



HAL
open science

Make Visible the Invisible. An Indian scenario of agroecology good for climate, biodiversity, food security and the SDGs

Bruno Dorin

► To cite this version:

Bruno Dorin. Make Visible the Invisible. An Indian scenario of agroecology good for climate, biodiversity, food security and the SDGs. LCS-RNet annual conference, LCS-RNet, Dec 2022, Tokyo (JP), Japan. hal-04351701

HAL Id: hal-04351701

<https://hal.science/hal-04351701>

Submitted on 18 Dec 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

MAKE VISIBLE THE INVISIBLE (in our science and models)
An Indian scenario of AGROECOLOGY
good for climate, biodiversity, food security and the SDGs National LCS-
RNet Event 15-16 December 2022
Session on Agriculture and Forestry

Bruno DORIN

CIRAD (French Agricultural Research Centre for International Development, Montpellier)
CIRED (International Research Centre on Environment and Development, Paris)
CSH (Centre for Social Sciences and Humanities, Delhi)

MAKE VISIBLE THE INVISIBLE (in our science and models)
An Indian scenario of AGROECOLOGY
good for climate, biodiversity, food security and the SDGs

Bruno DORIN
Senior economist (Ph.D.)
CIRAD/CIRED (Paris) – CSH (Delhi)
bruno.dorin@cirad.fr

Agro-industrial scenario?

Agroecological scenario?

A World Without Farmers

A World With Farmers and Nature

LCS-RNet Event 15-16 December 2022
Session on Agriculture and Forestry

www.cirad.fr
www.centre-cired.fr

[1] Dorin B., 2022. *Theory, Practice and Challenges of Agroecology in India*, International Journal of Agricultural Sustainability
[2] Paul N., Dorin B., Nagalchik., 2022. *A New Paradigm for Indian Agriculture: From Agroindustry to Agroecology*, NITI, Aayog
[3] Dorin B., July P. B., 2020. *Modelling world agriculture as a learning machine? From mainstream models to Agriflora 1.0*, Land Use Policy
[4] Dorin B., Aubron C., 2016. *Créissance et revenu du travail agricole en Inde*, Economie Rurale
[5] Dorin B., 2017. *India and Africa in the Global Agricultural System (1960-2050)*, EPW
[6] Dorin B., Hourcade J.-C., Benoit-Cattin M., 2013. *A World without Farmers?*, CIRED WP 47

Dear colleagues and friends,

To feed our discussions on how agricultural and forestry sectors could reduce their GHG emissions as well as increase CO₂ storage in soils and vegetation, I will try now to make visible something that you hardly find today in global thinking and modelling. It is mostly based on a collective foresight study that I am completing with my Indian colleagues.

Just published on French agriculture (Bamière et al. 2023)

Contents lists available at [ScienceDirect](#)

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

A marginal abatement cost curve for climate change mitigation by additional carbon storage in French agricultural land

L. Bamière^{a,*}, V. Bellassen^b, D. Angers^c, R. Cardinael^{d,e,f}, E. Ceschia^g, C. Chenu^h, J. Constantinⁱ, N. Delame^a, A. Diallo^b, A.-I. Graux^j, S. Houot^k, K. Klumpp^l, C. Launay^{b,i}, E. Letort^j, R. Martin^h, D. Mézière^o, C. Mosnier^h, O. Réchauchère^{h,i}, M. Schiavo^{l,o}, O. Thérond^j, S. Pellerin^h

- MACC shows abatement potential of 40–60 MtCO₂e.yr⁻¹ for carbon price 55–250 €.tCO₂e⁻¹
- French agricultural carbon sink potential is 5 times higher than anticipated by the government
- Key practices: agroforestry, hedges, cover crops, grasslands in crop sequences...

↳ **How many more carbon sinks in a tropical country like India with much more innovative and complex practices boosting agro-diversity & biological synergies on living soils???**

[*] But let us start with France, and a paper published few days ago. In this paper, the authors point out that French agricultural carbon sink potential is 5 times higher than what is anticipated by the government, through key practices such as agroforestry, hedges, cover crops and grasslands in crop sequences.





