

# Theory and evidence for a large-scale agroecological transition in India

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- (1) Dorin B., Hourcade J.-C., Benoit-Cattin M. (2013). *A World without Farmers?*, CIREC WP 47, Paris, 26 p.  
 (2) Dorin B., Aubron C., 2016. *Croissance et revenu du travail agricole en Inde, Economie Rurale*, 352, 41-65.  
 (3) Dorin B., 2017. *India and Africa in the Global Agricultural System (1960-2050)*, EPW, LII-25-26, 5-13.  
 (4) Dorin B., Joly P.-B., 2020. *Modelling world agriculture as a learning machine? From mainstream models to Agribiom 1.0*, Land Use Policy, 96:July, pp. 103624



**Agro-industrial scenario?**

**Agro-ecological scenario?**

Workforce  
Livelihood

Food



**A World Without Farmers**



**A World With Farmers and Nature**

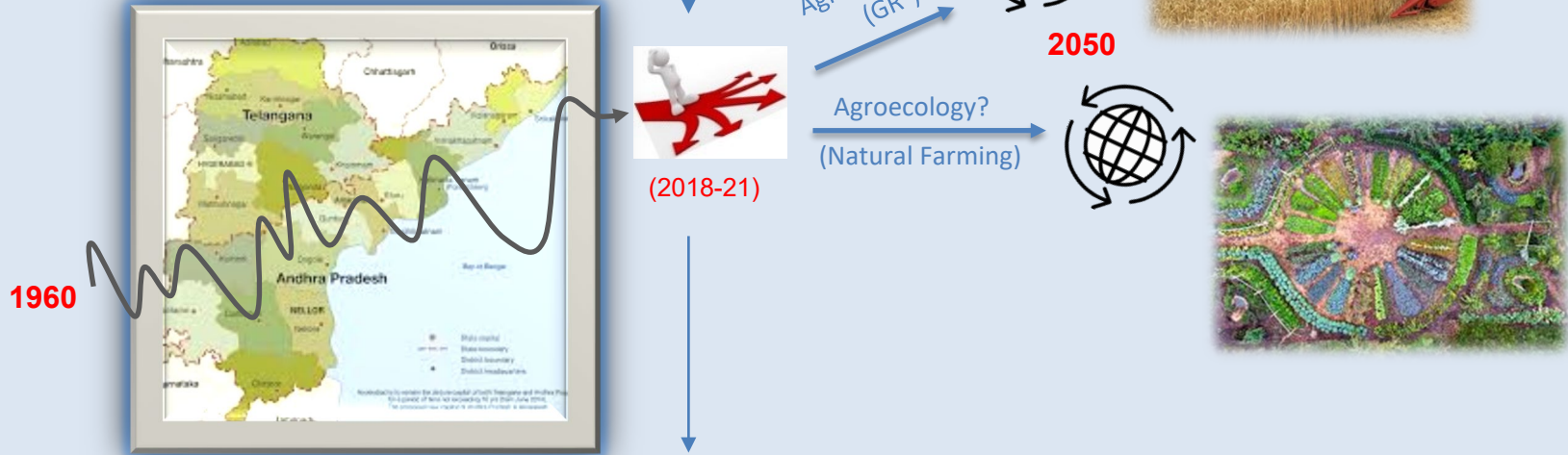


**CSH's seminar, 15<sup>th</sup> February 2021, 17:00-18:30**

# 1 Introduction

## Foresight AgroEco2050

A retro-prospective analysis (1960-2050)  
focused on Andhra Pradesh



### ■ A joint RySS-CIRAD-FAO project (Oct. 2018 – Dec. 2021)

- Rythu Sadhikara Samstha, Government of Andhra Pradesh ([www.ap.gov.in](http://www.ap.gov.in))
  - Food and Agricultural Organization, Delhi ([www.fao.org/india/fao-in-india](http://www.fao.org/india/fao-in-india))
  - French Agricultural Research Centre for International Development ([www.cirad.fr](http://www.cirad.fr))
- ...with the support of the Azim Premji Philanthropic Initiatives (APPI)

### ■ Objectives

- (1) to develop a comprehensive and credible scenario of full-scale NF/agroecology in AP
- (2) to contribute to state, national and international debates and researches on agroecology

### ■ Means

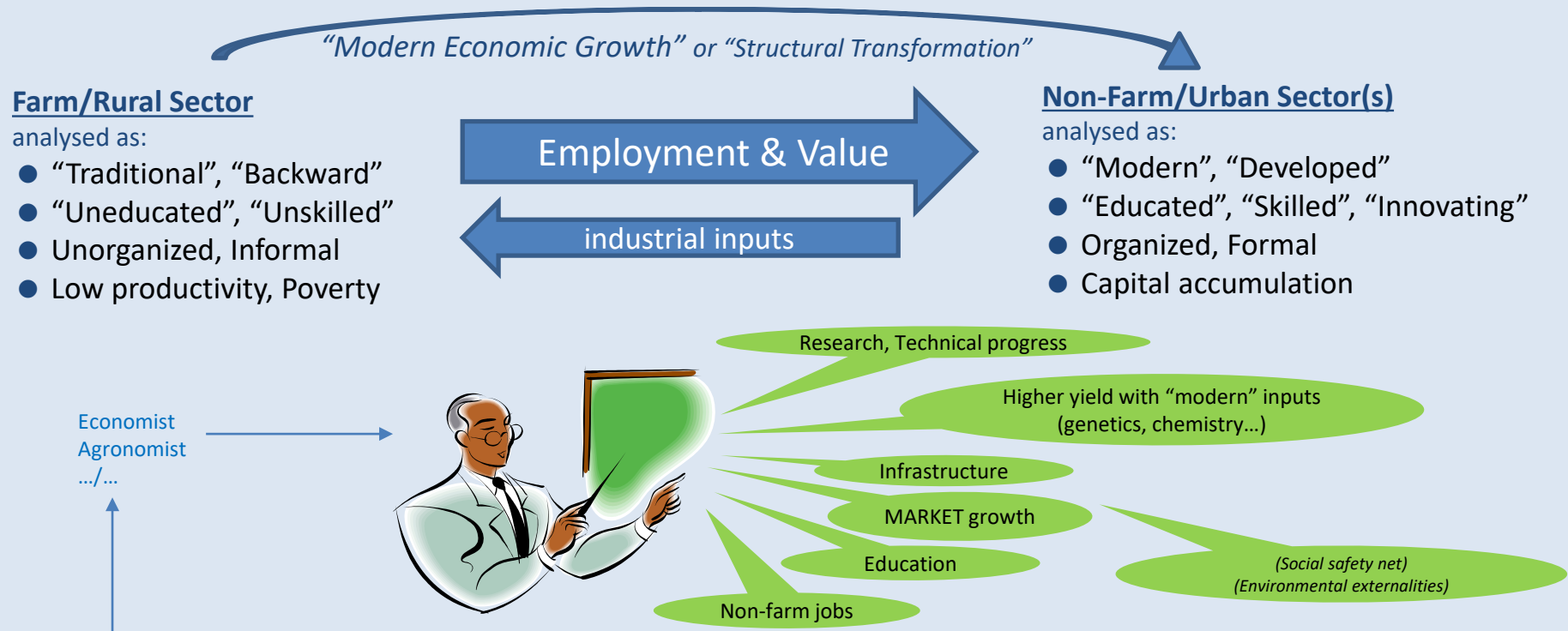
A foresight platform with various experts and public/private stakeholders:

- to revisit and discuss collectively past evolutions since the 1960s
- to build/discuss/compare 2 contrasted scenarios: BaU vs. NF



# 2 The “Lewis Path”

## ■ The theory of “modern economic growth”



**Agricultural economics** *Population pressure on land resources could be circumvented and **labour productivity** increased by several multiples (up to the levels of Western Europe in the early 1960s) by investing in agricultural research, human capital and modern agricultural inputs [Hayami & Ruttan, 1971, 1985, 2002]*

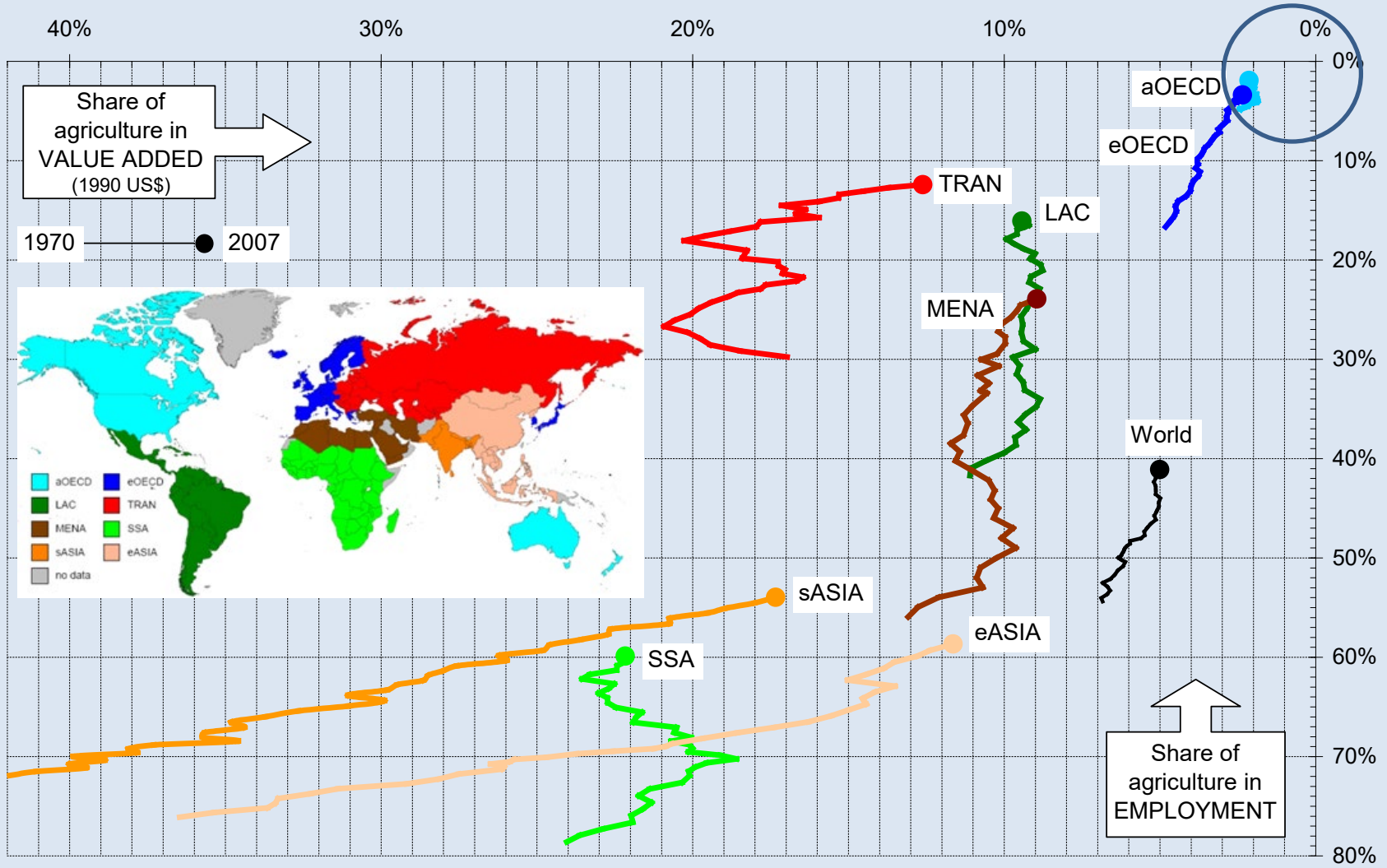
**Development economics** *Barriers to modern agricultural technology subject to exogenous technical change jam the whole development process [Gollin & al., 2002]*

