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

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Agro-industrial scenario?

Agroecological scenario?

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

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

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

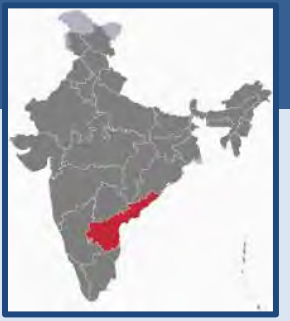
A marginal abatement cost curve for climate change mitigation by additional carbon storage in French agricultural land

L. Bamière [a,*], V. Bellassen [b], D. Angers [c], R. Cardinael [d,e,f], E. Ceschia [g], C. Chenu [h], J. Constantin [i], N. Delame [a], A. Diallo [b], A.-I. Graux [j], S. Houot [h], K. Klumpp [k], C. Launay [h,i], E. Letort [l], R. Martin [k], D. Mézière [m], C. Mosnier [n], O. Réchauchère [o,p], M. Schiavo [l,o,q], O. Thérond [r], S. Pellerin [s]

- MACC shows abatement potential of 40–60 $MtCO_2e.yr^{-1}$ for carbon price 55–250 $€.tCO_2e^{-1}$
- 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???

Rise of agroecology in Andhra Pradesh



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

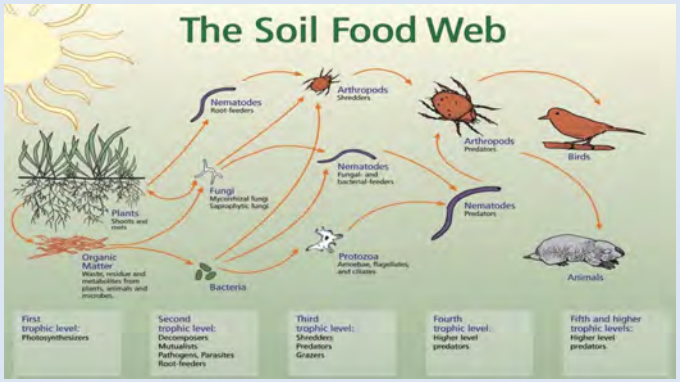
1 A state/national crisis of industrial agriculture & food (IA, or Green Revolution…)

- 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…)

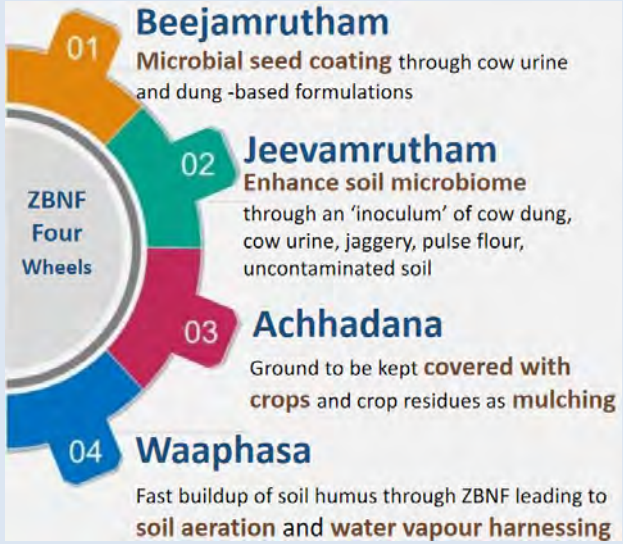
2 An alternative sociotechnical niche

"NATURAL FARMING" (APCNF) with:

- Zero fertilizer
- Zero pesticide
- Low or no irrigation
- BUT agro-biodiversity feeding the soil food web 365 days/year



Pre-Monsoon Dry Sowing (PMDS) +



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

Agro-industry *vs* Agroecology (or Nature-based Farming)

AGRO-INDUSTRY

- **Specialization** in a few standardized mass-productions (wheat, rice, corn, soya, palm oil, sugar cane, cow's milk…) to enable their mechanization/robotization and generate **economies of scale**, the profit-driver of any industrial activity
- With the use of **inputs produced by science & industry** to increase land productivity (genetic materials, water from dams, canals or pumps, fossil energy, chemical fertilizers, pesticides, herbicides or fungicides, growth hormones or antibiotics, robotics, artificial intelligence…)