These practices foreshadow agroecological systems. In India, agroecology it is developing in a much more complex and integrated way, especially in the state of Andhra Pradesh, and I am convinced that the potential for carbon sinks is much higher than in France, although I am totally unable to give you any estimates.

Rise of agroecology in Andhra Pradesh

Darin B., 2022. *Theory, Practice and Challenges of Agroecology in India*, International Journal of Agricultural Sustainability, 20(2), pp. 153-67

- 1 **A state/national crisis of industrial agriculture & food** (IA, or Green Revolution...)
 - farmers distress/suicides + "jobless growth" of the Indian economy
 - unbalanced & unhealthy food (pesticides...)
 - massive erosion of natural resources (soil, water, biodiversity...)
 - climate change deepened by massive agri-emissions of GHG (power for irrigation, fertilizers, cattle...)
 - etc. (subsidy scheme aggravating the whole...)
- 2 **An alternative sociotechnical niche**
"NATURAL FARMING" (APCNF) with:
 - Zero fertilizer
 - Zero pesticide
 - Low or no irrigation
 - BUT agro-biodiversity feeding the soil food web 365 days/year
- 3 **Supported by institutional innovations for collective actions and scaling**

Within 6 years (2016-2021) already 1 million micro-farmers practising "Natural Farming" in Andhra Pradesh

[*] Andhra Pradesh is a state in South India with a population of 53 million in 2020 including about 10 million active farmers. Since 2016, Andhra Pradesh has been experiencing something that now looks like the world largest agroecological transition.

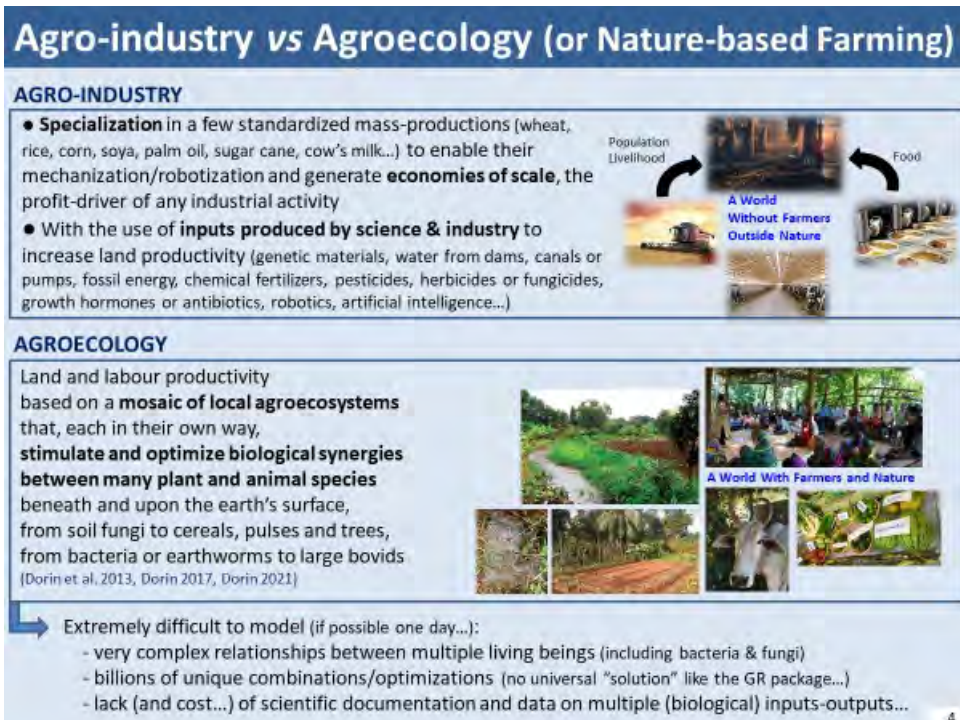
This experimentation is documented in the paper mentioned on the slide. It was a response to the dead ends of intensive industrial agriculture that had developed since the Green Revolution of the 1960s.