**New structural economics** *Firms in developing countries can exploit the industrial and technological gap with developed countries [on the global technology frontier] by acquiring industrial and technological innovations that are consistent with their new comparative advantage [Lin, 2011]*

**Neo-classical Growth theory** *Countries with access to identical technologies should converge to a common income level .../... Countries that are poorer and have higher marginal productivity of capital should grow more rapidly in the transition to the long-run steady state .../... Open global economy, access to foreign capital and foreign markets further strengthen the convergence [in Rodrik, 2013]*

# OECD countries now in a "World Without Agriculture" (WWA)

World Without Agriculture [Timmer 2009]  
( 3% of employment  
3% of GDP )



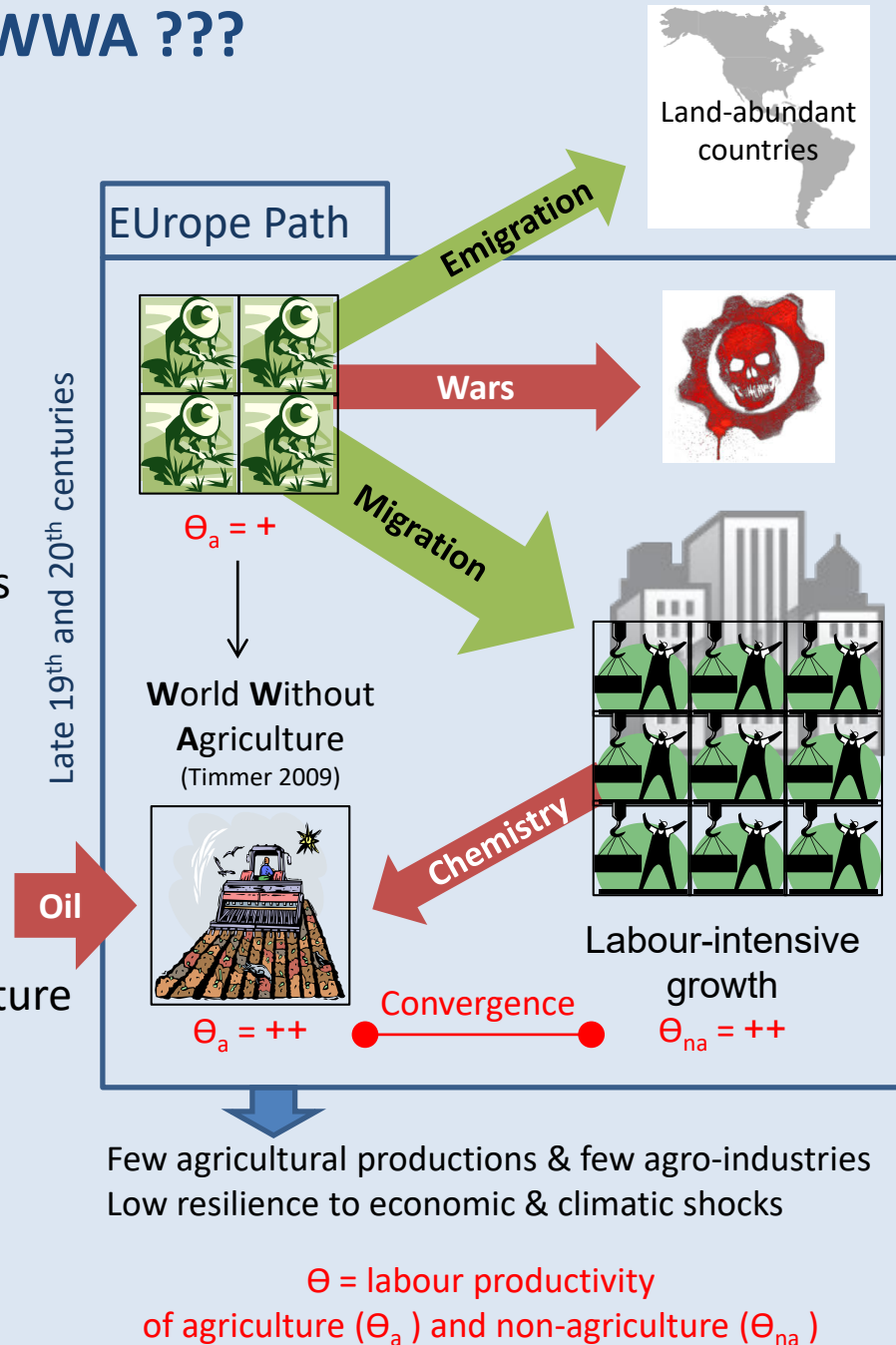
- How did OECD countries get into this WWA ???
- Is a WWA so desirable ???
- Can all countries migrate into a WWA ???

Source: Dorin & al 2013

# ■ How OECD countries got into a WWA ???

## The European path

- EMIGRATION to land-abundant countries: 40 million West-European to Americas from 1850 to 1914 (Hatton and Williamson 1994)
- WARS (1914-18, 1939-45), holocaust which killed above all the poor peasants
- LABOUR-INTENSIVE growth in nonfarm sectors (post-war demand for low-skill labour, low automation/robotization...)
- EASY URBANISATION (no megacity, high land availability per capita)
- Massive access to OIL and CHEMISTRY
- Massive PUBLIC SUPPORT to industrial agriculture (research in agrochemical inputs and genetics, price support for industrial productions, subsidized loans to mechanization, etc.)  
the “protection problem” of high-income economies (Shultz 1953)...

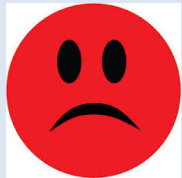


# ■ Is this WWA so desirable ???

## State of agriculture in OECD countries



- Farmer income  $\approx$  non-farmer income (on average...)
- Big farms with big machineries and robots
- Within global trade to “feed the world”
- .../...



- High farm specialisation: **low resilience to economic, climatic & biotic shocks**
- Dependence on **fossil-energy**
- Dependence on big machineries, industrial inputs and IPR
- **Over-indebtedness** and **suicides of smaller farmers**
- **Corporatization** of farms, **oligopsony** of input suppliers
- High level of **public subsidies**
- **Erosion of biodiversity, soil, water and air resources**
- Unbalance diet, junk food, obesity, **cardio-vascular diseases, cancers...**
- Sad landscape and rural life for tourism...
- .../...



Need for invent another dream of “modernity”,  
another model of economic development,  
with and for farmers and nature...

■ **Can all countries migrate into a WWA ???** => see next section

# 3 The “Lewis Trap”

## ■ The dynamics of farm labour productivity

Farm labour productivity can be increased through:

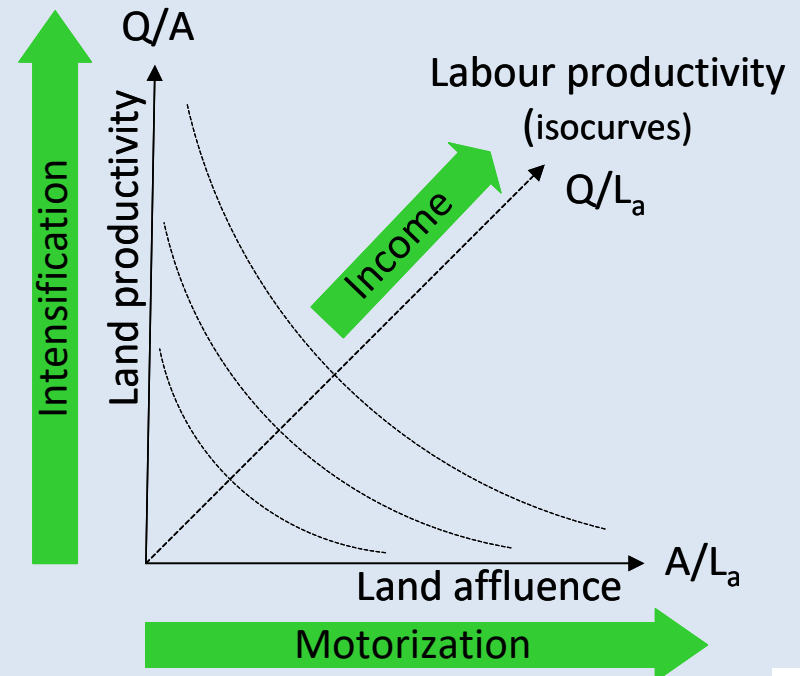
- “Intensification” (with irrigation, fertilizers, HYV, pesticides, etc.) to get higher yields per hectare
- “Motorization” (with tractors, combine harvesters, aeroplanes, etc.) to crop more land per farmer.

