pulses and trees, from bacteria or earthworms to large bovids, without forgetting huma, beings!*"

[*] Let us shift now to my second question: "*Is a world with no human labour and brain activity, but robots and artificial intelligence the world we aspire to?*"

May be for some as it seems, but certainly not for me for instance. However, this also sounds like what "technical progress" and "long-term steady-state" actually means in CGE models, with no more jobs but all in leisure activities with robots to feed and entertain us. If so, then we can wonder, for instance:

- How much extra fossil energy and other rare resources will be needed to build and run these robots?
- If there is no more jobs and wages, how wealth will be distributed?
- Who will own and drive theses robots and artificial intelligences? How competition and freedom can be secured if it comes to powerful states or multinational corporations as already today?

[*] And now my last questions: *"Are current scientific evidence and models able to produce agroecological scenarios?"*

- when there are vast areas still poorly studied and understood by science, such as soil microorganisms and their synergies
- or when some dimensions of complex systems can hardly be quantified, such as human happiness and self-fulfillment, yield of highly-diversified crops systems, values on ecosystem services that change over time, or most of the 13 agroecological principles of the HLPE (2019) with variables such as "Biodiversity", "Synergy", "Participation", "Co-creation of knowledge", or "Fairness".

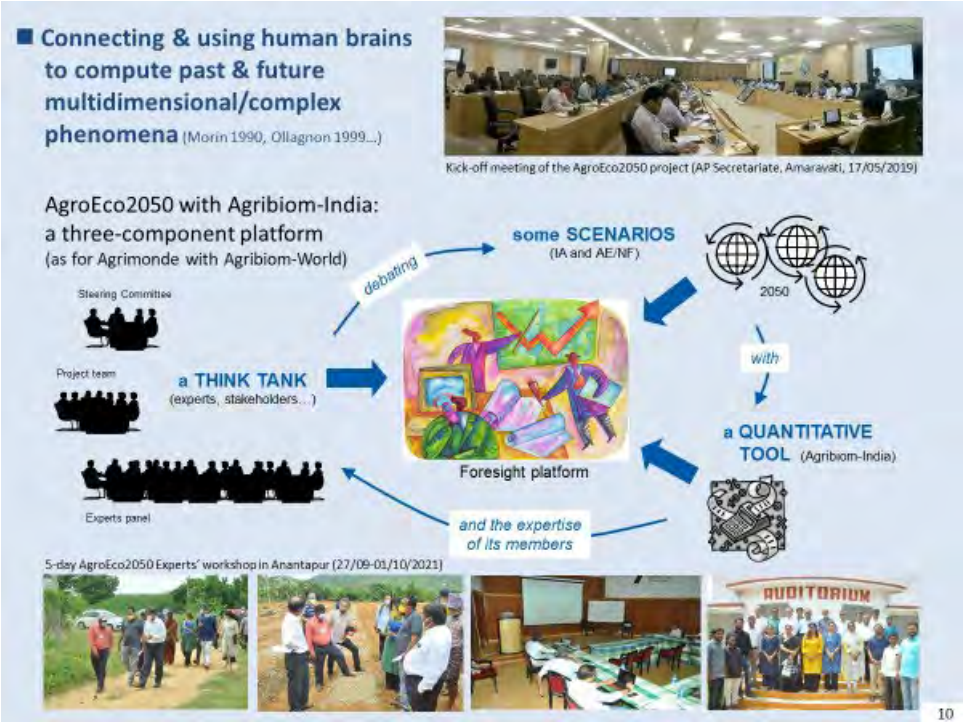
[*] I quickly conclude on the need of hybridizing science & digital models with other forms of knowledge and aspirations, especially if we wish other futures than the one already encoded in data and models available today, as I tried to show you in my presentation.

Towards this direction, long-term collective foresight is a tool that we have been thinking about and developing for quite a long time in France, with this well-known mantra: "*the best way to predict the future is to invent it!*". In a few minutes, Jean-Michel will say a lot more about what foresight is today in its different approaches and practices.

[*] For my part, I have been developing and experimenting for more than 15 years a tool called "Agribiom" which tries to hybridize data and model with other forms of knowledge and aspirations in the field of food and agriculture.

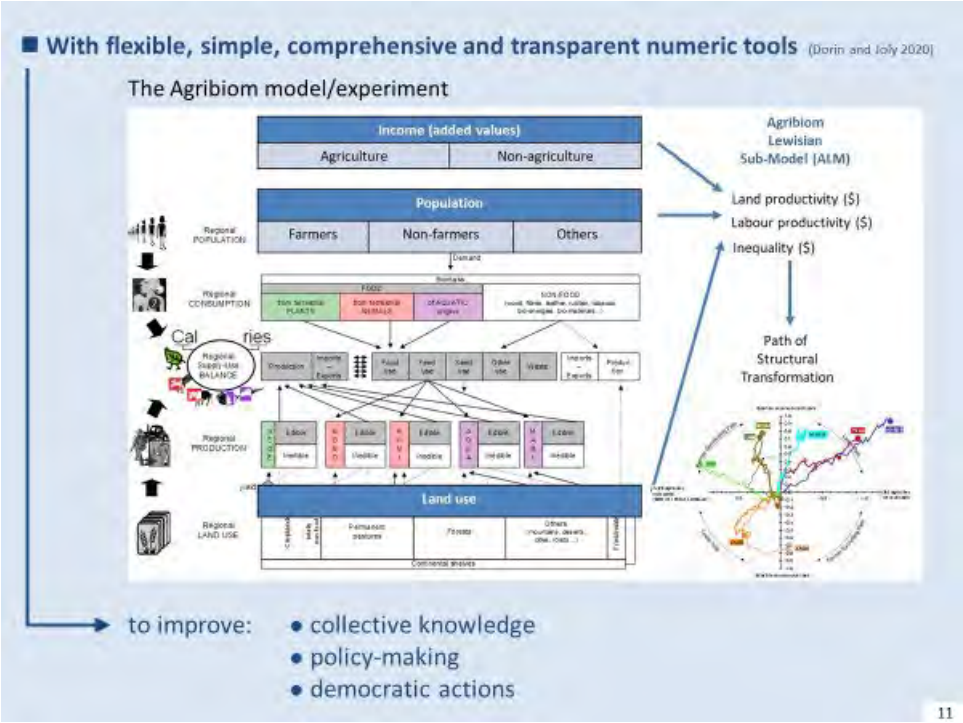
Retrospectively, Agribiom follows rather well the following three normative characteristics given by the cybernetician Robert Hoffman, Member of the Cub of Rome who passed away last June:

- Firstly, the objective of the model should be to explore alternative trajectories and communicate understanding; the emphasis should be on learning rather than prediction or prescription
- Secondly, the model must synthesise both the domain of economics with its focus on the behaviour of agents and exchange among agents, and the domain of the biophysical world
- Thirdly, the model must be global in scale to accommodate the concepts of biophysical limits and planetary boundaries, but must be spatially disaggregated to accommodate.



[*] This slide illustrates how Agribiom worked for our collective foresight AgroEco2050 on Natural Farming in India, with on the top left a very important methodological statement: faced with billions of qualitative and quantitative pieces of information as also uncertainties or unknowns on both the past and the futures, we believe that connecting and using human brains are the best to compute this complexity, provided:
- we document the process,
- guide the inputs content,
- and check the consistency of the outputs
so that it can be understood, shared and debated with others human beings.

Here lies for me the fundamental role of a quantitative foresight tool like Agribiom.



[*] And I will conclude more or less like in our paper with Pierre-Benoît Joly.

For a model to be a “learning machine” for various forms of knowledge and aspirations, there are at least three basic conditions, those which have conditioned the development of Agribiom:
(1) one: the model has to be flexible enough to allow the exploration of both historical pathways and very different future trajectories, including normative scenarios;
(2) two: the model has to privilege simplicity and comprehensiveness, thus aggregate region, product or process virtualities instead of detailed but selective sub-models that do not better capture the complexity and potentiality of the real world, or even reduce the representation of the latter;
(3) and three: the model has to be transparent through an interface that makes it understandable, accessible and driveable for a wide range of stakeholders.

When these conditions are met, the model can become a tool for exploring alternative trajectories collectively, constructing desired futures, testing consistency and identifying critical points. The key objective is no more prediction and prescription but collective learning.

Overall, in such modelling perspectives, what matters is no more “speaking truth to power” which is the traditional positivist stance, but, instead, improve collective knowledge, policy-making and democratic actions.

Thank you for your attention!

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