In this "Lewis Trap", as I call it, we have:

- growing over-indebtedness and suicides of petty farmers within a fast-growing economy that do not create enough jobs in other sectors, especially for women and high-educated people
- plus unbalanced & unhealthy food that led India to rank behind Sudan in the Global Hunger Index
- plus a massive and worrying erosion of natural resources on all fronts
- plus, of course, growing climate change which is deepened by the massive emissions of GHG from Indian crops, livestock and their industrial inputs including subsidized fossil energy for irrigation and chemical fertilizers.

[*] In response to this deep socioeconomic and environmental crisis, the Government of Andhra Pradesh ambitioned in 2016 to help converting its farmers to what is called "Natural Farming". This true form of agroecology doesn't rely on fertilizers, pesticides and irrigation, but on the combination of many plants and animal species that feed the soil food web and let the microbes work and the plants grow 365 days a year.

Today, about 1 million micro-farmers of Andhra Pradesh are practising "Natural Farming", and the ambition of the programme is to convert all of them before 2030.



[*] This Natural Farming is a complete paradigm shift from the current global regime of industrial food and agriculture which has two main characteristics:

- (1) One: the specialization in a few standardized mass-productions to enable their robotization and generate economies of scale, the profit-driver of any industrial activity
- (2) Two: the use of inputs produced by conventional science & industry to increase land productivity provided you add and pay for genetic materials, chemical fertilisers, pesticides, machineries and now artificial intelligence.

This paradigm of modern economic growth leads to what Peter Timmer has called a “World Without Agriculture”, a world where agriculture represents less than 3% of employment and 3% of GDP as today in OECD countries.

[*] In agroecology on the contrary, land and labour productivity are based on a mosaic of local agroecosystems that, each in their own way, stimulate and optimize biological synergies amongst 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.

The big problem with this potential multitude of unique and complex agroecosystems is that they are very difficult to model, unlike industrial agriculture with few commodities and simple inputs-outputs relationships.

Too complex to model = No future ??? (in India and elsewhere)

No agroecological scenario in global models (IPPC & Co) which makes future and benefits of agroecology invisible

Yet, first observations and/or evidence of Natural Farming in India show multiple benefits of agroecological scenarios:



T. Vijay Kumar

With Natural Farming, we can boost biomass productions (& incomes) without fertilizer, pesticides, massive irrigation & subsidies, but yet science very little understand why and how!!!

(T. Vijay Kumar 2022)

- 1 **Much higher carbon sink** than with industrial agriculture (that kills soil life...)
 - hundreds of millions micro-farmers (and not few CCS industries...) could contribute to climate mitigation
- 2 **High production** in useful biomass per surface unit (no yield penalty, higher efficiency of small-scale agriculture...)
 - food security is not endangered, and should even be improved (more nutritious and healthy food)
- 3 **High resilience** to economic, climate and biotic shocks (due to biodiversity and no industrial inputs)
 - adaptation to climate change is improved (droughts, floods, typhoons...)
 - reliance on conventional inputs prices is reduced (fossil energies, chemicals, insurances...)
- 4 **More profitability** for micro-farmers, primarily through input savings (lab-seeds, chemicals, machineries, credit, insurance... that can not benefit from economy of scale with micro-farms)
 - poverty and domestic farm-nonfarm income gap could be reduced
- 5 **More inclusive and labour intensive** than input & capital intensive
 - hundreds of millions of currently unemployed people could find a useful job
- 6 **High production in many environmental goods & services** (mitigation & adaptation to climate change, drinking water, biodiversity reservoirs, soil fertility, nutrient recycling, pollination...)
 - hundreds of millions of micro-farmers could receive PES to avert future local and global disasters, and supplement their income constrained by the micro-size of their farms