### ① The “TALA” equation

$$\frac{Q}{A} \cdot \frac{A}{L_a} = \frac{Q}{L_a}$$

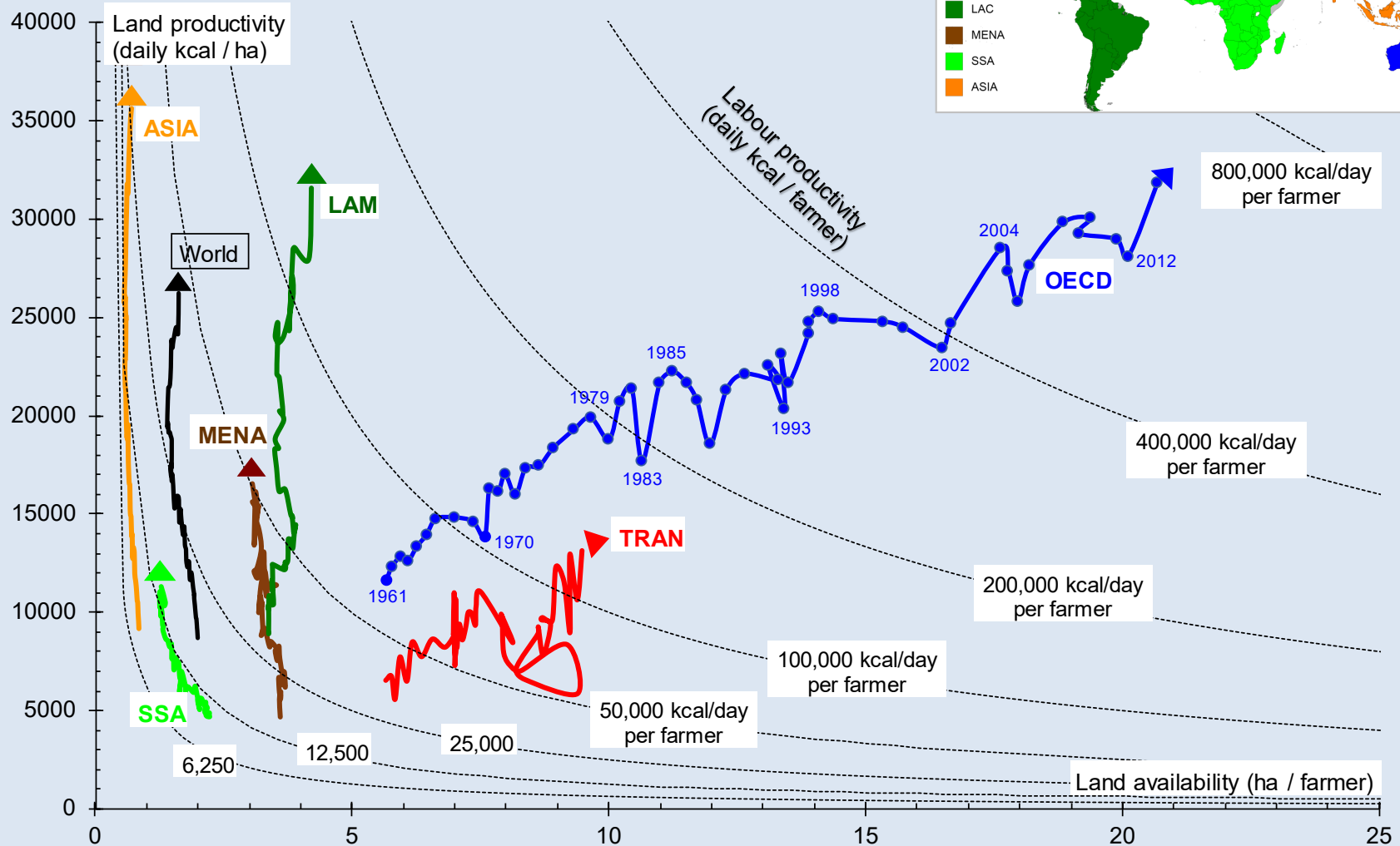
Technology Availability      Labour  
(Land productivity)      in land      productivity  
(Land/Worker)

### ② The corresponding graph



# TALA 1961-2013

Yield (Y axis) \* Land availability (X axis)  
= labour productivity (isocurves)



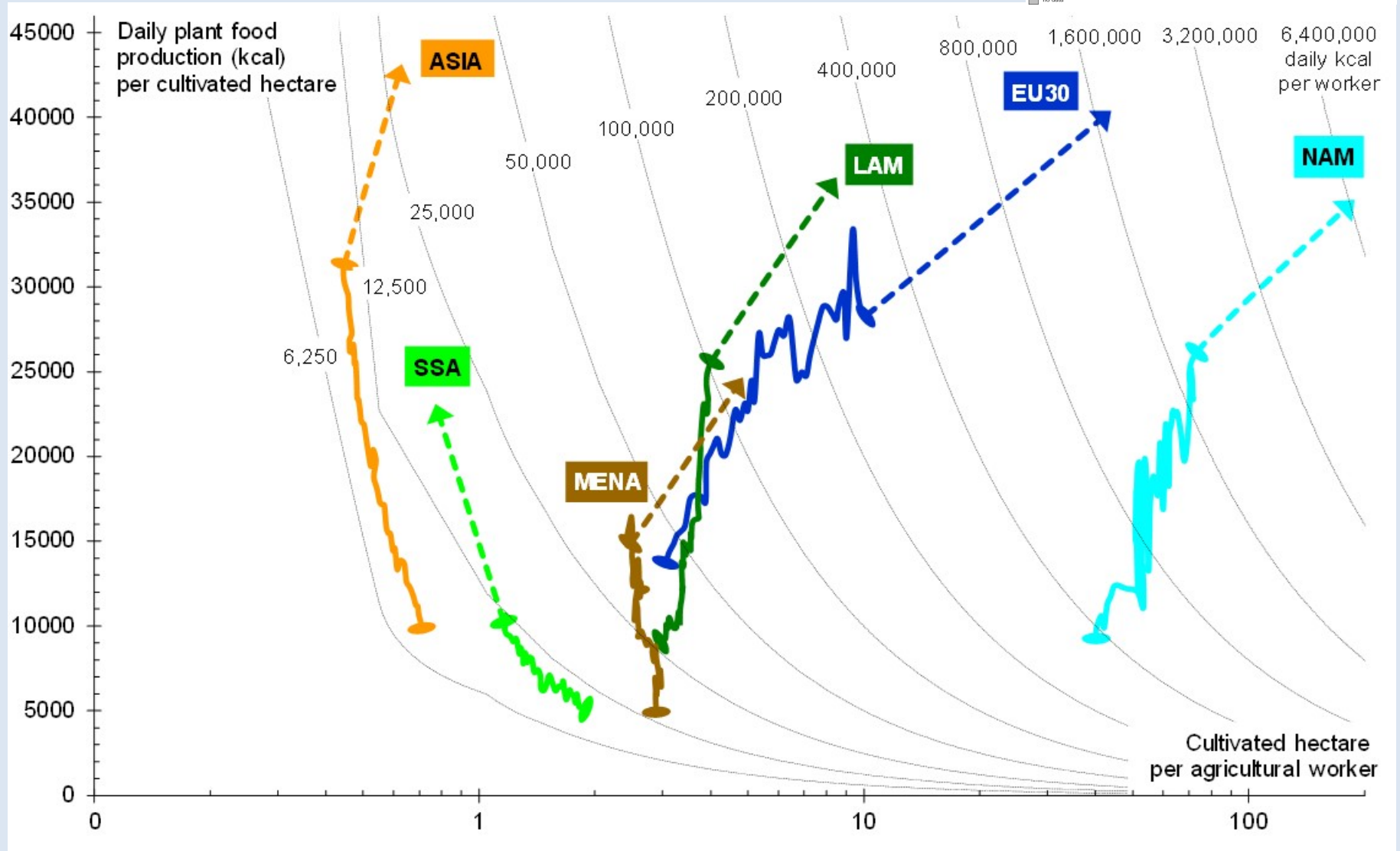
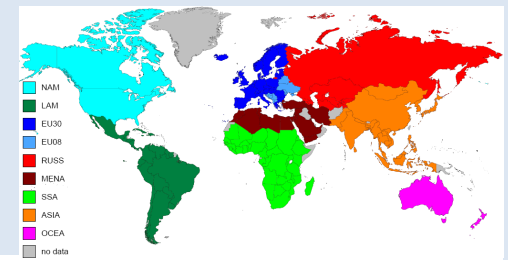
Notes:

- (1) Source: based on Dorin et al. (2013: Figure 5a), updated from 2007 to 2013, and using ILOSTAT (2019) and no longer FAOSTAT for active populations in agriculture, except for deducting values before 1991 with former annual growth rates
- (2) Countries of the world are grouped under the 6 regions of the MEA (2005), with ASIA = Asia without Japan, LAM = Latin America, MENA = Middle East and North Africa, OECD = OCDE countries in 1990, SSA = Sub-Saharan Africa, TRAN = transition countries (former USSR).



# TALA 1960-2050

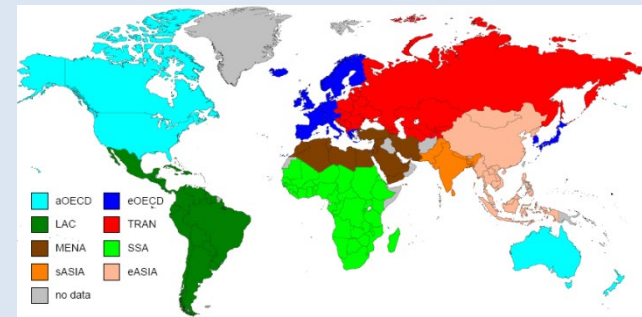
- observed (1961-2007, annually)
- projection based on FAO (2006-2050)