AGROECOLOGY

Land and labour productivity
based on a **mosaic of local agroecosystems**
that, each in their own way,
stimulate and optimize biological synergies between many plant and animal species
beneath and upon the earth's surface,
from soil fungi to cereals, pulses and trees,
from bacteria or earthworms to large bovids
(Dorin et al. 2013, Dorin 2017, Dorin 2021)

Extremely difficult to model (if possible one day…):
- very complex relationships between multiple living beings (including bacteria & fungi)
- billions of unique combinations/optimizations (no universal "solution" like the GR package…)
- lack (and cost…) of scientific documentation and data on multiple (biological) inputs-outputs…

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:


The Hindu, 14/07/2018

With Natural Farming,

we can boost biomass productions (& incomes) without fertilizer, pesticides, massive irrigation & subsidies,

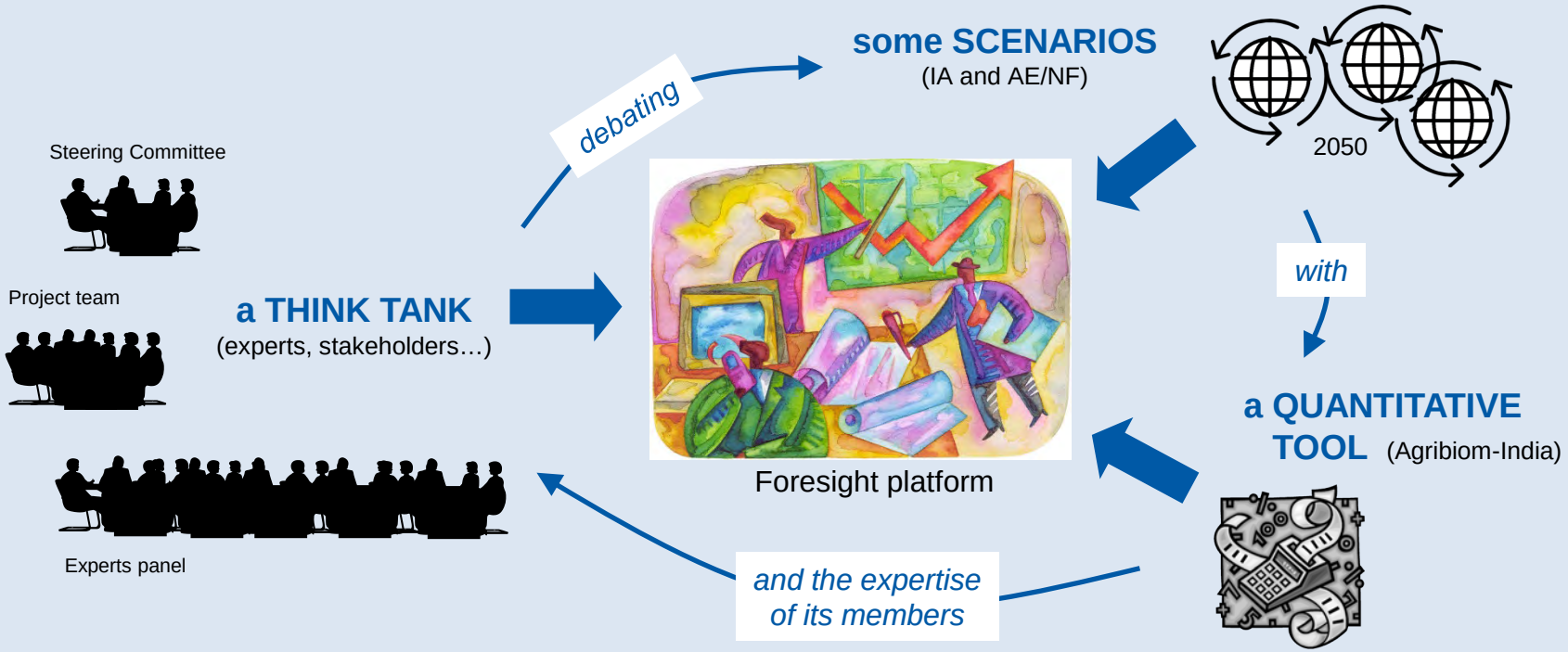
but yet science very little understand why and how!!!

(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

Make visible an agroecological scenario for India

The foresight platform “AgroEco2050” (2019-2022)

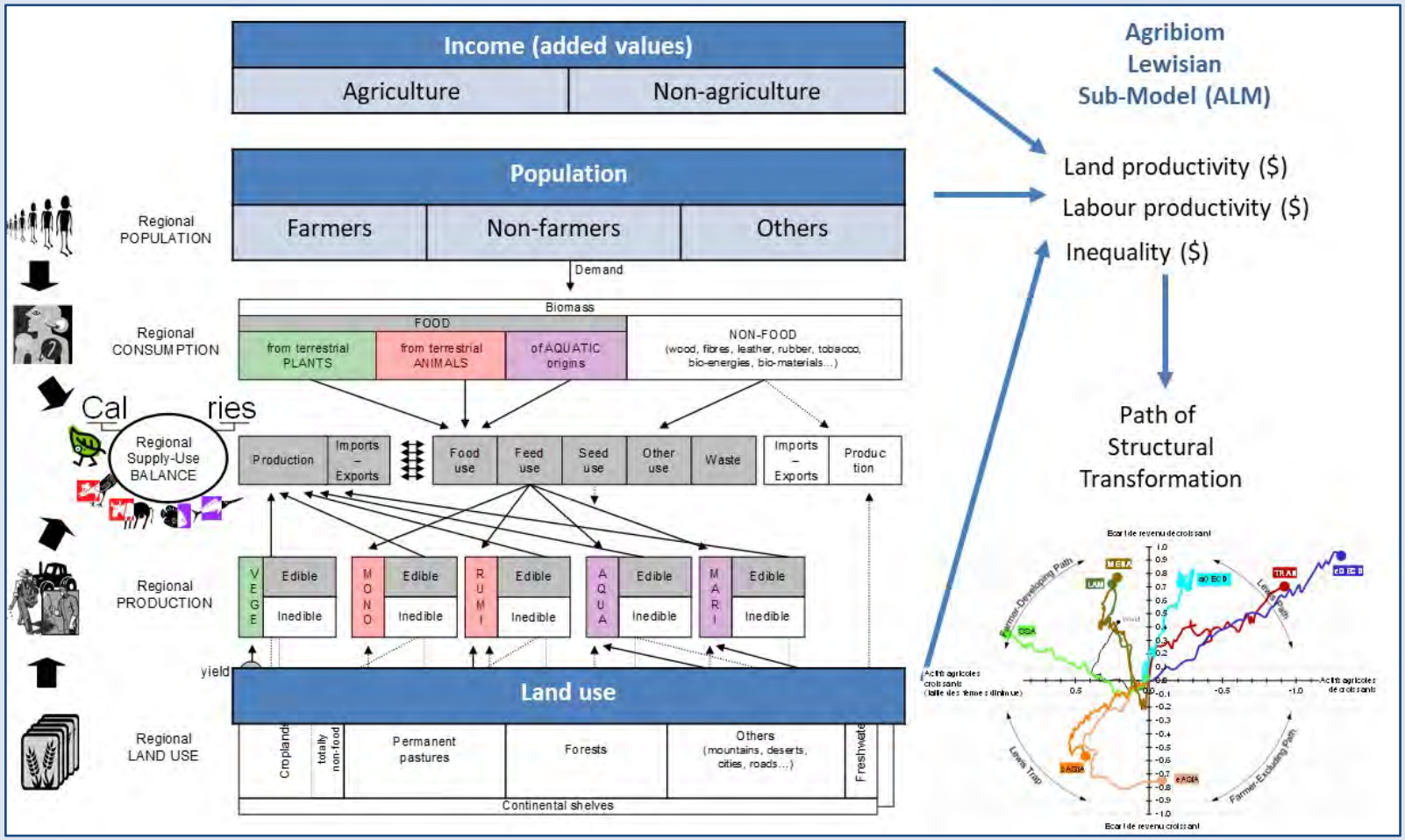


Kick-off meeting of the AgroEco2050 project (AP Secretariate, Amaravati, 17/05/2019)

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

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 (+6.7% 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

15%

7%

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

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