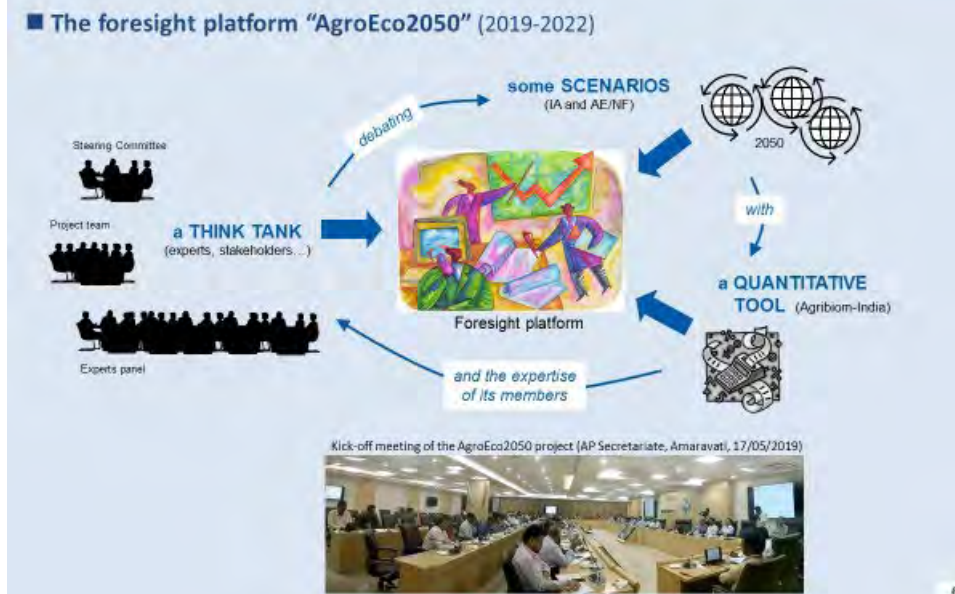
5

[*] And when we don't model agroecology, we have no future scenario of agroecology, so no future other than industrial food and agriculture.

This should question our community of economists, agronomists and modelers since first observations and evidence show that agroecology such as practiced in Andhra Pradesh

- sinks much more carbon than the few monocrops of the Green Revolution
- is highly productive in useful biomass per surface unit
- is highly resilient to economic, climate and biotic shocks
- is more profitable for micro-farmers primarily through input savings
- is more labour-intensive than input- and capital-intensive
- and is also highly productive in many environmental goods & services such as drinking water, biodiversity reservoirs, soil fertility, nutrient recycling, pollination or just beautiful landscapes.

Make visible an agroecological scenario for India



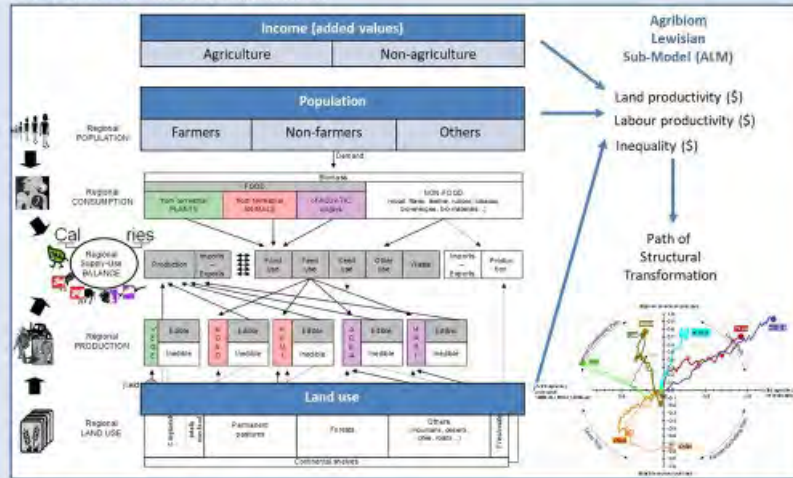
[*] To bypass this absence of agroecological scenarios in India and elsewhere, the Government of Andhra Pradesh, the Cired and the FAO settled in 2019 a foresight platform with 3 components:

- a think tank gathering various expertise and knowledge, from academics to farmers' representatives
- who discussed and debated assumptions for two contrasted scenarios in 2050, 100% industrial agriculture and 100% natural farming
- with the support of the quantitative tool that I built for such collective exercise

■ **With a flexible, simple, comprehensive and transparent numeric tools**

(Dorin B., Joly P.-B., 2020. Modelling world agriculture as a learning machine? From mainstream models to Agribiom 1.0, Land Use Policy)

The Agribiom model/experiment



- to improve:
- collective knowledge
 - policy-making
 - democratic actions

[*] Agribiom was designed as a flexible, simple, comprehensive and transparent numeric tools, including an India Lewisian sub-model focusing on employment, productivities and inequality, the three biggest challenges of an economy like the Indian one.