Source: Dorin, 2017

# Structural Transformations

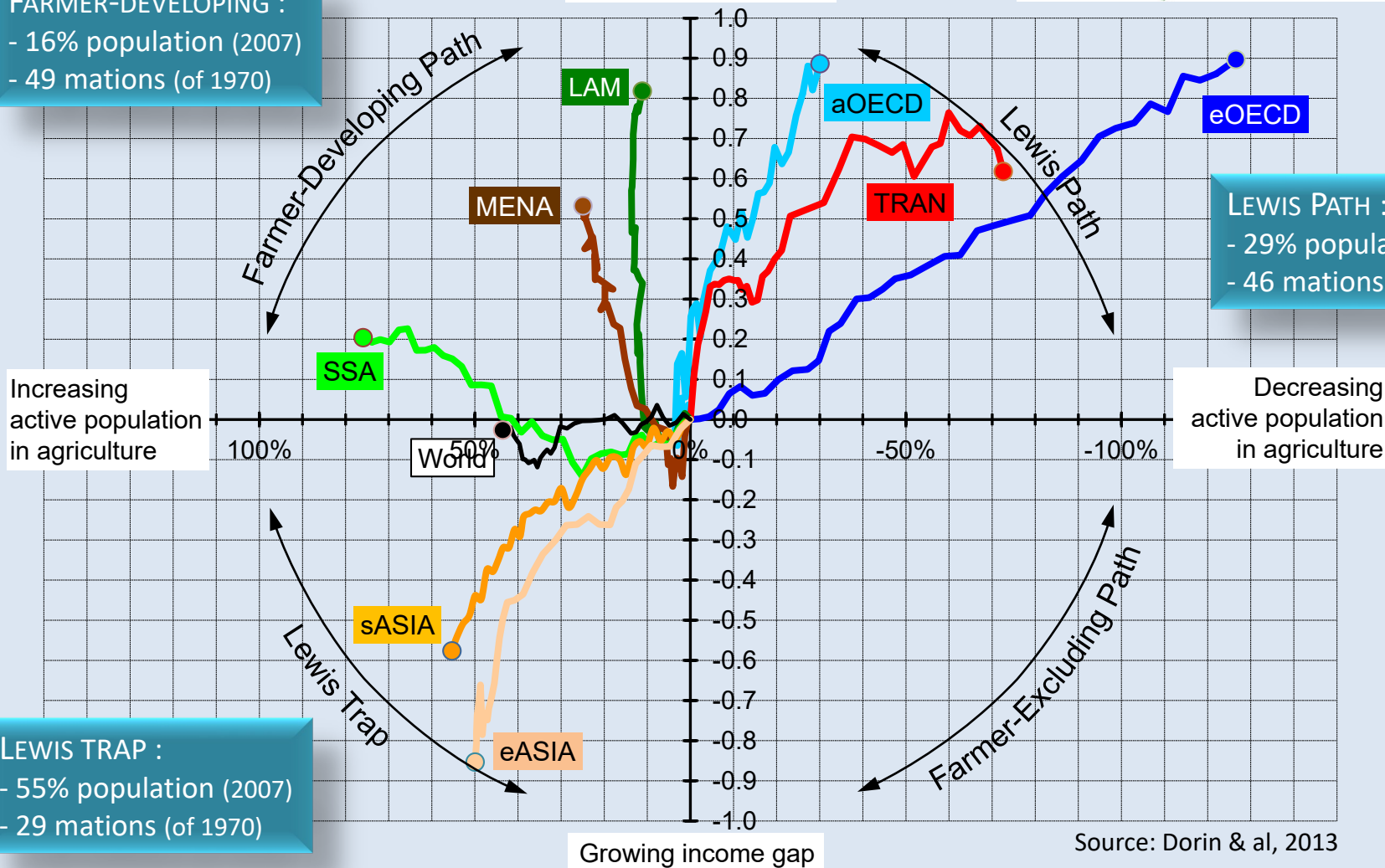
1970 (centre) → 2007 (●)  
 (cumulated annual growth rates)



## FARMER-DEVELOPING :

- 16% population (2007)
- 49 mations (of 1970)

## Narrowing income gap



## LEWIS PATH :

- 29% population (2007)
- 46 mations (of 1970)

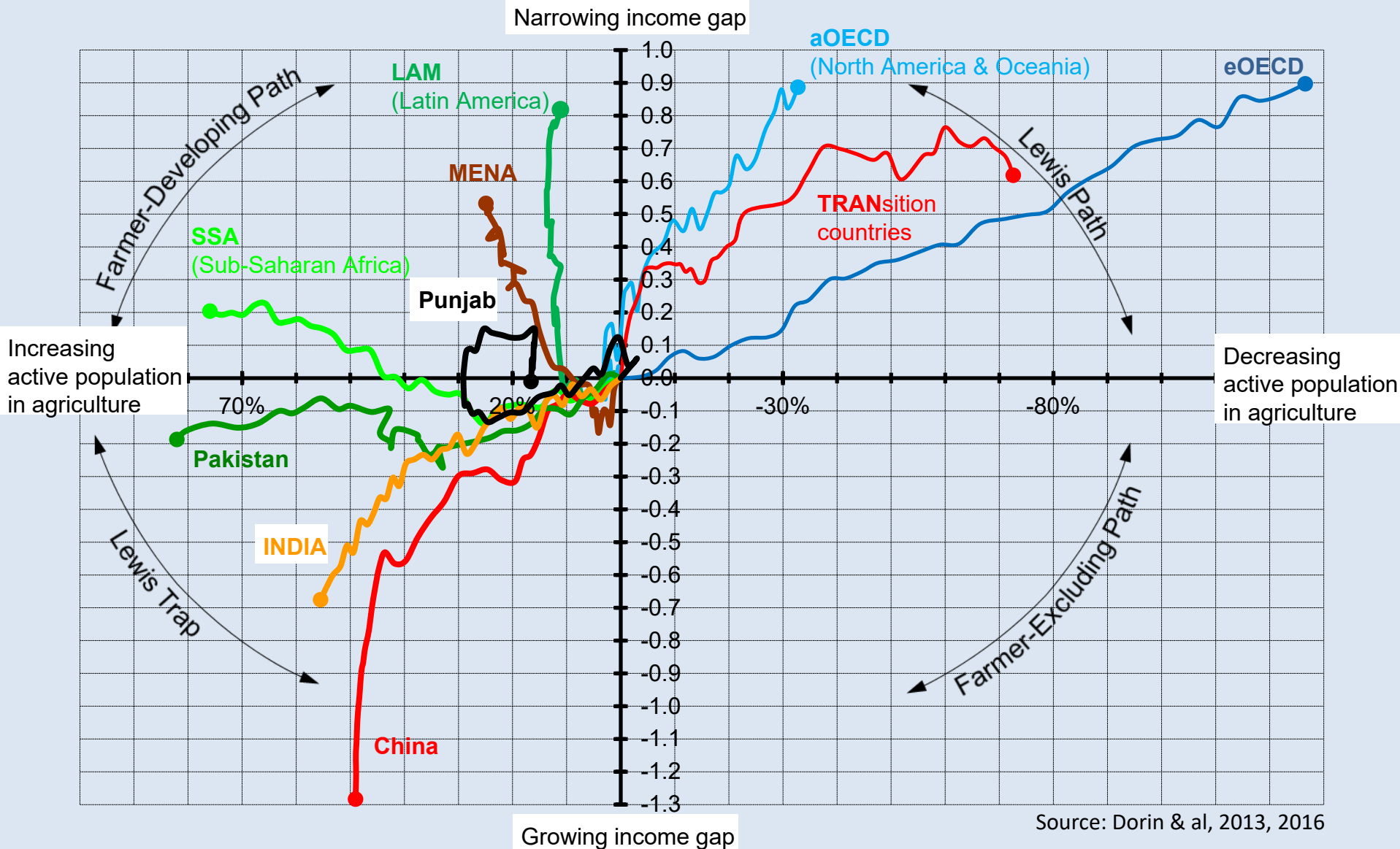
## LEWIS TRAP :

- 55% population (2007)
- 29 mations (of 1970)

Source: Dorin & al, 2013

# Structural Transformations

1970 → 2007 (2011 for Punjab)  
(cumulated annual growth rates)

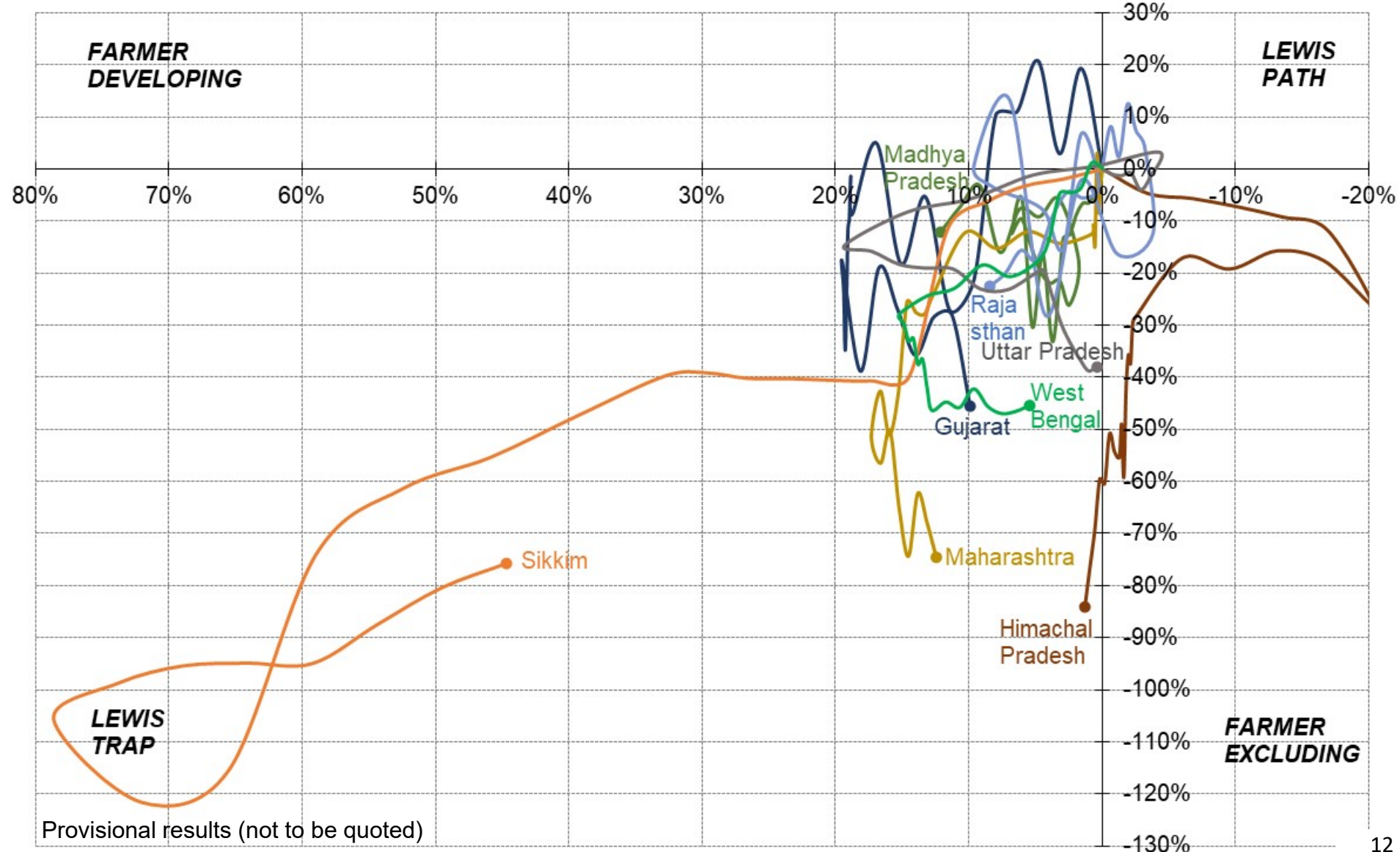


Except for Punjab, the figure (Dorin 2013, 2016) represents the cumulative annual growth rates from 1970 (=0) to 2007, of: (1) the active population in agriculture (x-axis) (FAO, 2010), (2) the income differential between agricultural and non-agricultural workers (y-axis) measured with the Labour Income Ratio calculated in 1990-US\$ from UNSTAT (2010). The longer the curve, the faster the process. For Punjab, the period starts in 1970 too, but ends in 2011, and national data were used (Censuses and NSDP, provisional results)

# Structural Transformations of Indian States since 1993 (provisional results)

## (1) States falling further into the "Lewis Trap"

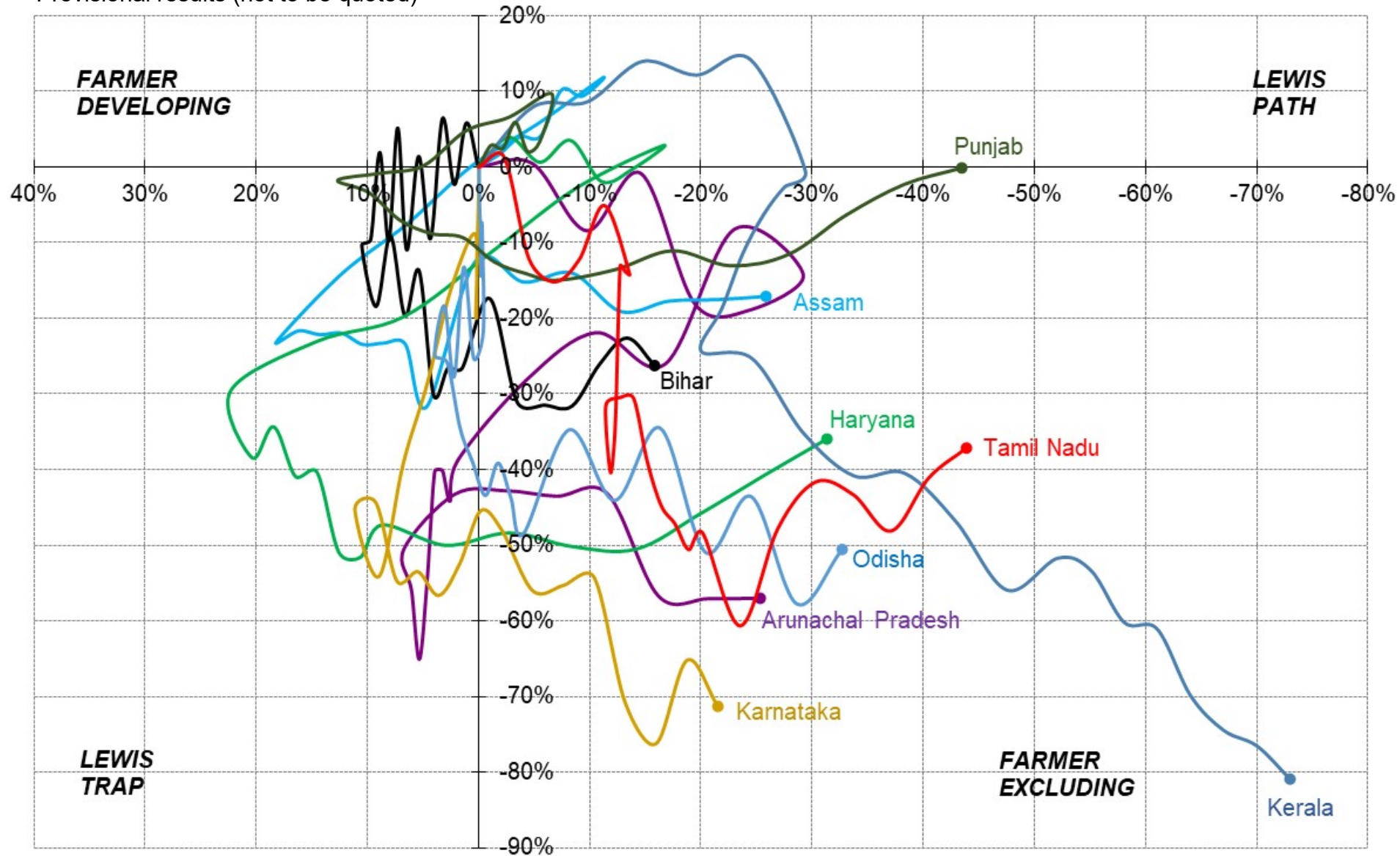
1993-94 → 2018-19  
(cumulated annual growth rates)



## (2) States shifting from the “Lewis Path” to the “Farmer Excluding” path

1993-94 → 2018-19)  
(cumulated annual growth rates)

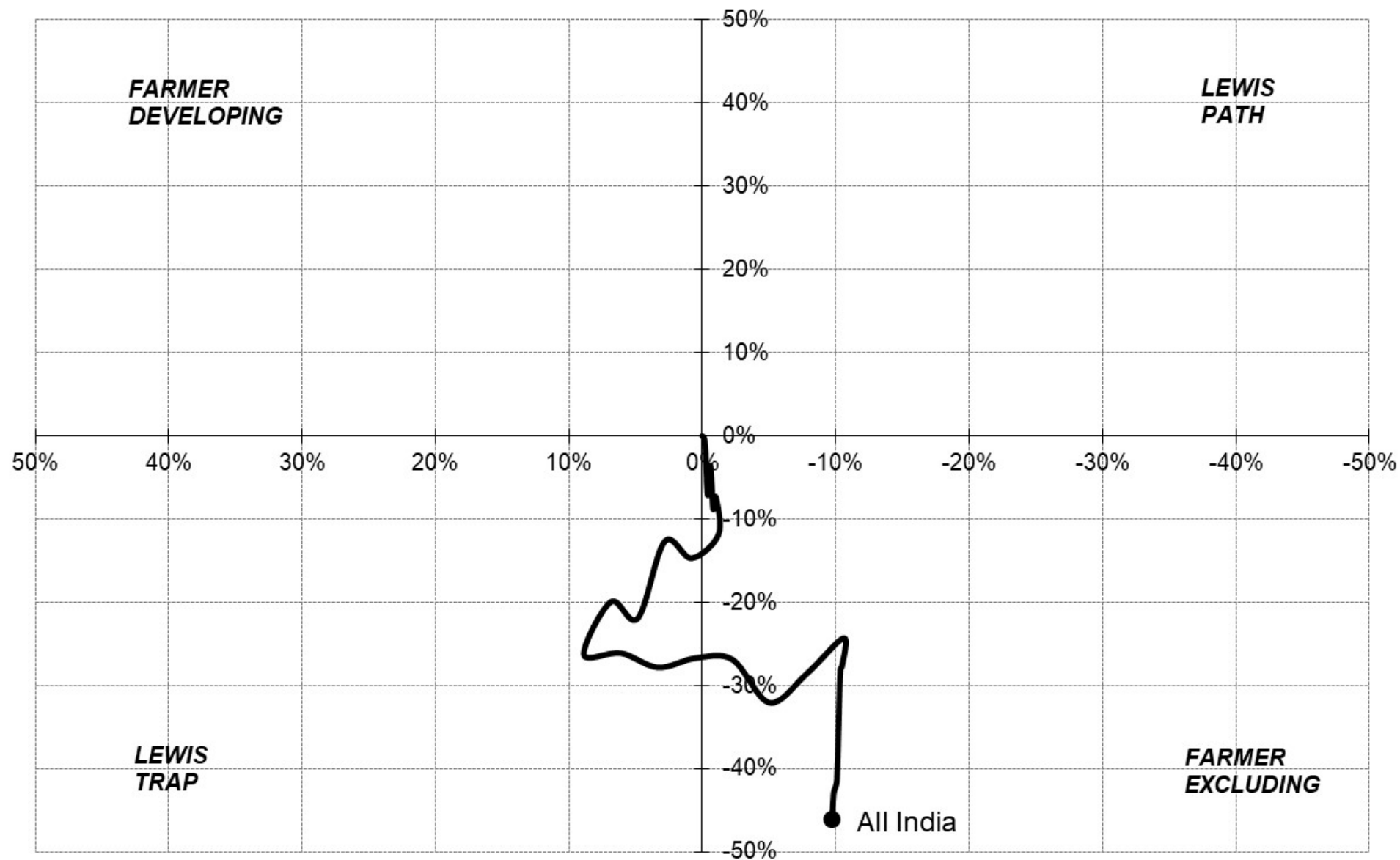
Provisional results (not to be quoted)



### (3) Overall picture since 1993-94

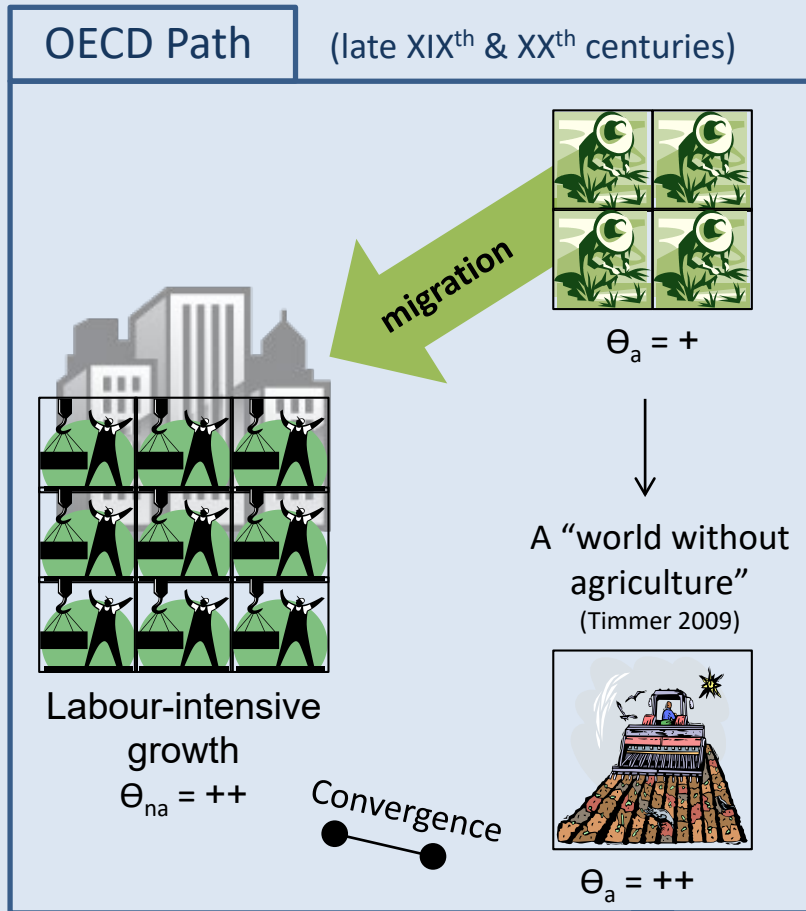
1993-94 → 2018-19)  
(cumulated annual growth rates)