■ Inequality: UBI + input & price subsidies vs. PES/farmer?

2050 (from 2019)	100% Industrial	100% Natural
Population (million capita)	59.5 (+0.4% p.a.)	59.5 (+0.4% p.a.)
Workforce (20-64 years)	35.4 (+0.3% p.a.)	35.4 (+0.3% p.a.)
Unemployment	10.6 (30%)	0 (0%)
Employment	24.8 (70%)	35.4 (100%)
- Farmers	5.0 (20%)	12.4 (35%)
- Nonfarmers	19.8 (80%)	23.0 (65%)
Cropland (million ha)	5.5 M (-0.4% p.a.)	8.3 (+0.9% p.a.)
GVA (trillion INR-2011)	36.9 (+6.0% p.a.)	42.6 (+6.5% p.a.)
- Farm sector	5.4 (+3.5% p.a.)	11.2 (+6% p.a.)
- Nonfarm sector	31.5 (+6.7% p.a.)	31.4 (+5.7% p.a.)
Productivity (INR/day)	4080 (+5.7% p.a.)	3307 (+5.0% p.a.)
- Cropland (ha)	2670 (+3.9% p.a.)	3719 (+5.0% p.a.)
- Farmer	2967 (+5.6% p.a.)	2489 (+5.0% p.a.)
- Nonfarmer	4359 (+5.3% p.a.)	3748 (+4.8% p.a.)
Agri income gap (INR/day)	1392	1259
Structural Path (2019-2050)	Farmer Excluding	Farmer Developing

Social policies
 Universal Basic Income at 1450 INR/cap/day
 Input & price subsidies to close the gap
22% of GDP

Environmental services without scale economies
 PES/farmer to close de gap
13% of GDP

8

[*] I have no time to explain you in detail this slide of provisional outputs, which is just there to show that with agroecology, we could employ almost 100% of the 20-64 year group in 2050, and that the cost to reduce income inequality and to boost the GDP would be far higher in the industrial scenario than in the agroecological scenario.

Conclusion

All in all, today's societies have to choose between two contrasting paths:

- ① continue to massively produce a few products that are processed, assembled and differentiated downstream, where market values, investments and jobs are increasingly concentrated, particularly to resolve the social and environmental flaws in the system (rising costs of healthcare, water depletion & pollution, soil and biodiversity erosion, climate change...)
- ② produce in symbiosis in and with nature, with markets values, investments and jobs concentrated upstream to provide a diversity of quality products, as well as services (to be paid unlike today) such as water filtering, soil carbon sequestration, or resilience to biotic and abiotic shocks (energy price, climate change...)



With hundreds millions of micro-farmers
(best insurance for high yields + people & nature health)
India has a comparative advantage
to gain and lead with option 2

9

[*] To conclude, this collective foresight exercise has shown that there is an alternative to industrial agriculture and food through agroecology, and that today's societies are now invited to choose between two contrasting paths since each promotes very different values about wealth, happiness, society and nature:

(1) The first path is to continue to massively produce a few products that are processed, assembled and differentiated downstream, where market values, investments and jobs are increasingly concentrated, particularly to resolve the social and environmental flaws in the system, such as rising costs of healthcare, water depletion and pollution, soil and biodiversity erosion, climate change...

(2) The second path is to produce in symbiosis in and with nature, with markets values, investments and jobs concentrated upstream to provide a diversity of quality products, as well as much sought-after but currently unpaid environmental services to small agroecological farmers.

Thank you for your attention.