Provisional results (not to be quoted)



# From a modern path to a postmodern trap...

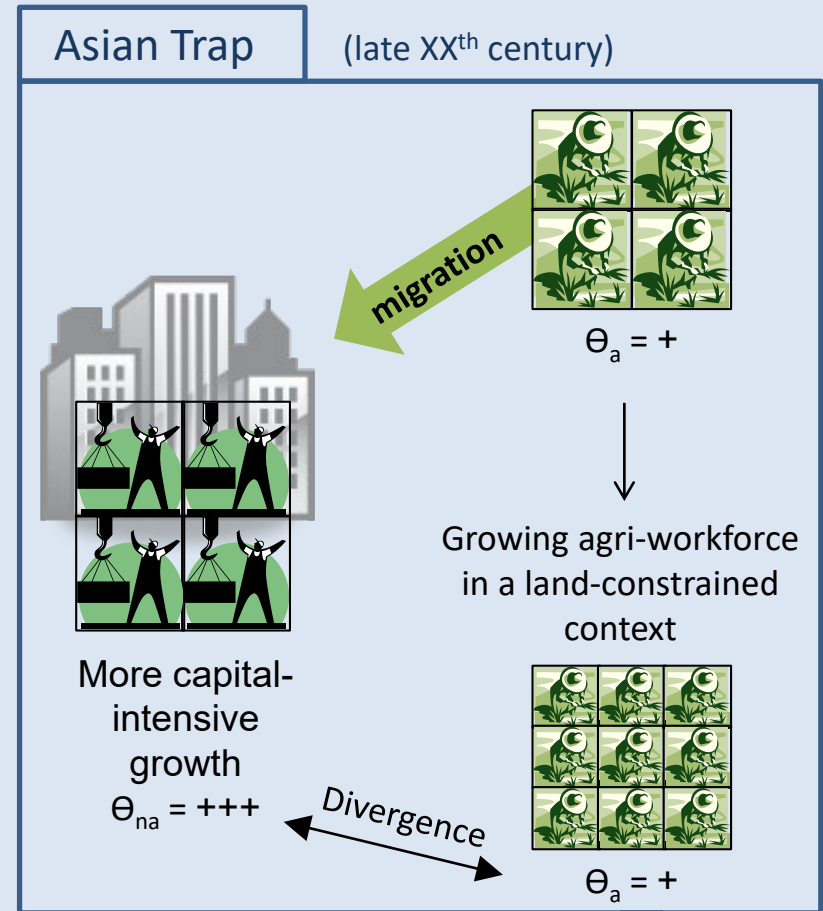
## Basic mechanisms



Few monocultures & few agro-industries  
Low resilience to economic & climatic shocks

## Historical evidences

Higher land acreage per farmer was the main driver for boosting:  
- agricultural labour productivity ( $\Theta_a$ )  
- convergence of labour productivity across sectors ( $\Theta_a = \Theta_{na}$ )



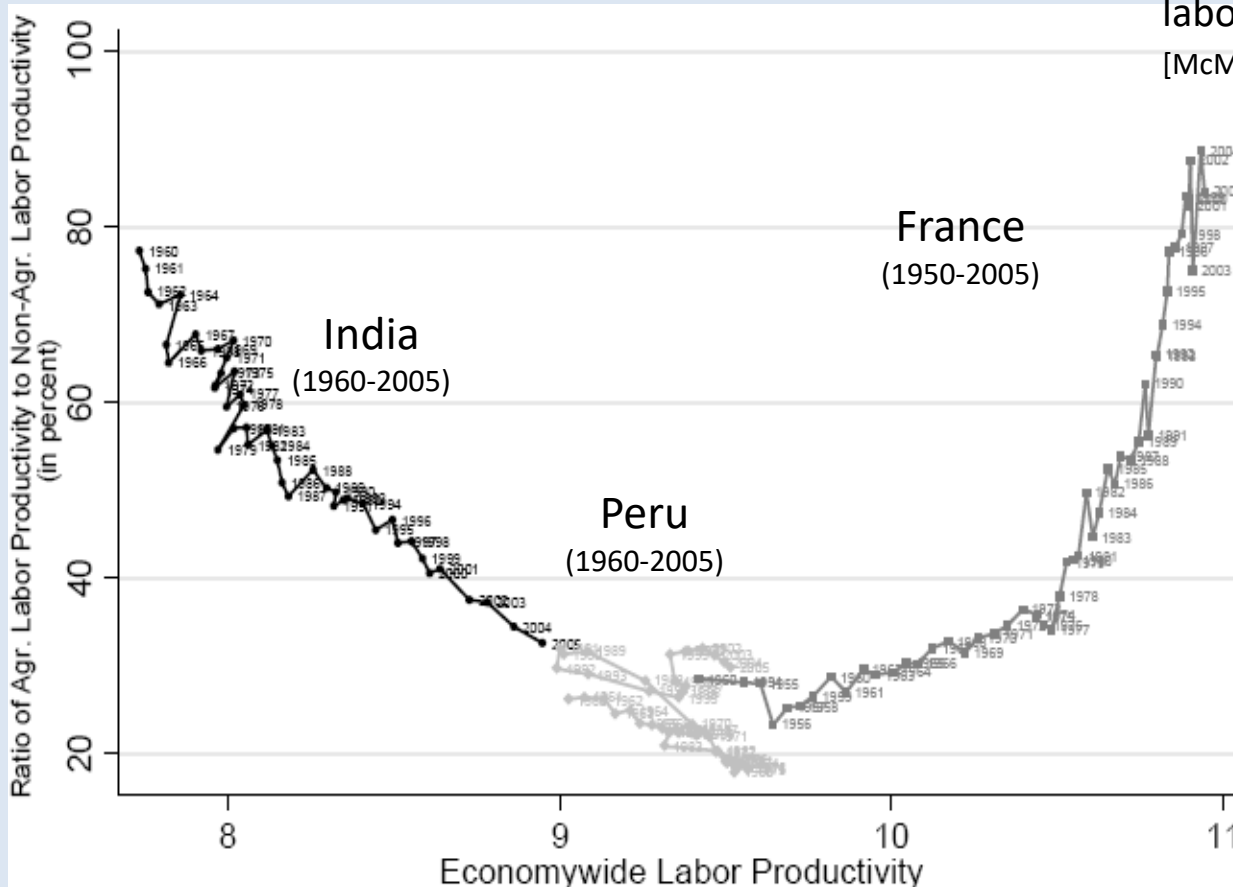
Rapid depletion of natural resources (soil, water...)  
Risk of severe social and political crises

# 4 Can India ever get out of the trap?

- Nothing wrong, let us wait?

Structural transformation is a long historical process characterized in the early stages by a widening gap between farm and non-farm labour productivity

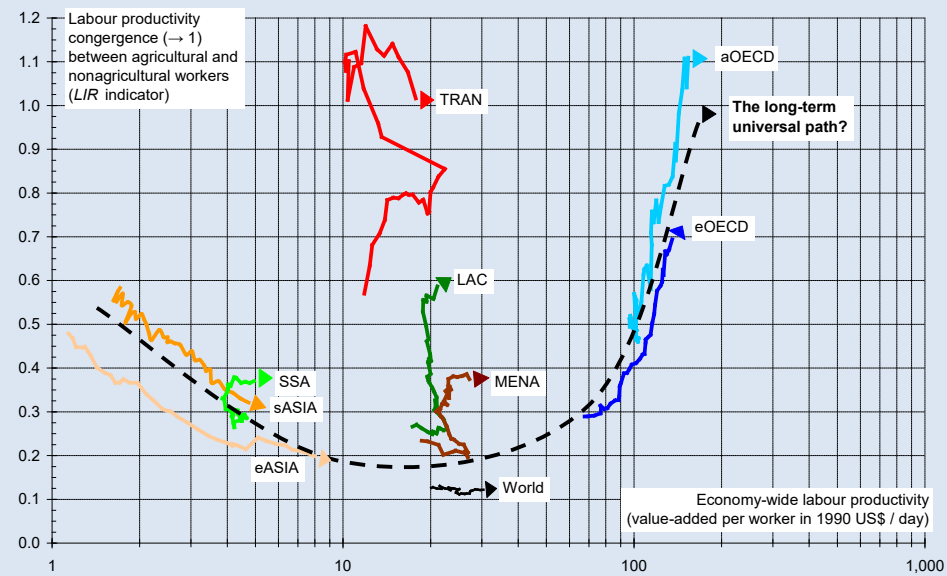
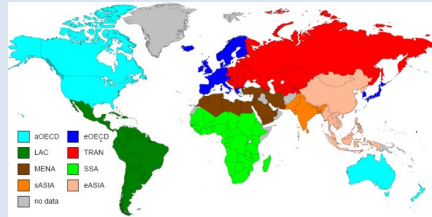
[McMillan & Rodrik, 2012, pp. 9-10]



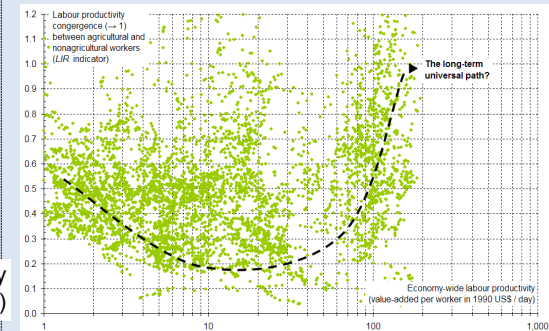
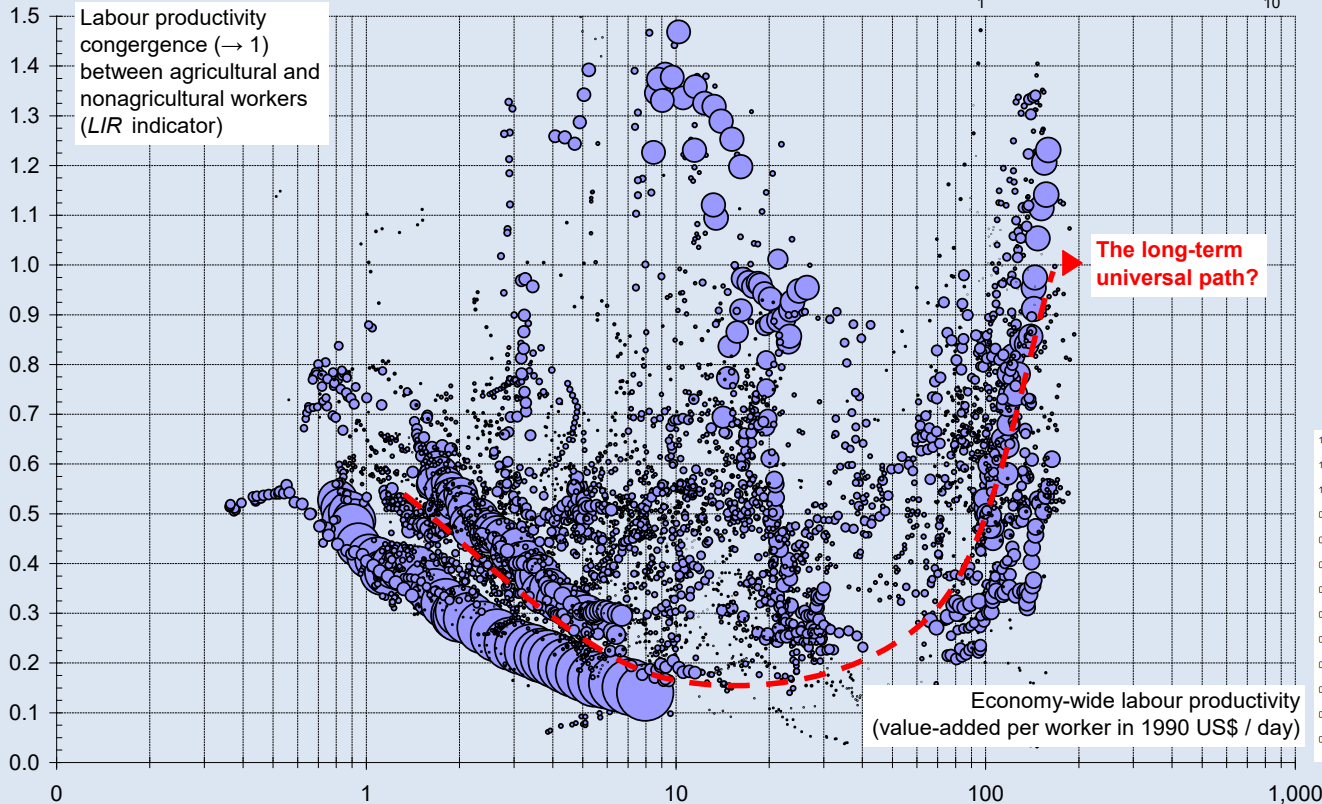


# A long-term universal OECD path?

All countries into eight regions (1970-2007)



All countries weighted by their active population (1970-2007)



# ■ A heuristic numerical experiment on India

Source: Dorin & al, 2013  
<https://hal.archives-ouvertes.fr/hal-00866413>

	Past 1980 => 2007	Shukla & Dhar's scenario 2007 => 2050	"Lewis Path" scenario 2007 => 2050
<b>Population</b>	+1.94 % => 1165 M	<b>+0.76 % =&gt; 1615 M</b>	<b>+0.76 % =&gt; 1615 M</b>
<b>Growth (GDP) (Y)</b>	+6.1 %	<b>+7.3 %</b>	<b>+7.3 %</b>
- agriculture ( $Y_a$ )	+3.0%	<b>+2.6 %</b>	<b>+2.6 %</b>
- non-agriculture ( $Y_{na}$ )	+7.2%	<b>+7.7 %</b>	<b>+7.7 %</b>
<b>Labour productivity (<math>\theta</math>)</b>	+3.9 %	<b>+6.2 %</b>	<b>+6.2 %</b>
- agriculture ( $\theta_a$ )	+1.6 %	<b>+3.0 %</b>	<b>+9.3 %</b>
- non-agriculture ( $\theta_{na}$ )	+3.7%	<b>+5.4 %</b>	<b>+4.6 %</b>
<b>Workforce (L)</b>	+2.2 % $\Rightarrow$ 463 M	<b>+1.1 % <math>\Rightarrow</math> 735 M</b>	<b>+1.1 % <math>\Rightarrow</math> 735 M</b>
- agriculture ( $L_a$ )	+1.4 % $\Rightarrow$ 259 M (56%)	-0.4 % $\Rightarrow$ 217 M (30%)	-6.2 % $\Rightarrow$ 17 M (2%)
- non-agriculture ( $L_{na}$ )	+3.4 % $\Rightarrow$ 204 M (32%)	+2.2 % $\Rightarrow$ 518 M (70%)	+3.0 % $\Rightarrow$ 718 M (98%)
<b>Income gap Agri/Non-Agri</b>	1 / 6	1 / 17	1 / 1



Workforce in agriculture  
(change over the period)

+ 82 M workers  
(+146 M people)

- 41 M workers  
(- 156 M people)

- 242 M workers  
(- 547 M people)



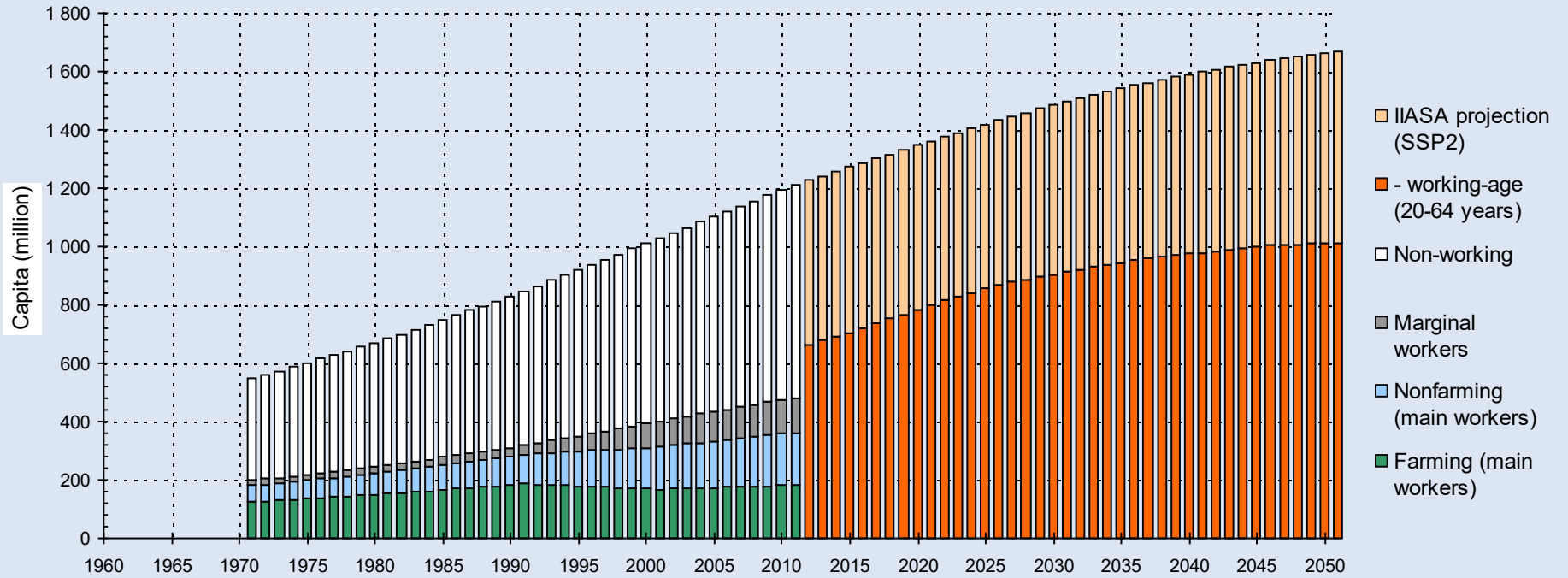
Land availability (end year)

0.66 ha/worker

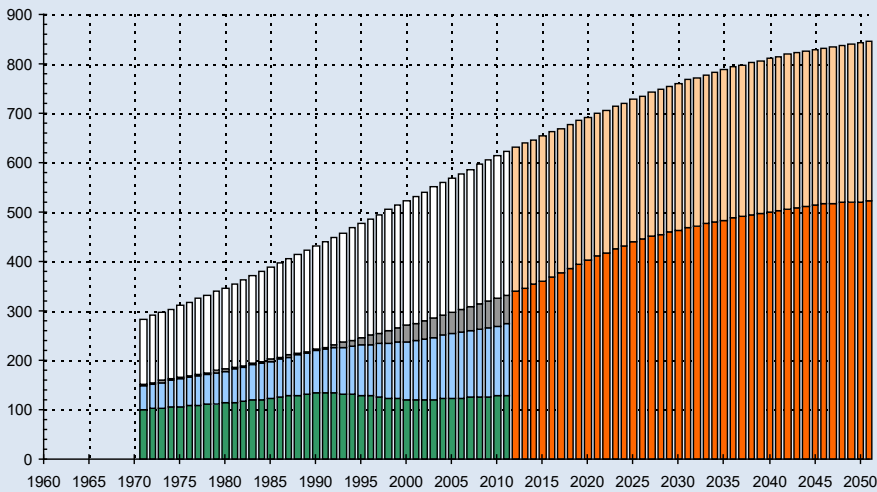
0.78 ha/worker

Max 10 ha/worker

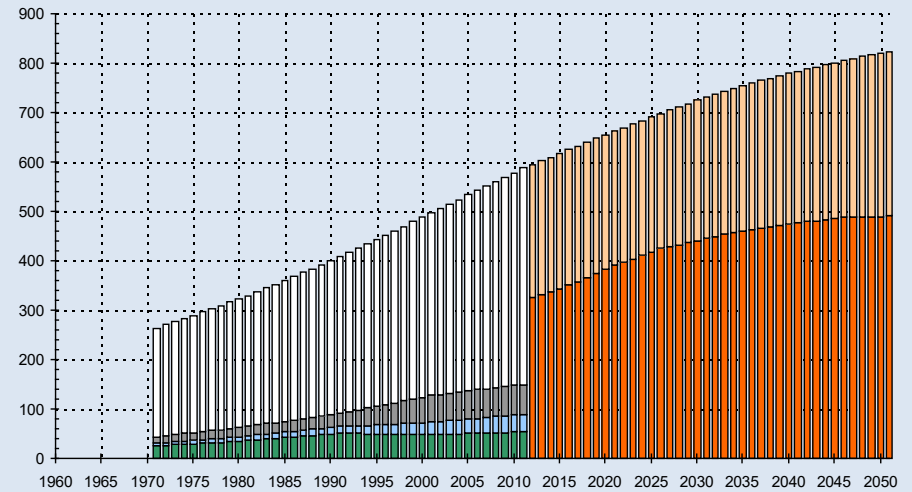
# A workforce of one billion Indian adults in 2050...



## Males



## Females



## ■ The elusive “Lewis Path” through industrial agriculture

Unless labour is as free to move worldwide as capital today, a country like India can hardly follow the Lewis Path of OECD countries

### (1) Industry is less able to absorb labour than at the time of “manufacture”

- Labour productivity ↗ (economy of scale, motorization/automation)
- Sector growth slows down (increasing cost of oil and other non-renewable raw materials, strengthening of environment-friendly regulations, market saturation in industrialized countries, slower increase of wages in developed economies not compensated by an increase elsewhere...)

### (2) It would require a mega-urbanization ever faced in history

- No more “open spaces” for exporting labour surpluses  
(60 million Europeans emigrate to the “New Worlds” between 1850 and 1930)
- Lewis Path scenario for India (2050): 80% of the population (1.3 billion people out of 1.6) lives in cities whose density reaches 55,000 inhabitants per km<sup>2</sup>  
(35,000 in Dhaka and 27,100 in Mumbai in 2010, the two densest cities in the world)

### (3) Farm labour productivity cannot be boosted as in OECD countries

Limited prospects of:

- Large-scale moto-mechanization: max 10 ha/farmer in 2050 (150 in CA, 63 in US, 30 in FR... in 2007)
- Higher yield with modern industrial inputs (fertilizer, pesticide, oil...):  
ever-increasing costs + decreasing marginal productivity + negative externalities  
(on natural resource, climate, animal and human health...)
- International market: trade barriers + market powers  
(from large-scale and well-organized agro-industries that emerged during the past century)

# 5 A New Paradigm for agriculture

## ■ The equation at stake

Increasing  
farmers' income  
& production

...without sending  
most of them  
to shantytowns

$$\theta_a = (pQ - Y_{na}^a) / L_a$$

Prices

Costs of  
non-agricultural inputs

## ■ A 2050 vision

Science & farmers managing  
a mosaic of agro-ecosystems  
boosting local synergies  
amongst many plant and animal species  
above & below the ground surface.

## AGROECOLOGY

“A science, a movement and a practice”

(Wezel & al,2009)

- 1 Higher biodiversity & biological synergies
  - ↗ production  $Q$  (total useful biomass)
  - ↗ resilience to economic & climatic shocks
- 2 Saving of inputs  $Y$ 
  - ↘ production costs (higher incomes)
  - ↘ environmental costs
- 3 Higher prices  $p$ 
  - ↗ quality (tasty/nutritious food)
  - ↗ co-products (wood, fuel, fibre, drugs...tourism)
  - ↗ ecosystem services (local & global)
- 4 Higher labour intensity  $L_a$ :
  - for knowledge-intensive & context-specific work
  - small family farms usually more productive & profitable per hectare (Sen 1964; Wiggins et al. 2010)

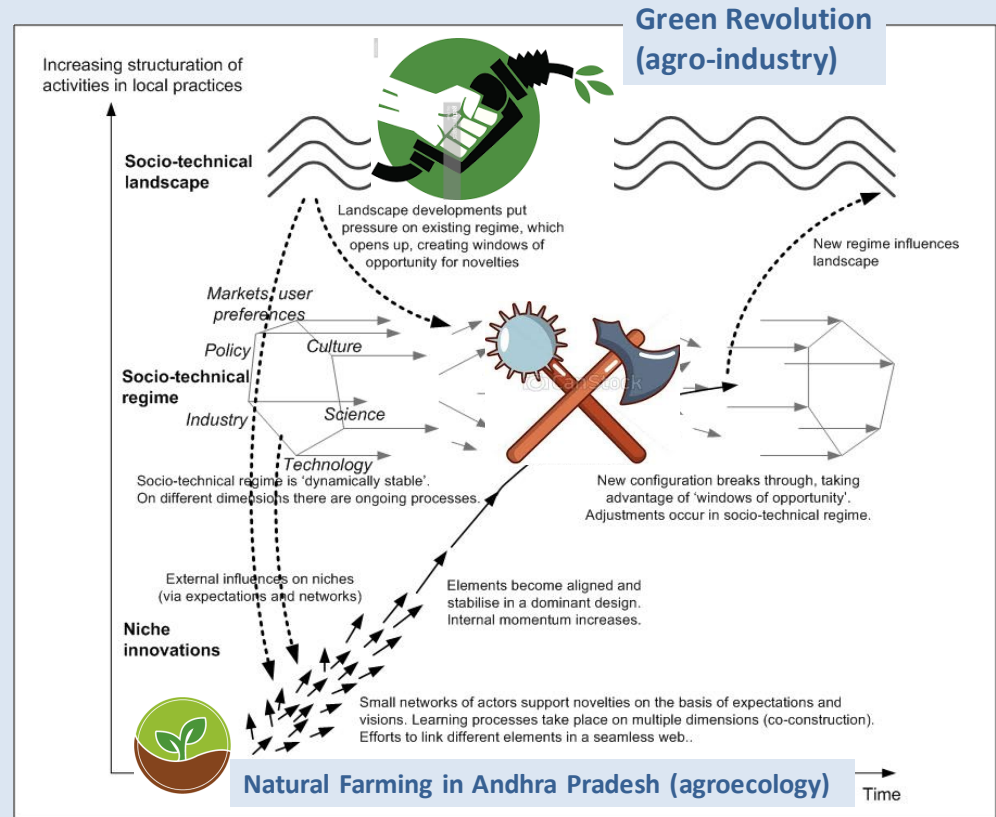
# ■ Changing the sociotechnical regime

A **sociotechnical regime** is a set of aligned rules that are carried by a range of actors (firms, users, government, scientists...) that together form a community for how to produce, use and regulate specific products and processes [Schot et Geels, 2007]

Since the Green Revolution of the 1960s, India has extended the sociotechnical regime of **industrialisation** (born in the 18th century) to agriculture, as in the global North and elsewhere:

- specialization of tasks and specialization in a few products (wheat, rice, corn, sugar cane, cotton, etc.) to benefit from economies of scale (the larger you are, the better), the main driver of profit and labour productivity in any industry
- use of a common technology (genetics + irrigation + chemical fertilizers + pesticides/antibiotics... and fossil fuels for the whole system!) which theoretically guarantees poor countries to converge in the long term with rich countries (savings in R&D expenses and faster development), all then served by robots and fed with medical solutions.

But the industrialization of agriculture is a **trap in land-squeezed countries**



**Agroecology**, such a Andhra-Pradesh Community-managed Natural Farming (APCNF), looks a better sociotechnical regime, but it has to fight against the dominant one to change the mindsets on how to increase land and farm labour productivities...

## ■ Guidelines for a paradigm shift to convert the burden of small-scale farming into a comparative advantage...

Source: Dorin Bruno, 2019. "Rethinking Indian Agriculture: A French Economist's Perspective", [Development Alternatives Newsletter](#), 29:2, pp. 8-9.

- (1) Deep overhaul of agricultural incentives  
towards agroecological practises and markets
- (2) Information, communication, training (farmers, consumers, central government, foreign markets)
- (3) Special incentives for group farming & group actions
- (4) Payments for Environmental Services (from local & global organizations)
- (5) Benchmarks for quantifying future improvements
- (6) Need for new performance measures beyond yield
  - water withdrawal per unit of biomass produced (plant and animal products)
  - fossil energy used per unit of biomass produced (including through chemical fertilizers and other inputs)
  - soil organic carbon (SOC)
  - annual work unit equivalents (AWUs) engaged permanently or temporary on the farm  
(production, processing, marketing)

## 6 Concluding bullet points

- 1 Enlargement of farm size (economy of scale) is the profit driver of industrial agriculture, and it worked well in land-abundant OECD countries (“Lewis Path”)
- 2 In India (and many other countries, especially in Asia), not only has the average farm size not increased, it has declined, due to population growth and less-and-less labour-intensive industries (“jobless growth”)
- 3 Despite world best growth and ranking in agricultural yields (to counter the decrease in farm size), labour income gap of Asian farmers has widened (1960-2020) vis-à-vis OECD farmers but also nonfarm Asian workers
- 4 The Indian agrarian crisis won't be solved with industrial agriculture, or at very high socioeconomic/health/environmental/public costs
- 5 Small-scale agro-ecological farms (such as Natural Farming in AP) could be an alternative to mega-slum-urbanization, and could give India a comparative advantage in the long run



# The path to follow, to encourage, to learn from...

## Natural farming in Andhra Pradesh

A niche with a guru (Maharashtra)

Zero Budget Natural Farming (ZBNF) with Subhash Palekar



A national/state crisis: agrarian distress, farmer suicides...



A grassroots aspiration: "Knowledge + Technology + Community in harmony with Nature"

An experimented & charismatic bureaucrat: T. Vijay Kumar, IAS

Who is T. Vijay Kumar, and what is he doing to promote natural farming in Andhra Pradesh?

A State enterprise: RySS (2014)



[www.thehindu.com](http://www.thehindu.com) (14/07/2018)

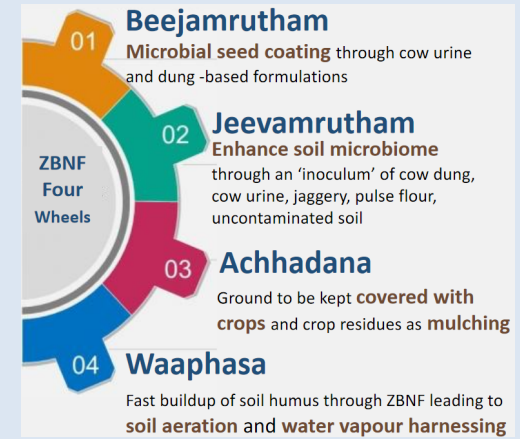
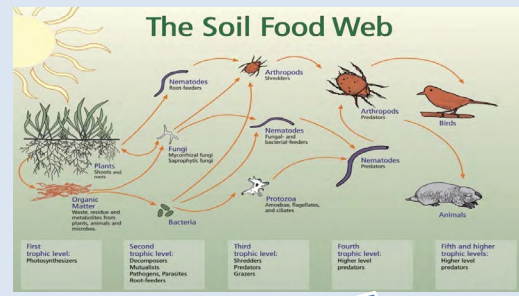
A core Technology:  
Regenerative agriculture

Zero chemical fertilizer  
Zero pesticide BUT:

Some money:



+ Schemes of the Govt of India (RKVY & PKVY)



<http://apzbnf.in>

Institutional innovations:

