Agricultural Transformation and Rural Development

EC 390 - Development Economics

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2025

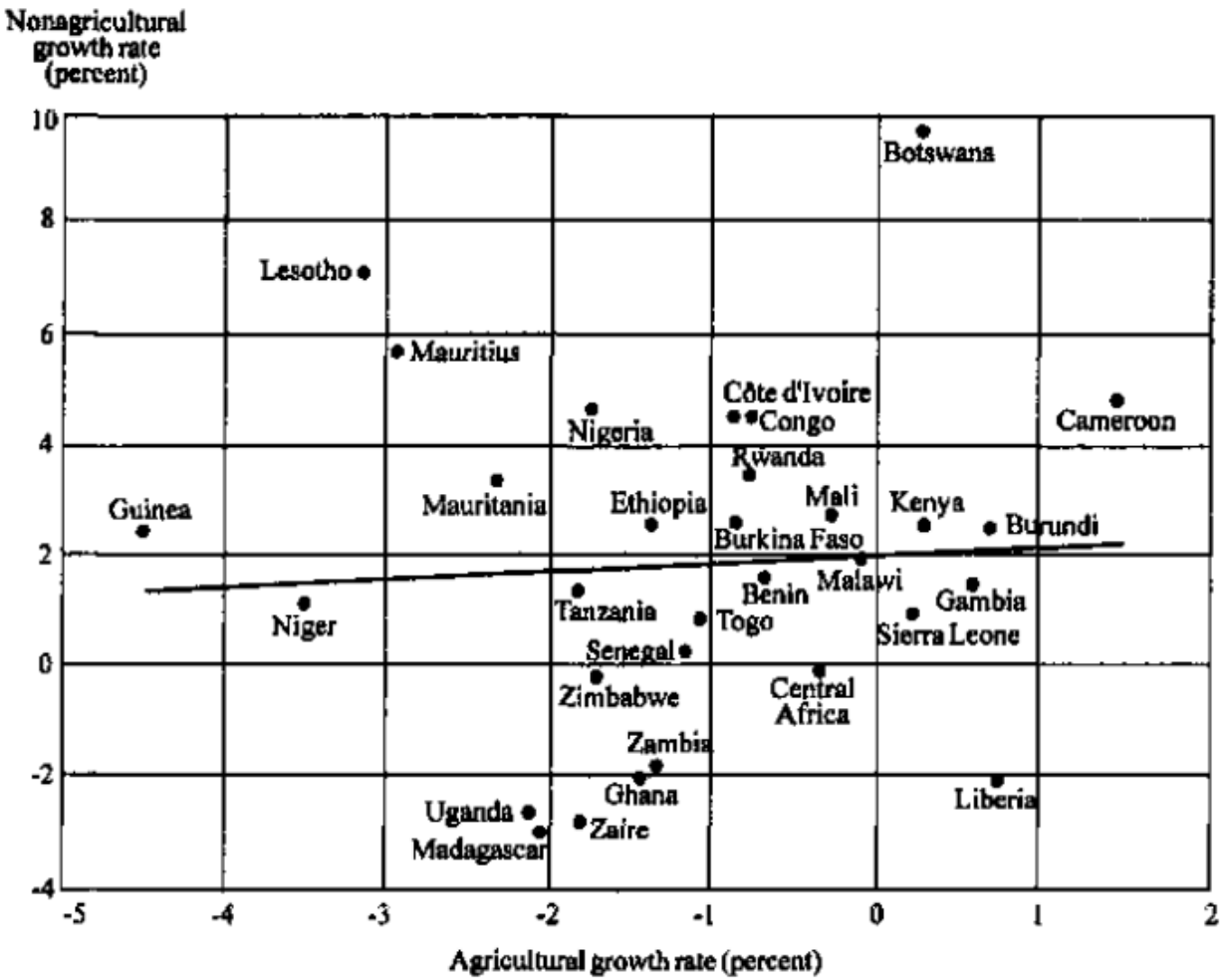
Motivation

As of 2018, over **3 Billion people** live in rural areas in developing countries and about 25% of them in **extreme poverty**

Why do we discuss agriculture so much?

- Many people in developing nations **work in agriculture**
- We would like to address **subsistence economies**
- There is a “somewhat” positive relationship between growth in agriculture and growth in GDP

Africa

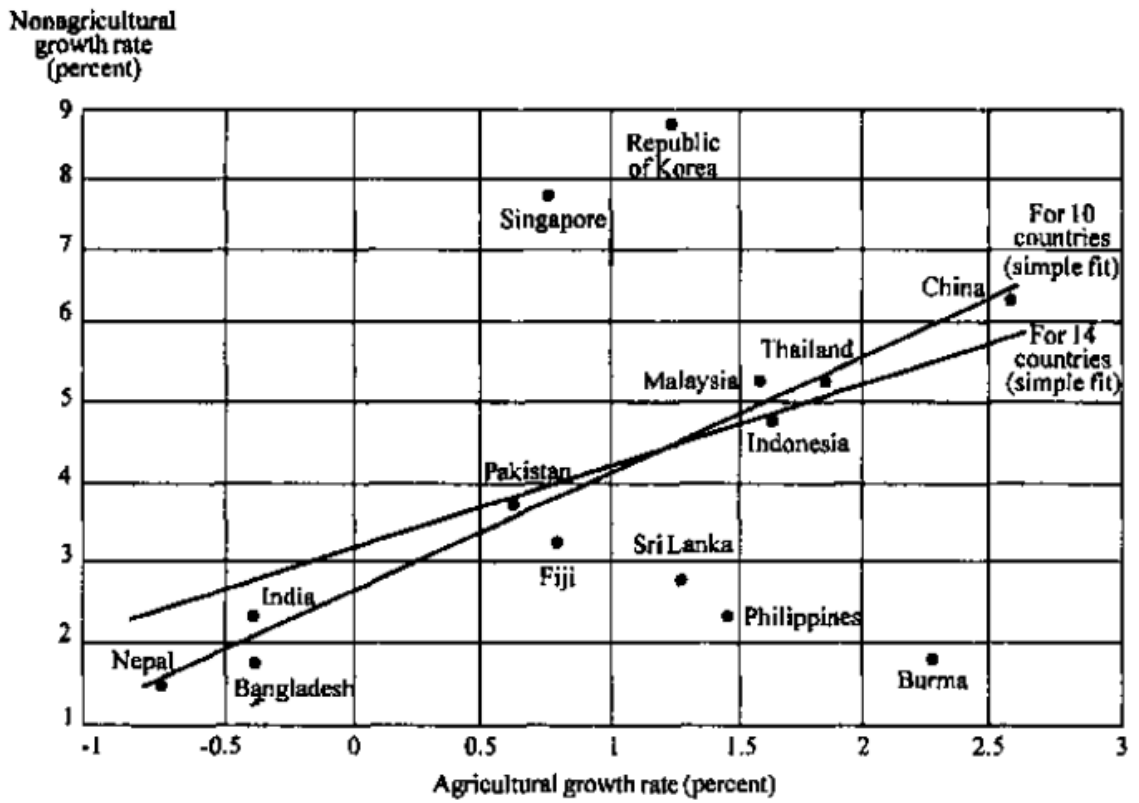


Source: World Bank (1989).

Note: Descriptive variables for simple fit: R-square 0.0029; value of coefficient of agricultural growth rate, 0.025; *t*-statistic of agricultural growth rate, 0.29; standard error of agricultural growth rate, 0.085. Constant 1980 GDP at market prices in local currency.

Asia

FIGURE 1.1 Growth rates of per capita agricultural and nonagricultural GDP, various Asian countries, 1960–1986

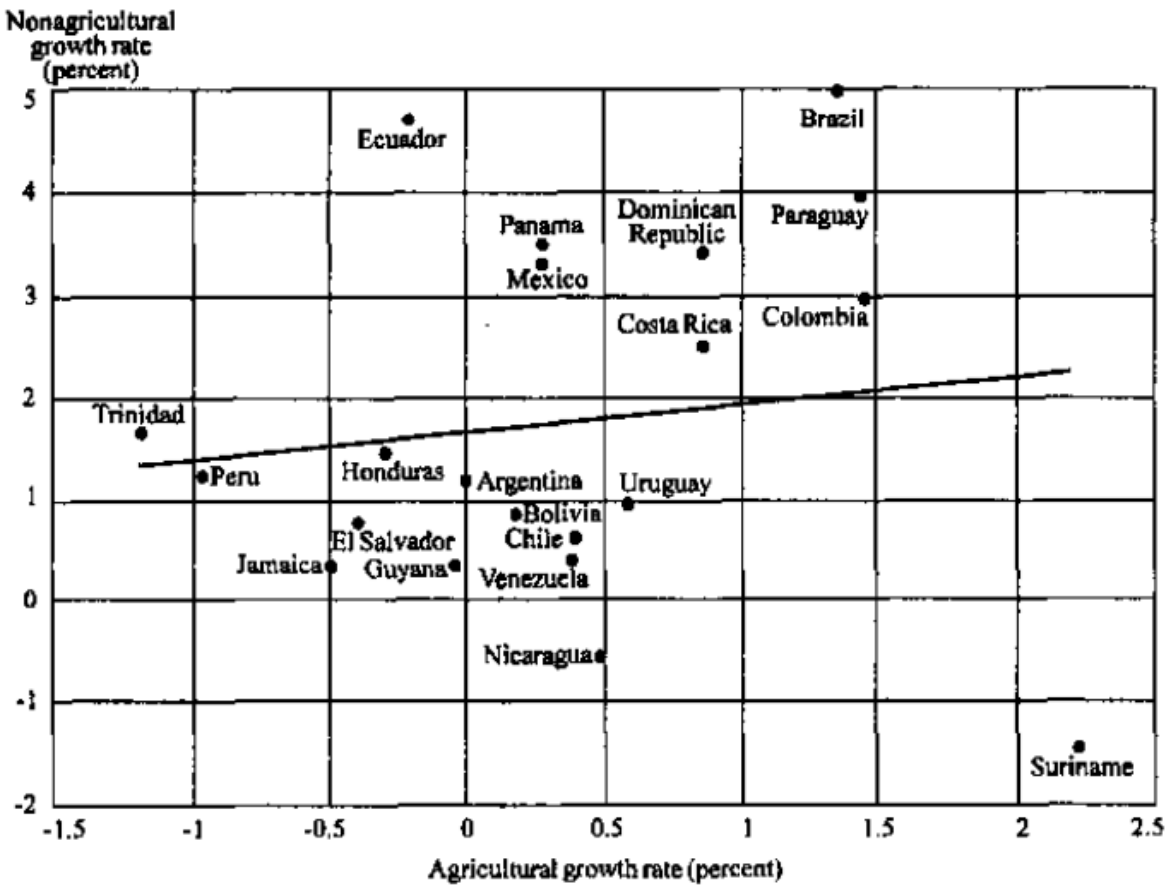


Source: World Bank (1989).

Note: Descriptive variables for simple fit of 10 countries (excluding Burma, Philippines, Republic of Korea, and Singapore): R-square, 0.91; value of coefficient of agricultural growth rate, 1.43; *t*-statistic of agricultural growth rate, 9.33; and standard error of agricultural growth rate, 0.15. Descriptive variables for simple fit of 14 countries: R-square, 0.23; value of coefficient of agricultural growth rate, 1.07; *t*-statistic of agricultural growth rate, 1.92; and standard error of agricultural growth rate, 0.56. Constant 1980 GDP at market prices in local currency.

Latin America

FIGURE 1.3 Growth rates of per capita agricultural and nonagricultural GDP, various Latin American countries, 1960–1986



Source: World Bank (1989).

Note: Descriptive variables for simple fit: R-square 0.0170; value of coefficient of agricultural growth rate, 0.2714; *t*-statistic of agricultural growth rate, 0.57; standard error of agricultural growth rate, 0.47. Constant 1980 GDP at market prices in local currency.

Motivation

Percent of people living in rural communities across the world:

- Sub-Saharan Africa → 64%
- South Asia → 69%
- India → > 67%
- Ethiopia, Nepal, Nepal, Niger, Papua New Guinea, Rwanda, South Sudan, Sri Lanka, Uganda → >80%

Over **2/3 of the world's poor** live in rural areas

- Where Income = Subsistence Agriculture

Agriculture

Farming Across the World

We can juxtapose farmers in the developing world to farmers in the US, to better understand the scale of the difference

Farmers in Developing Countries

- Very small farms → Less than 10 acres (on average)
- Less farming technology
- Need to adapt to hotter and more humid climates
- Farmers supply food for themselves

Farmers in the US

- Farms are large → 441 acres (on average)
- Farming technology is highly advanced
- Technology is well-aligned with local climates
- Farmers supply food for many people → 144 people per farmer (on average)

Farming Across the World

Farming in Sri Lanka

Farming in the US

Malthusian Trap

Malthus (1789) argued that population growth would lead to mass shortages of food

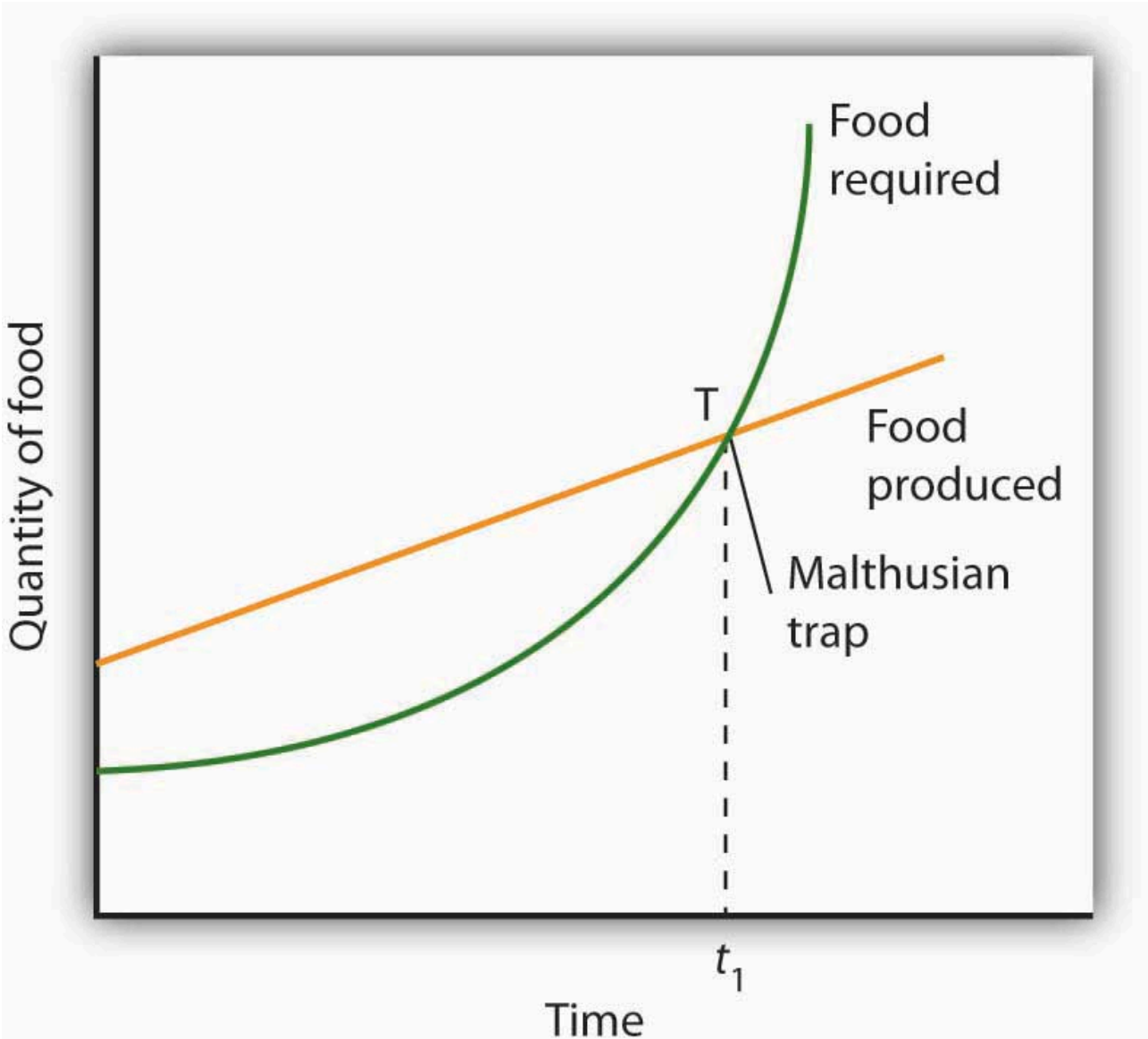
- This is thought to describe how **population growth tends to outpace the growth of resources**
- This was called the “Malthusian Trap” or Malthusian Theory of Population

Malthusian Trap

Assumptions used for this argument:

- Population grows exponentially **(1, 4, 9, 16,...)**
- **Diminishing returns** to land, labor, capital, etc. means that **resources** grow linearly **(1,2,3,4,...)**
- There exists a limit to the amount of food that can be produced
- So there is a **carrying capacity** due to the food supply limit

Malthusian Trap



Malthusian Trap

The assumptions are relatively true, but still we don't see any **Malthusian Trap**

Why is this?

Technological advancement

Green Revolution

Green Revolution ← I made it green

Boost in grain production associated with the **scientific discovery of new hybrid-seed varieties** of wheat, rice, and corn that resulted in high yields in many developing countries

Key Elements

- **High-yield crop varieties**
- **Chemical fertilizers and pesticides**
- **Irrigation expansion**
- **Modern farming techniques**

New Seeds

- Resistance to drought and pests
- Give higher yields

Table 9.1 Average Annual Growth Rates of Agriculture, by Region (%)

Source: IFPRI (International Food Policy Research Institute). 2013. Global Food Policy Report, Table 1. Washington, DC.

	1971–1980	1981–1990	1991–2000	2001–2010	1971–2010
High-income countries	1.83	0.97	1.25	0.47	1.14
Developing countries					
Latin America and Caribbean	2.93	2.35	3.09	3.21	2.89
Northeast Asia	3.23	5.04	5.04	3.39	4.19
South Asia	2.19	3.70	2.76	2.80	2.86
Southeast Asia	3.66	3.32	3.41	4.23	3.64
Sub-Saharan Africa	1.05	2.68	3.11	2.97	2.44
West Asia and North Africa	3.31	3.84	2.61	2.75	3.13
Transition countries	0.81	1.42	−4.03	2.28	0.04
World	2.08	2.42	2.09	2.42	2.25

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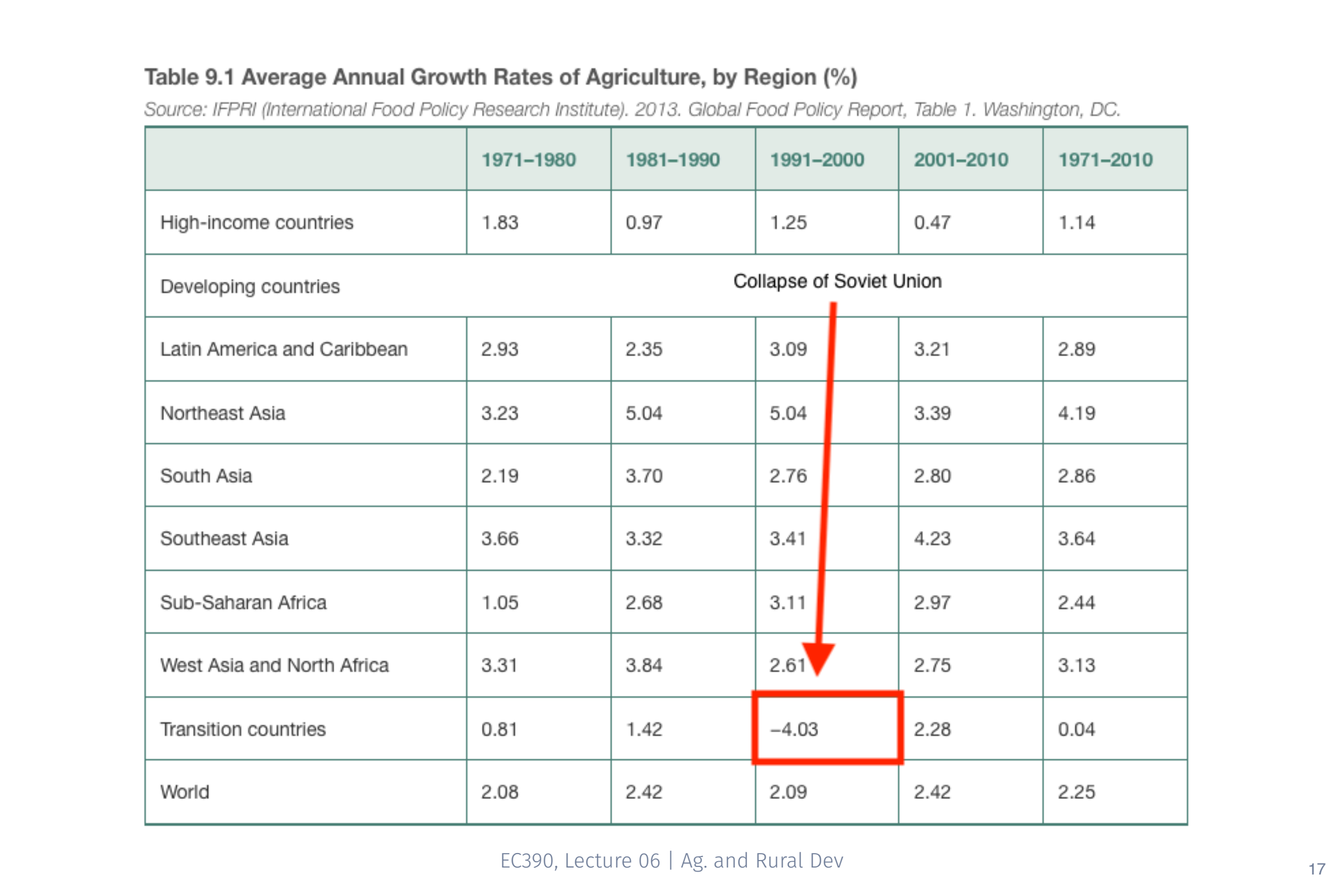
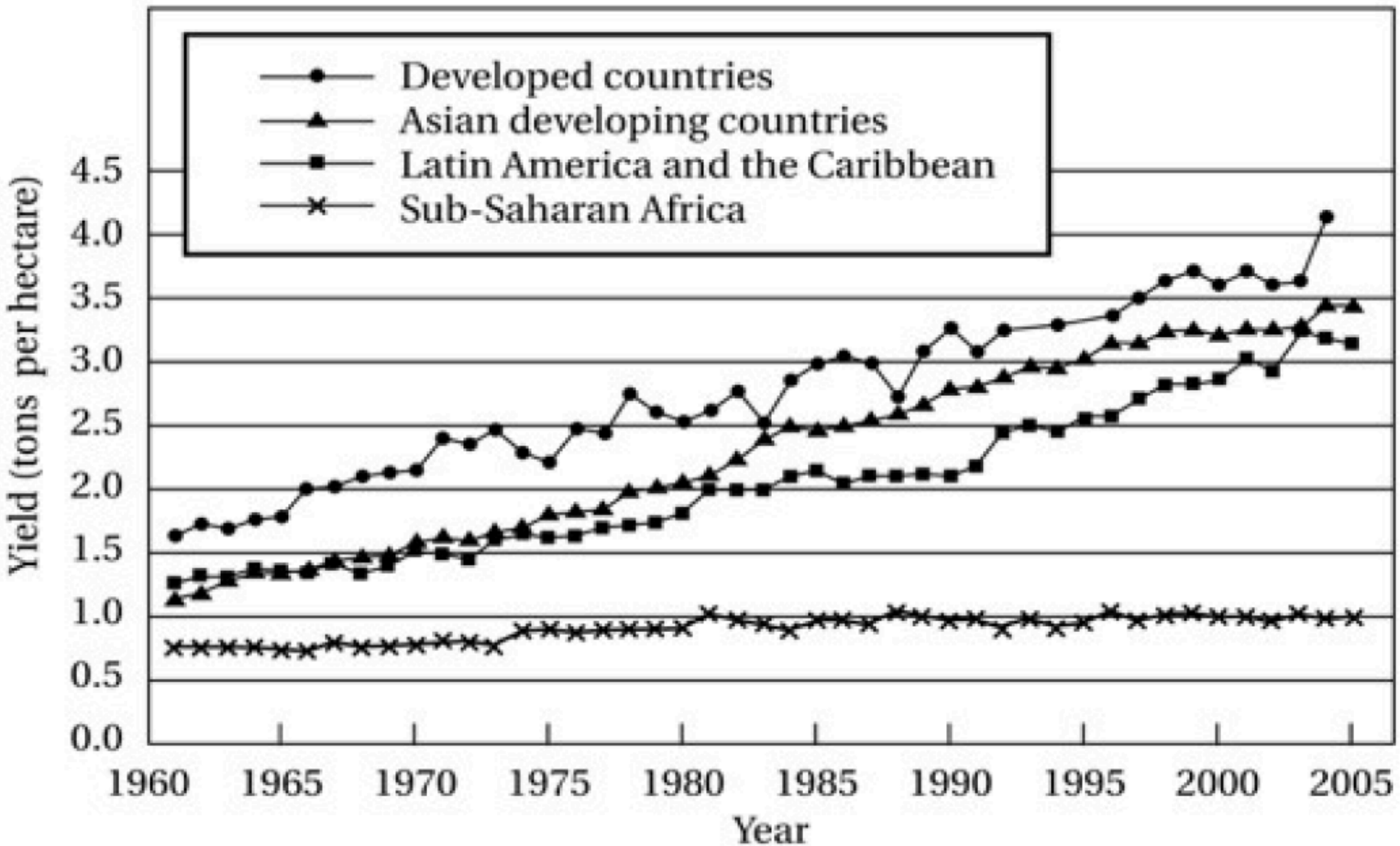




Source: International Bank for Reconstruction and Development/The World Bank, *World Development Report, 2008*. Reprinted with permission.

Agrarian Systems in Developing Countries

There are **different agricultural practices** in developing economies

We can think of three separate stages

1. **Agriculture-based countries**
2. **Transforming countries**
3. **Urbanized countries**

1. Agriculture-Based Countries

- About 417 Million people live here

- More than 66% of the poor in these countries live in **rural areas**
- Agriculture accounts for 32% of GDP growth (on average)
- Rely heavily on **traditional agricultural practices**
  - **"Slash-and-Burn" → No Bueno**

Slash-and-Burn

Rotating plots of land

Here is the process:

- Remove trees and vegetation
- Burn the area (increases nutrients in the soil)
- Plant crops directly into nutrient-rich ash
- Cultivate until plot becomes **infertile**
- Abandoment and fallow

Very old agricultural process and it is not very efficient if you are not moving around the world

- Also leads to **deforestation and erosion**

2. Transforming Countries

- Largest concentration of people living in a rural setting (2.2 Billion)

As the name implies, its a transition toward urbanization

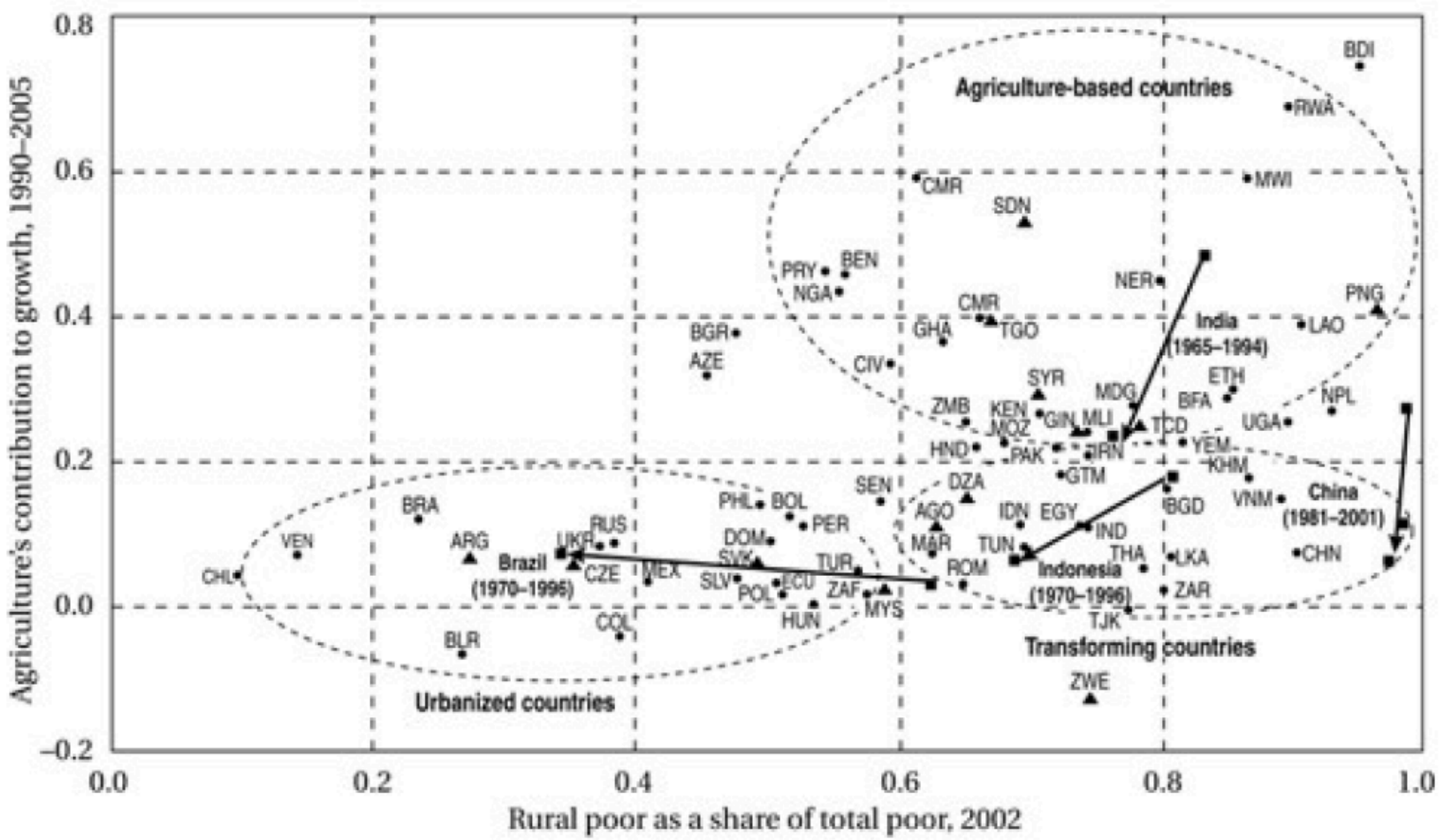
- Rural poverty is high, but agriculture contributes about 7% to GDP growth
- **Labor** begins to move out of agriculture and into other sectors **(manufacturing, services, and construction)**
- **Urbanization** accelerates as people migrate to cities for jobs
- Potential for **income growth**
  - Increased probability of **income inequality**

3. Urbanized Countries

- Half or more than the country's poor live in cities

- Very few working people are in the agricultural sector
- Agriculture contributes even less to GDP growth
- Typically will find an industrial agricultural sector (US)
- Typically countries with large urban centers
- **Technological innovation and human capital drive growth**

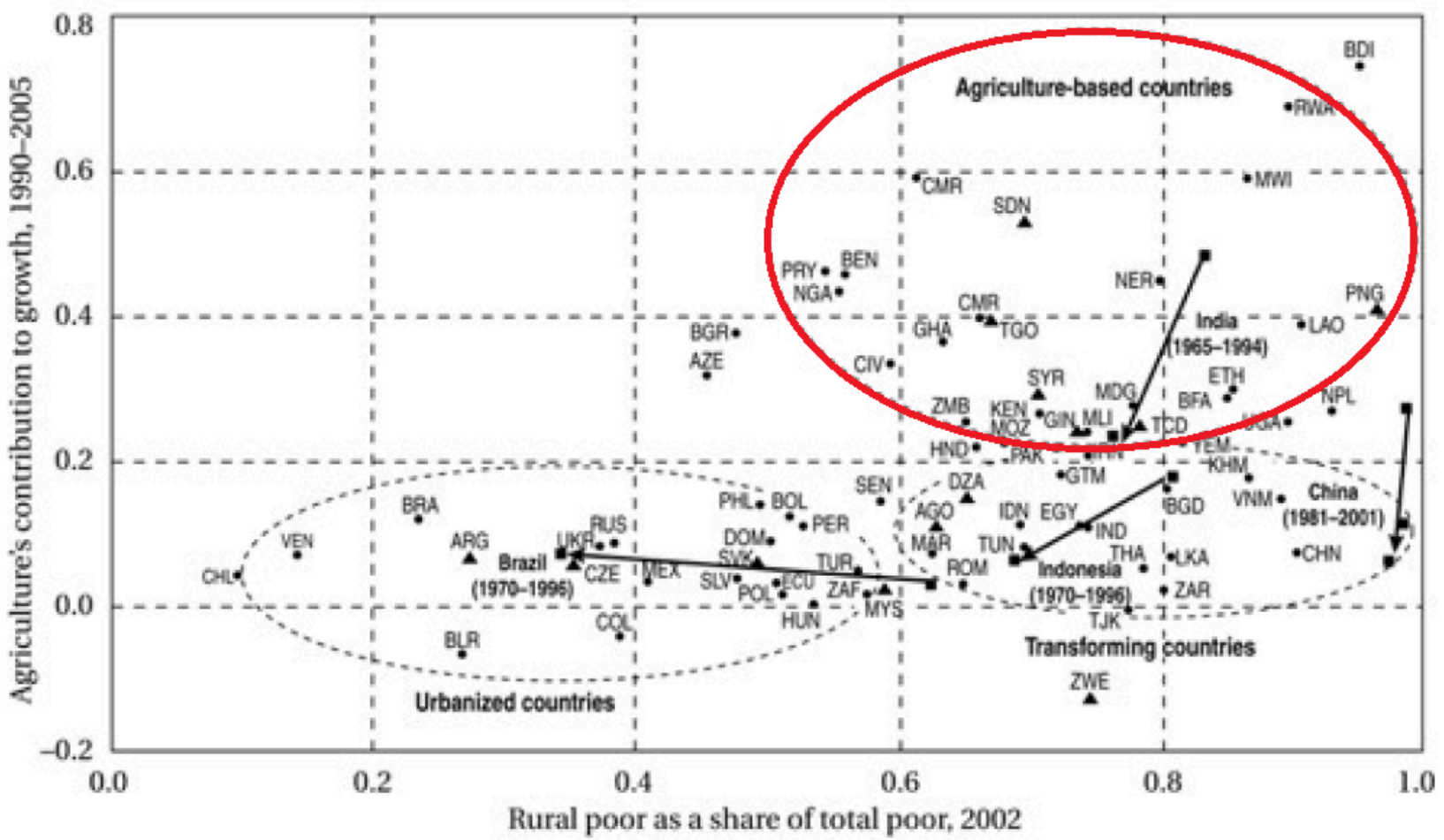
Three Systems of Agriculture



Source: International Bank for Reconstruction and Development/The World Bank, *World Development Report, 2008*. Reprinted with permission.

Note: Arrows show paths for Brazil, China, India, and Indonesia in previous periods. A triangle denotes predicted poverty data used. Country letter codes are found in Table 2.1 on pp. 40–41.

Three Systems of Agriculture



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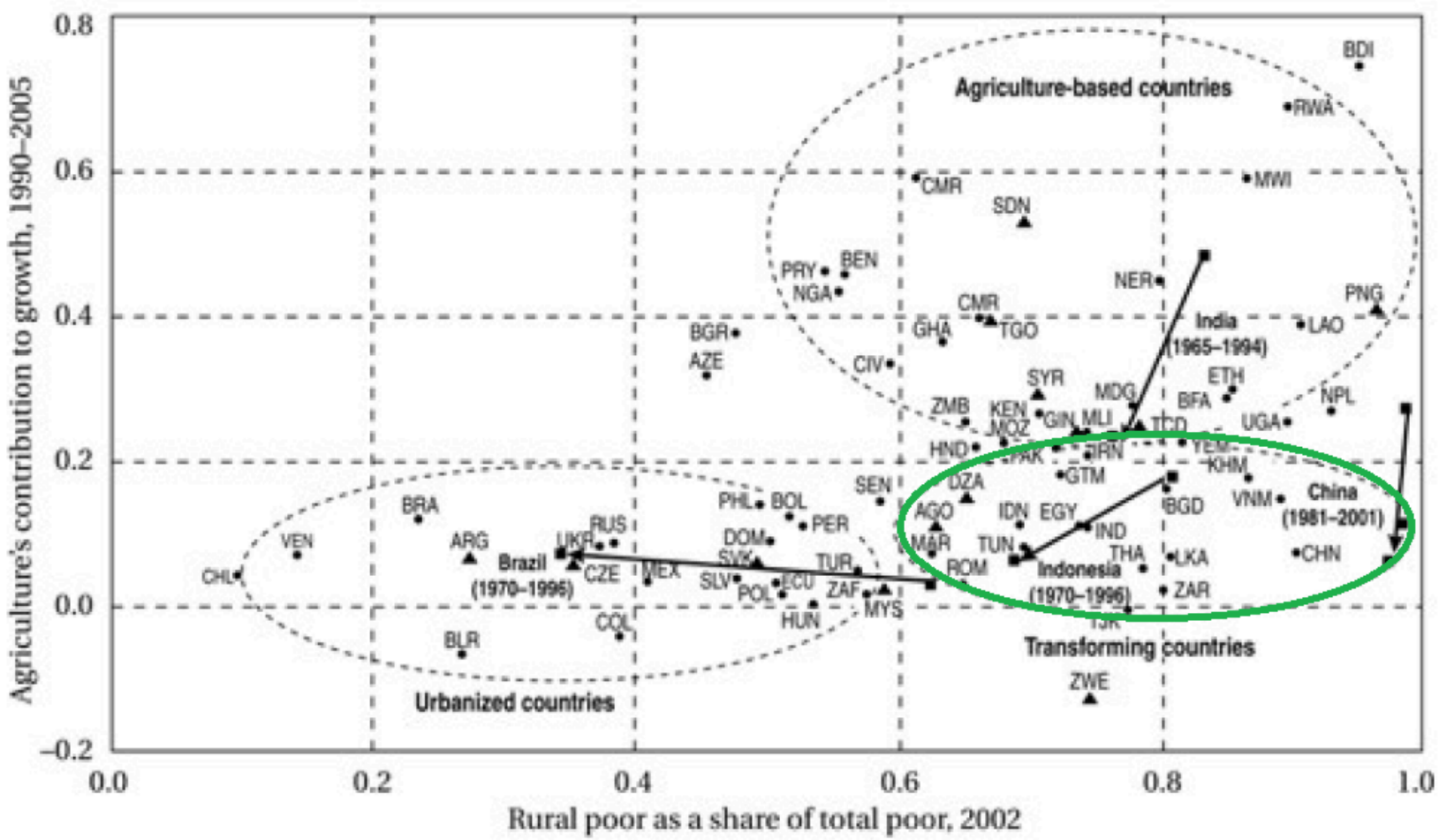

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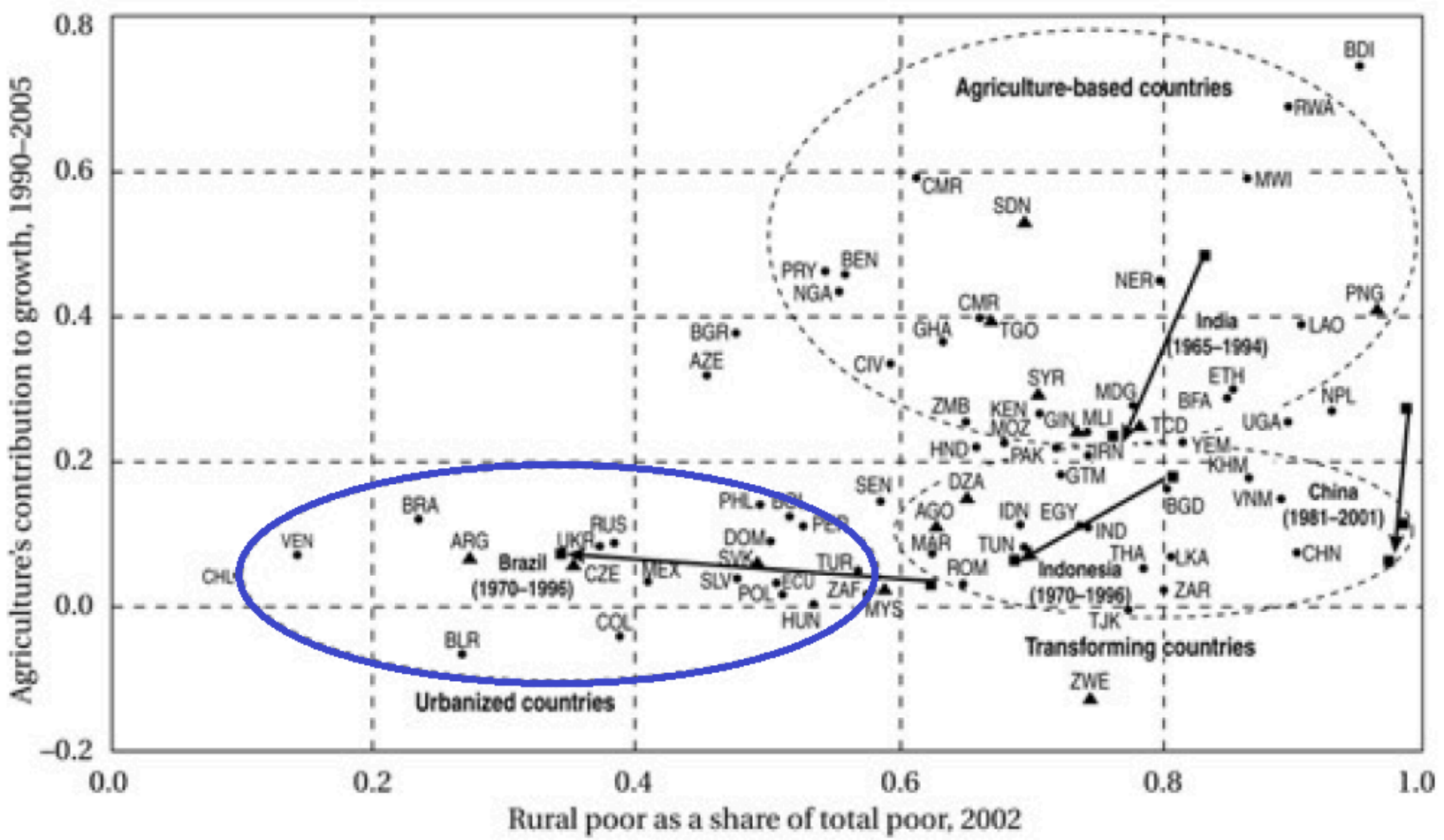

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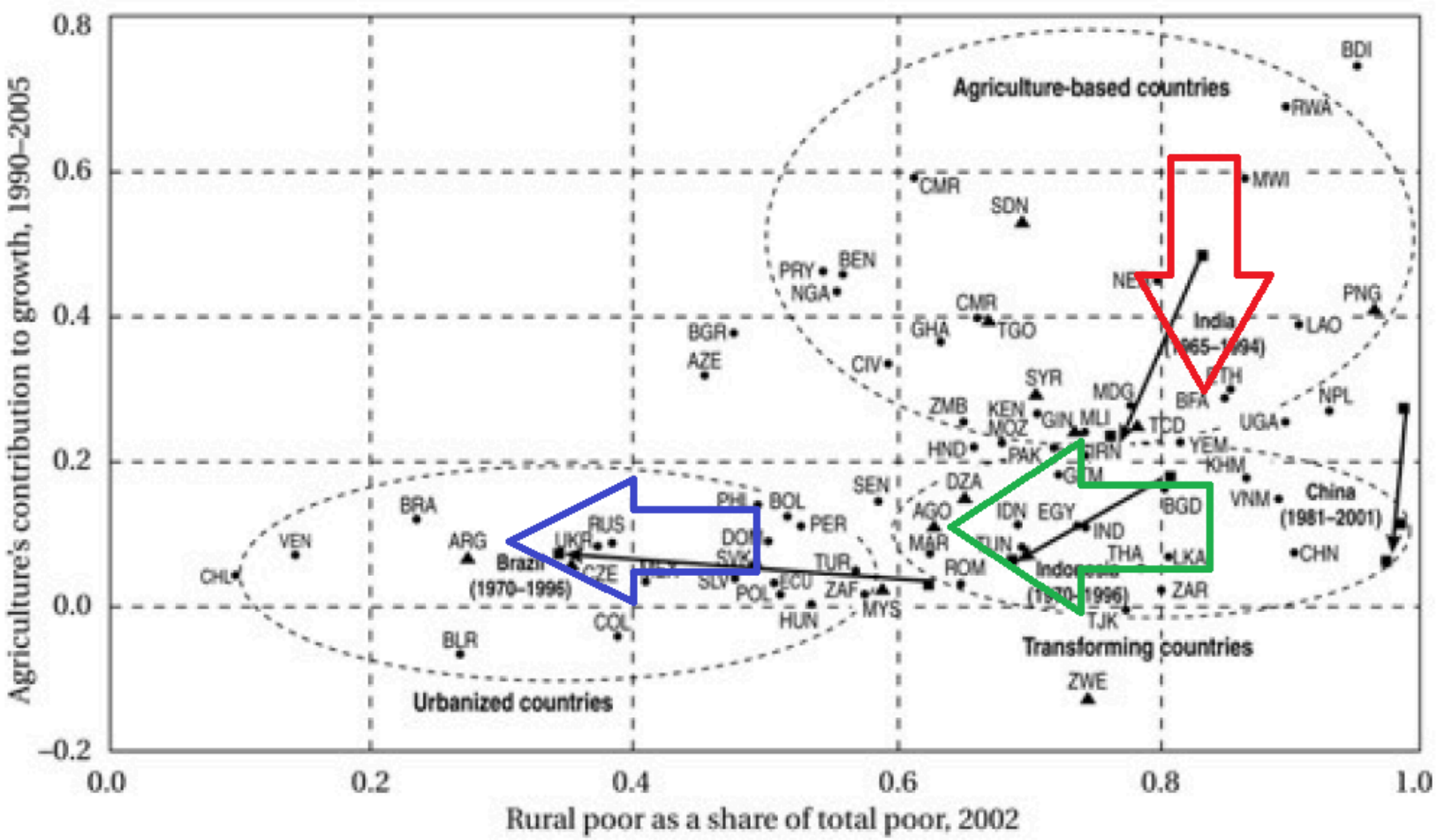

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Problems in Agricultural Development

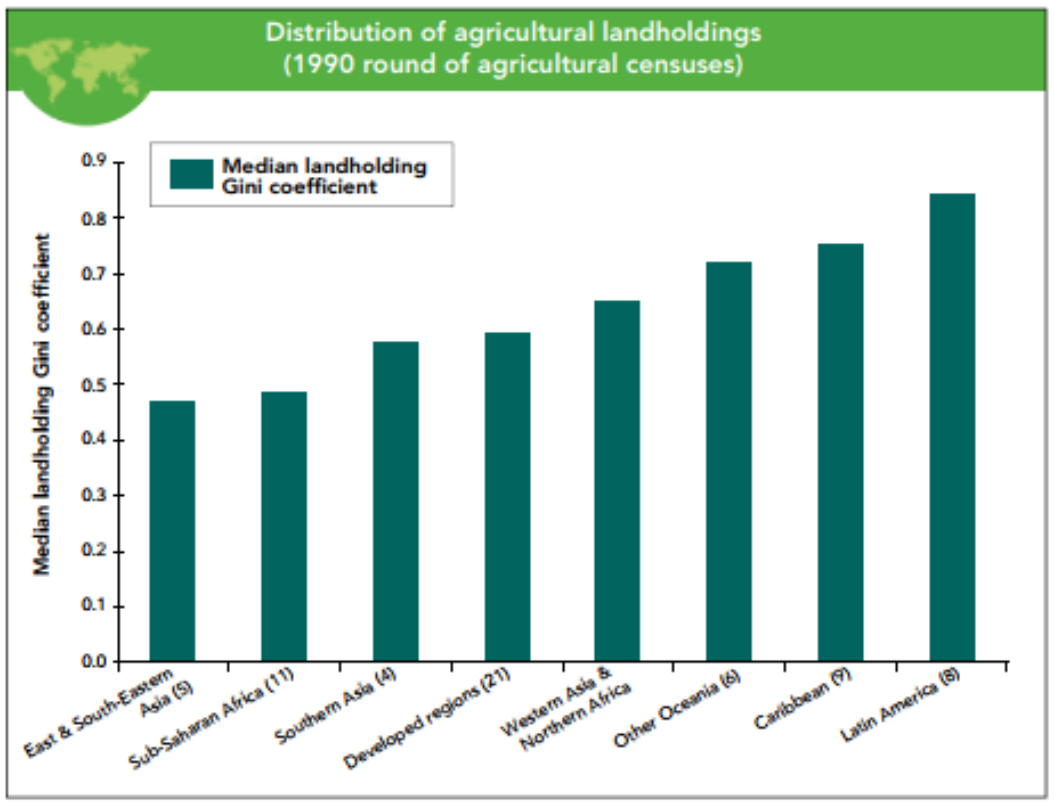
As with everything, there are issues of inequality

- Here we are talking about **inequality in land holdings** (specially in LATAM)

- **Huge** farms employ many people
  - However, **land owners** care more about **maintaining market power** than increasing output
- Medium sized farmers are rare
  - Farms these size potentially have a better mix of capital and labor, are more productive, have lower transaction costs than larger farms
- Some very small farms
  - These are household farms
  - Because they are small, there are **no economies of scale**

Land GINI

Access to and distribution of agricultural land



Source: FAO online agricultural census data.

Note: The numbers in parentheses indicate the number of countries from which medians were obtained. FAO defines an agricultural holding as an economic unit of agricultural production under single management comprising all livestock kept and all land used wholly or partly for agricultural production purposes, without regard to title, legal form, or size.

Problems in Agricultural Development

Subdivision of land in Asia

- Pre-colonial Asian cultures prefer cooperation, **sharing resources** within villages
- **Colonial institutions** assigned property rights to land
- Most **landlords live elsewhere**, and rely on **sharecroppers** to produce agricultural goods
  - **Sharecroppers:** Renter farmers, which kickback a percentage of the crops in exchange for lease of the land
- **Land is scarce**, so rents are high
- At the same time, **labor is abundance**, so wages are low

Problems in Agricultural Development

Subsistence farming in Africa

- Most farming takes place on small plots to produce for one family
- Three main reasons for this persistence:
  - Most farming is done by individuals using **traditional tools**
  - Farming usually involves shifting cultivation once land nutrients have been used
  - Leads to inefficencies since individuals must wait for nutrients to replenish
- This causes large swings in employment
  - **During farming times**, labor is scarce
  - **During non-farming times**, labor is in excess
- It is hard to sustain populations with the amount of food grown in these economies

Microeconomics of Farming

Microeconomics of Farming

Classical Theory has **two factor models of production** where **capital is fixed**, but **labor is variable**

- Households can adjust how much they work on their farm, but not what tools they use
- Gives rationale for **low productivity**
- **Does not** explain why small farm owners are resistant to technological innovation
- Theory says they will choose the method of production that gives the **lowest cost**
- Also implies **perfect knowledge** of types of technology, needed inputs, the weather, etc.

Microeconomics of Farming

The problem is that classical theory of agricultural production does not consider farmer's uncertainty

Which would you prefer?

10 dollars with certainty	**50% chance of getting 30 dollars and 50% chance of paying 10 dollars**

- Both have the same **expected payoff**
- But the **first** has more **consistent outcomes**
- People tend to be **risk-averse**
  - Do not like uncertaincty/variance in their outcomes

Microeconomics of Farming

Take the following **farming techniques**

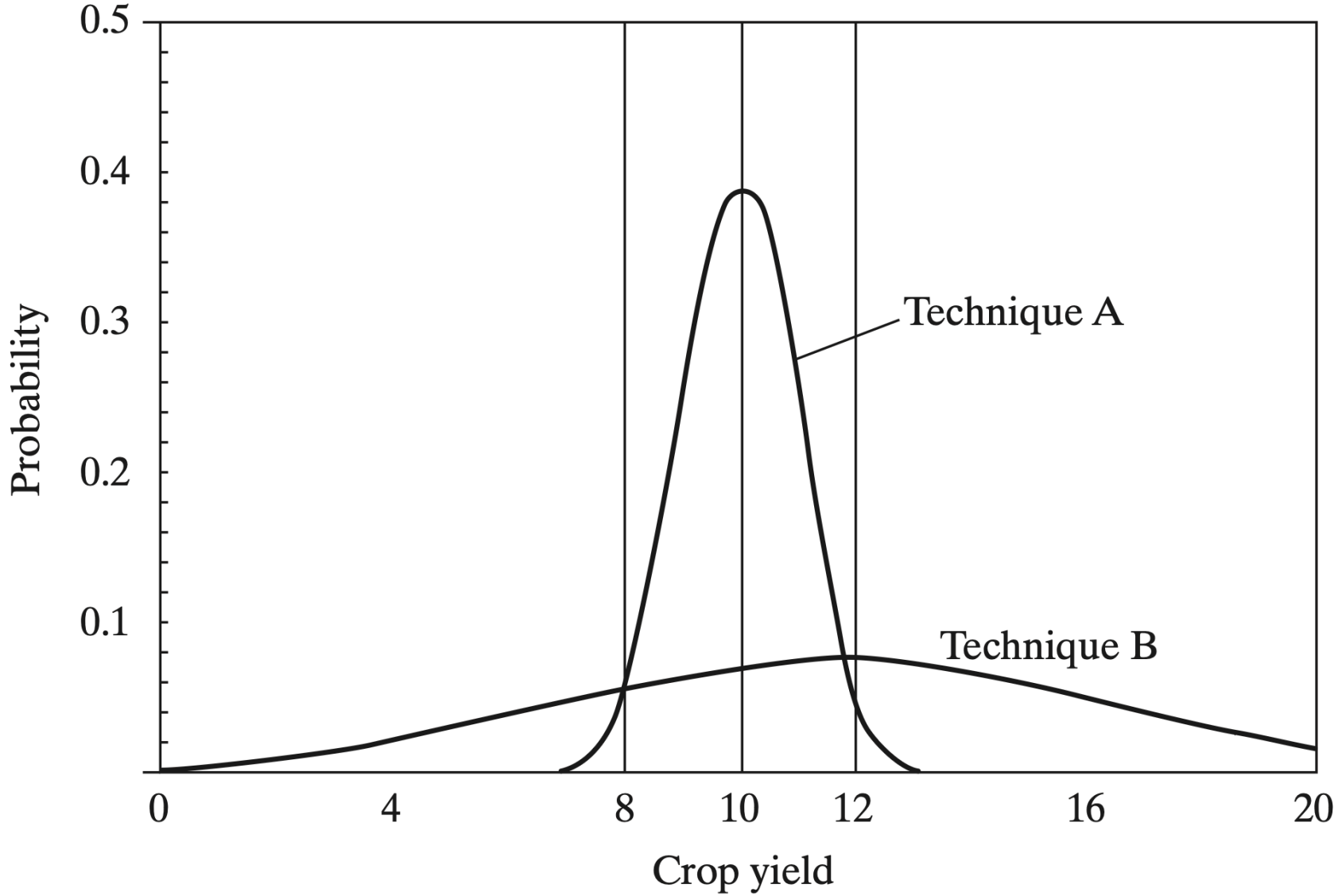
Technique A

- Offers a **lower average yield**
- Low variance

Technique B

- Offers a **higher average yield**
- Higher variance

Suppose you need a consistent food supply, which technique will leave you starving more often?



Risk-averse farmers will tend to choose the safe option rather than gamble on a new method

Microeconomics of Farming

But we are leaving potential higher yields on the table

- **Crop insurance** helps with this problem
  - This can be an **actual insurance policy**
- This would mean that **farmers get paid** when they have **low yield**
- Alternatively, diversification of crops can work as insurance
  - Farmers would still have some y ield even if one crop does not work out
- The goal is to **allow farmers to take risks**

Microeconomics of Farming

Let's do math

- Consider my crop yield is X and my neighbor's is Y
- If I rely on my own crops, I get $E[X]$ on average with a variance of $Var(X)$
- If my neighbor and I **share our yields** we each get:

$$\frac{E[X] + E[Y]}{2}$$

on average with a variance of

$$Var\left(\frac{X+Y}{2}\right) = 0.25 * Var(X) + 0.25 * Var(Y) + 0.5 * Cov(X,Y)$$

We can get this from: $Var(aX + bY) = a^2 Var(X) + b^2 Var(Y) + 2abCov(X,Y)$

Covariance

$$Var\left(\frac{X+Y}{2}\right) = 0.25 * Var(X) + 0.25 * Var(Y) + 0.5 * Cov(X,Y)$$

Covariance in our Farming Example

$$Var\left(\frac{X+Y}{2}\right) = 0.25 * Var(X) + 0.25 * Var(Y) + 0.5 * Cov(X,Y)$$

Imagine you and your neighbor are growing crops

- You share a common goal: to produce a high amount of consistent food
- What should you and your neighbor do to accomplish this?

- Grow crops that have a **negative covariance**
- This would be a form of insurance (informal insurance)

Consumption Smoothing

Definition: Maintaining a consistent level of consumption over time

- Why might the goal be to maintain a consistent level of consumption?
  - We prefer to maintain a stable standard of living over time
- How do we consumption smooth?
  - Savings accounts, social security, **insurance**, etc.

- If a farmer has a really bad year, insurance kicks in and helps maintain consumption levels
- But in many developing countries, saving is difficult and there is no formal insurance
- What can individuals do?

Sharecropping

Sharecropping

Definition: A form of agriculture in which a landowner allows a tenant to use the land in return for a share of the crops produced on their portion of land

- Popular form of agriculture in many parts of the world
- **Risk-aversion** helps explain why we observe it so frequently, even though it is inefficient
- To understand why, we need to think about the **incentives of the farmer and landlord**

Sharecropping

Let's recall some microecon terms

1. **Maringal Product of Labor (MPL)**
2. **Value of Marginal Product of Labor (VMPL)**
3. **Opportunity Cost**

Sharecropping

Let's recall some microecon terms

1. **Maringal Product of Labor (MPL)**

- The **change in output resulting from one more unit of labor**
- Example: The change in rice yield resulting from working one more hour on your farm

2. **Value of Marginal Product of Labor (VMPL)**
3. **Opportunity Cost**

Sharecropping

Let's recall some microecon terms

1. Maringal Product of Labor (MPL)
2. **Value of Marginal Product of Labor (VMPL)**

- **How much the output from an additional unit of labor is worth**
- Wage is one way to think about **VMPL**

3. Opportunity Cost

Sharecropping

Let's recall some microecon terms

1. Maringal Product of Labor (MPL)
2. Value of Marginal Product of Labor (VMPL)
3. **Opportunity Cost**

- The **value of the next best alternative**
- The opportunity cost of being in college is (in part) the wage you could be earning if you were working

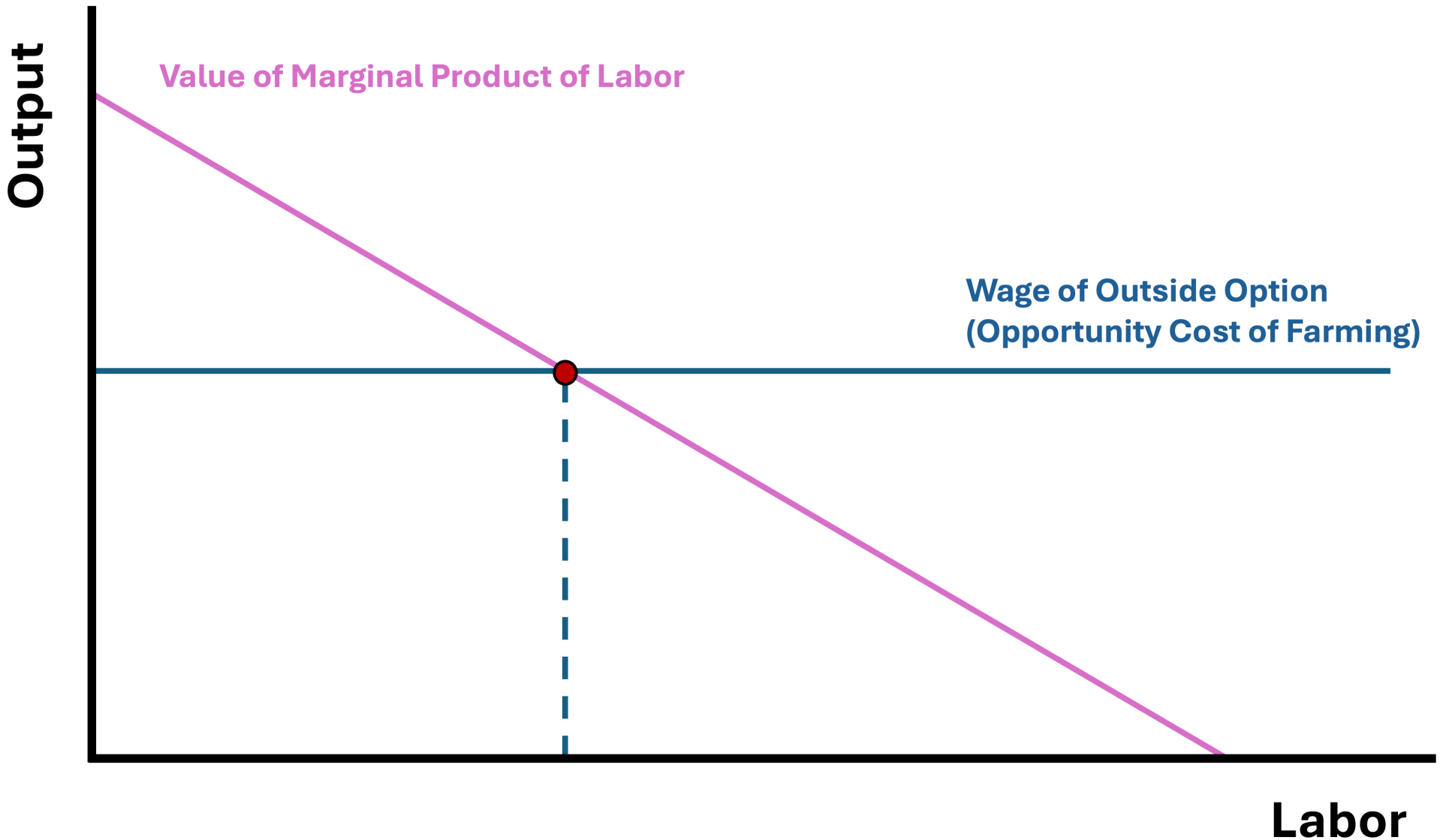
Optimal Labor

If a farmer is working on their own plot of land, they will decide the optimal amount of hours to work

But how?

- By finding where **marginal product of labor** equals the **value of the next best alternative** **Why?**
  - If $VPML <$ Opportunity Cost, then the farmer should **stop working and do something else**
  - If $VPML >$ Opportunity Cost, then the farmer should **work more and dedicate themselves to this work**
- Because of this, there is **clearly one optimal labor amount**

Optimal Labor

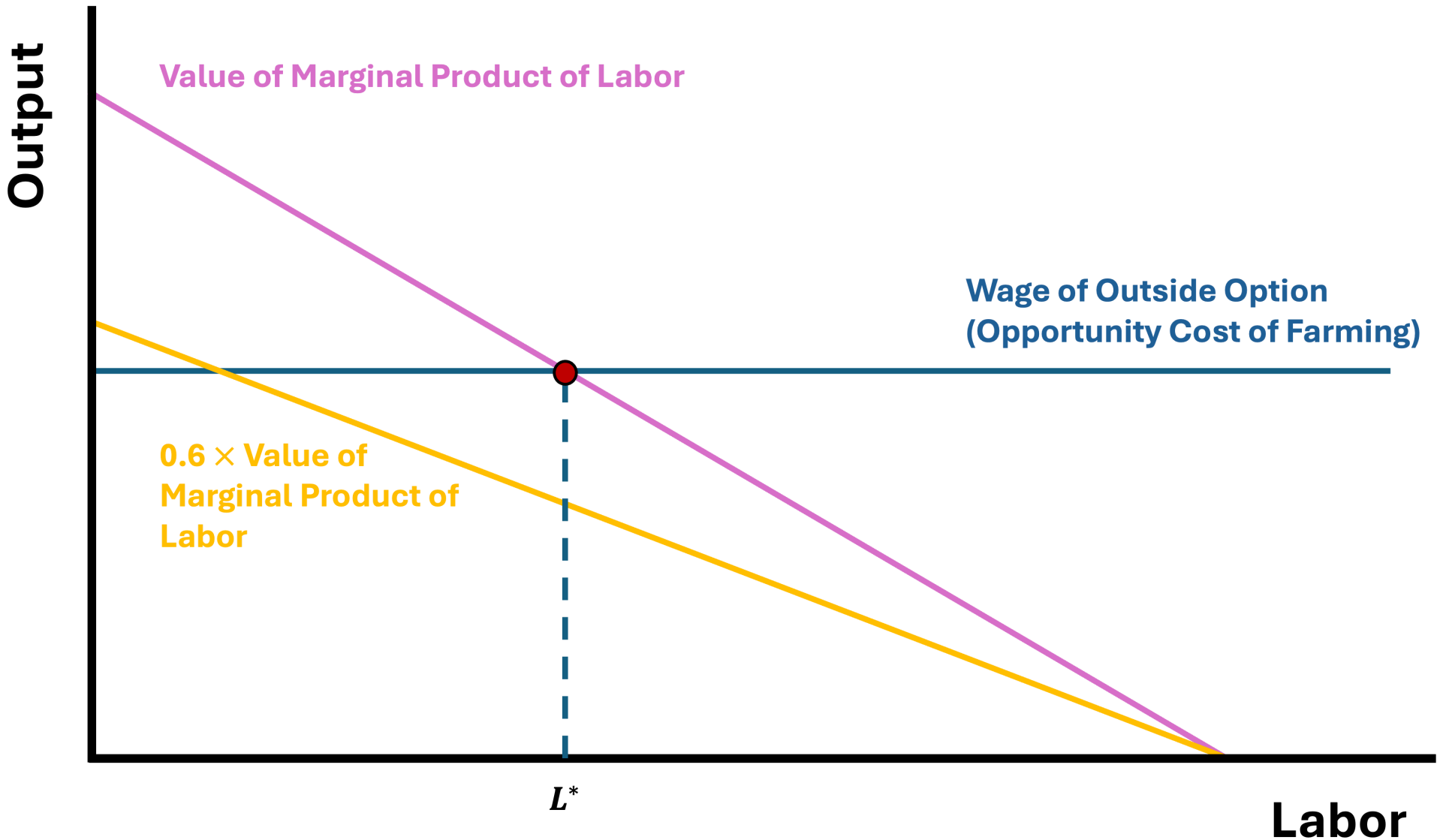


Sharecropping Impact

Suppose the farmer **does not own the farm**

- Further suppose that the **farmer only gets to keep 60% of the VMPL**
- They give up **40% of their yield** to the farm owner as a form of payment

Optimal Labor



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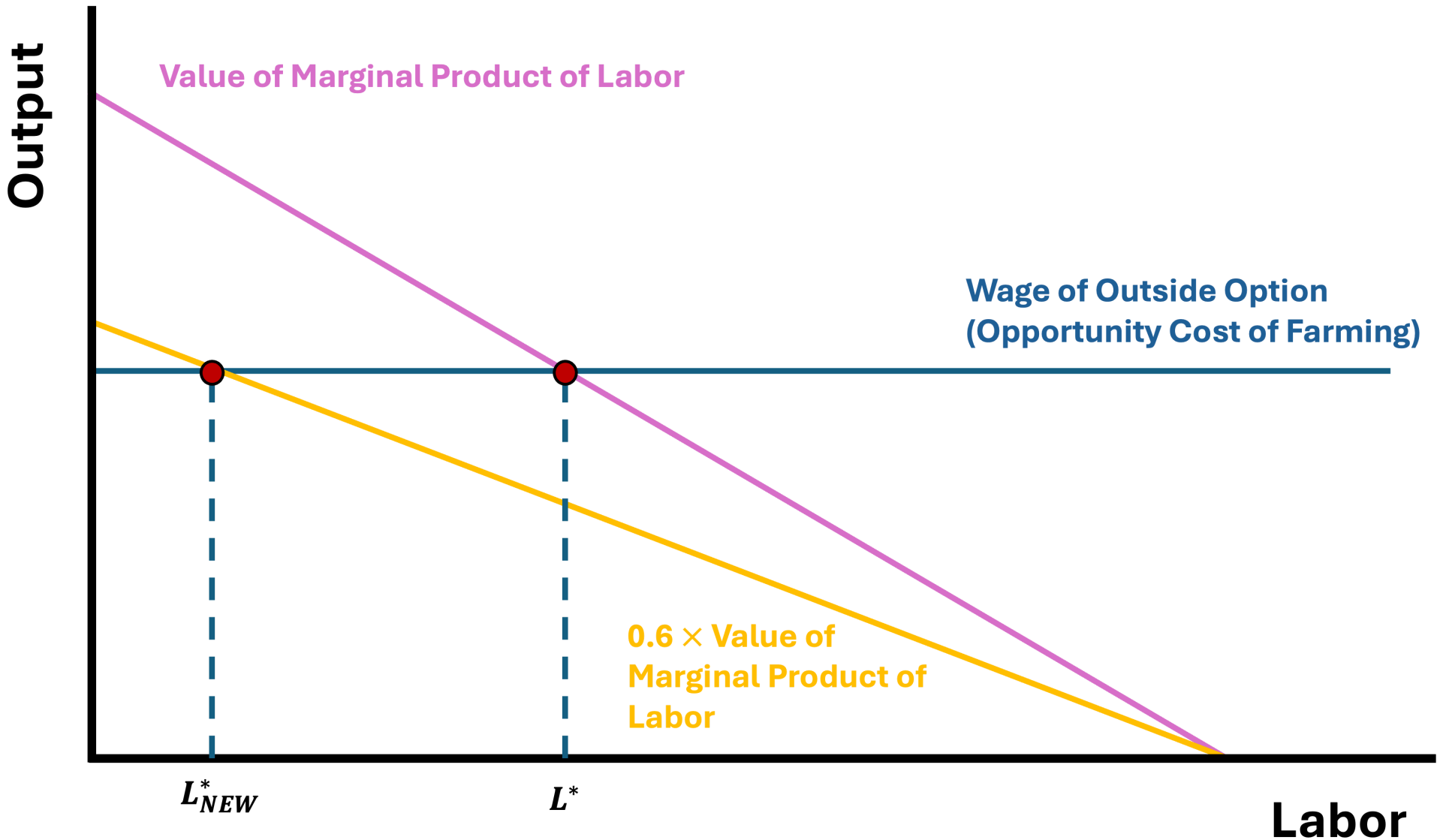
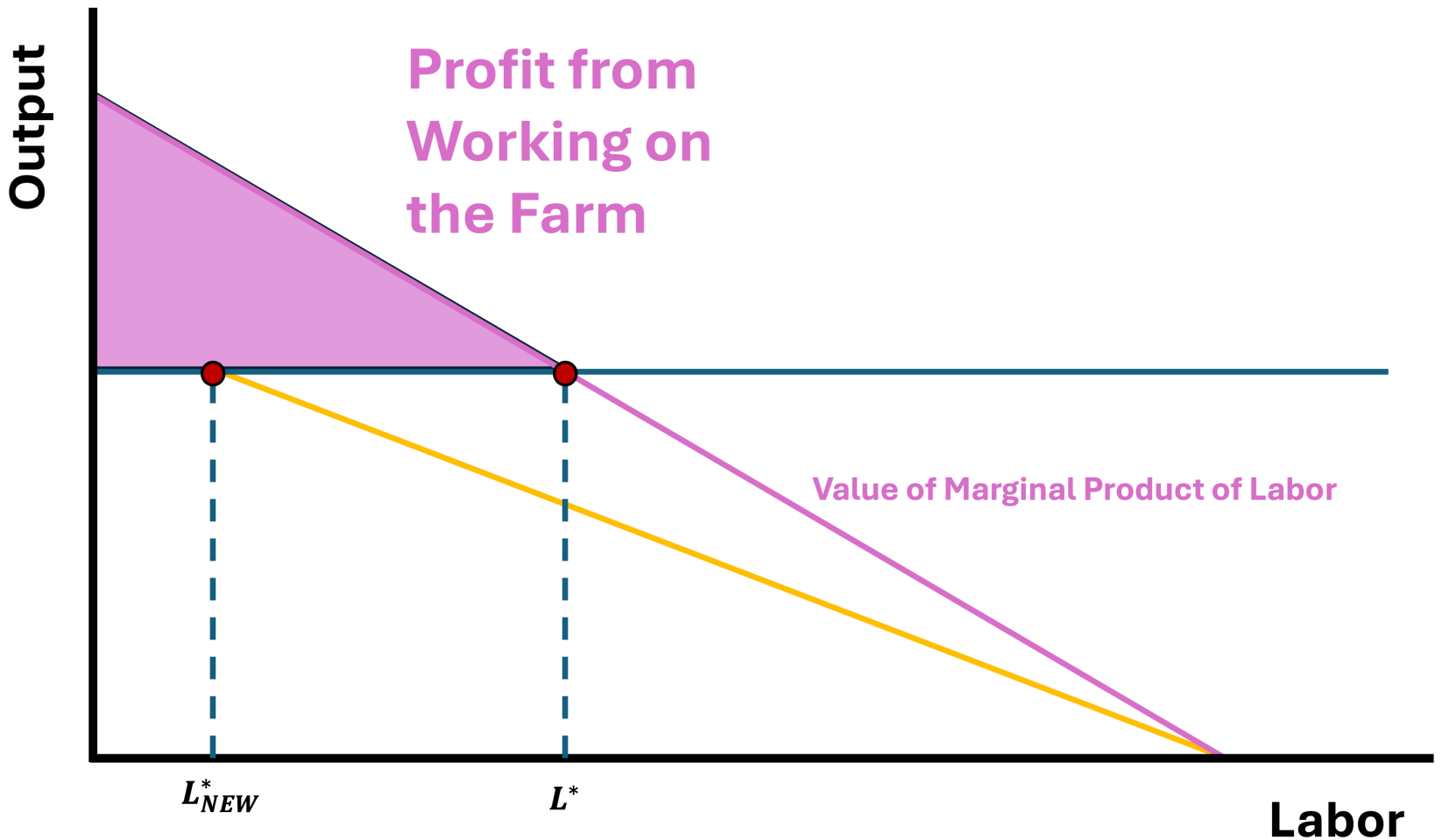


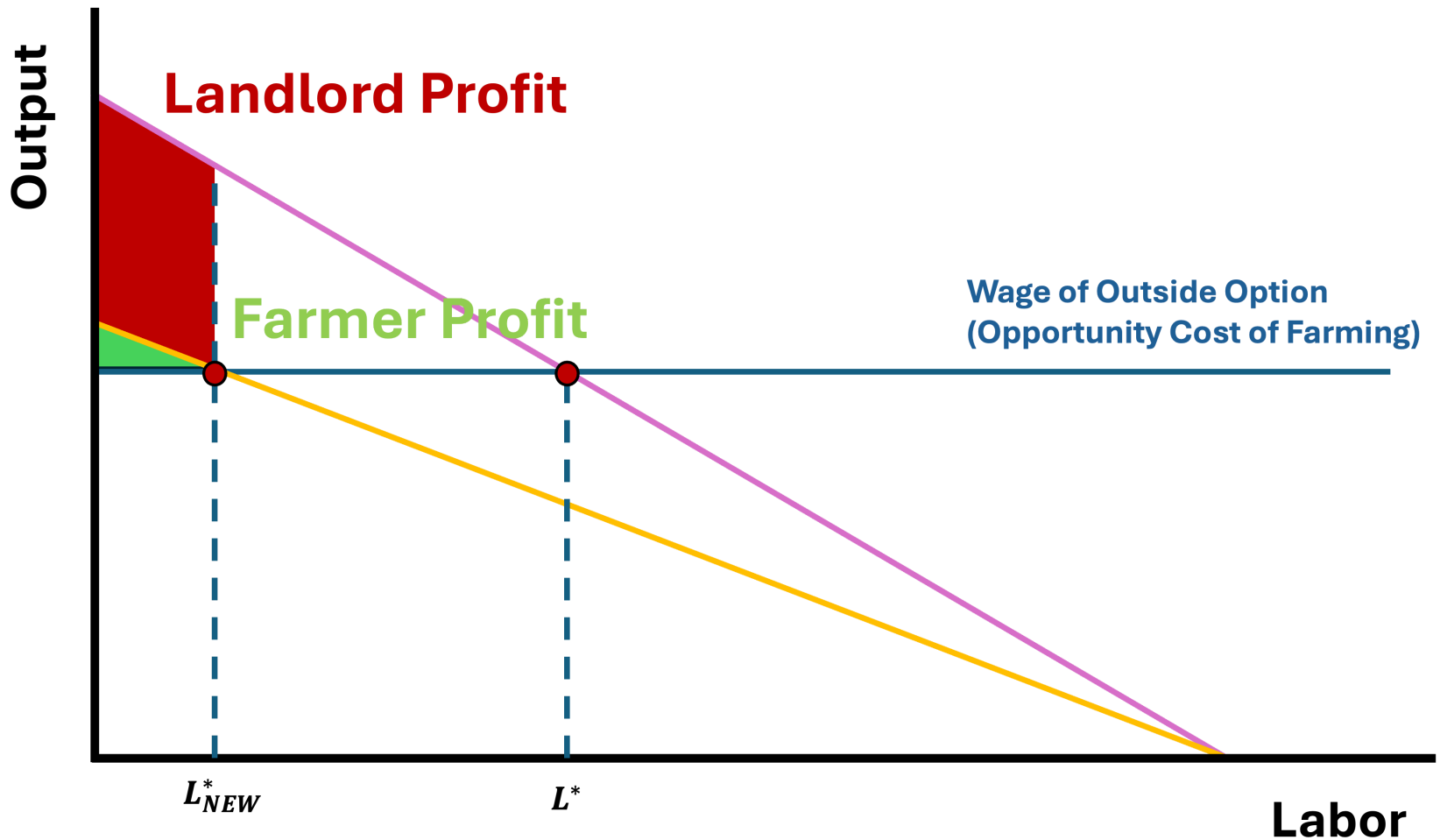
Sharecropping Impact

If we think of **profit** in this market as the **difference between VMPL and Opportunity Cost**, then **profit from working on the farm is given by**



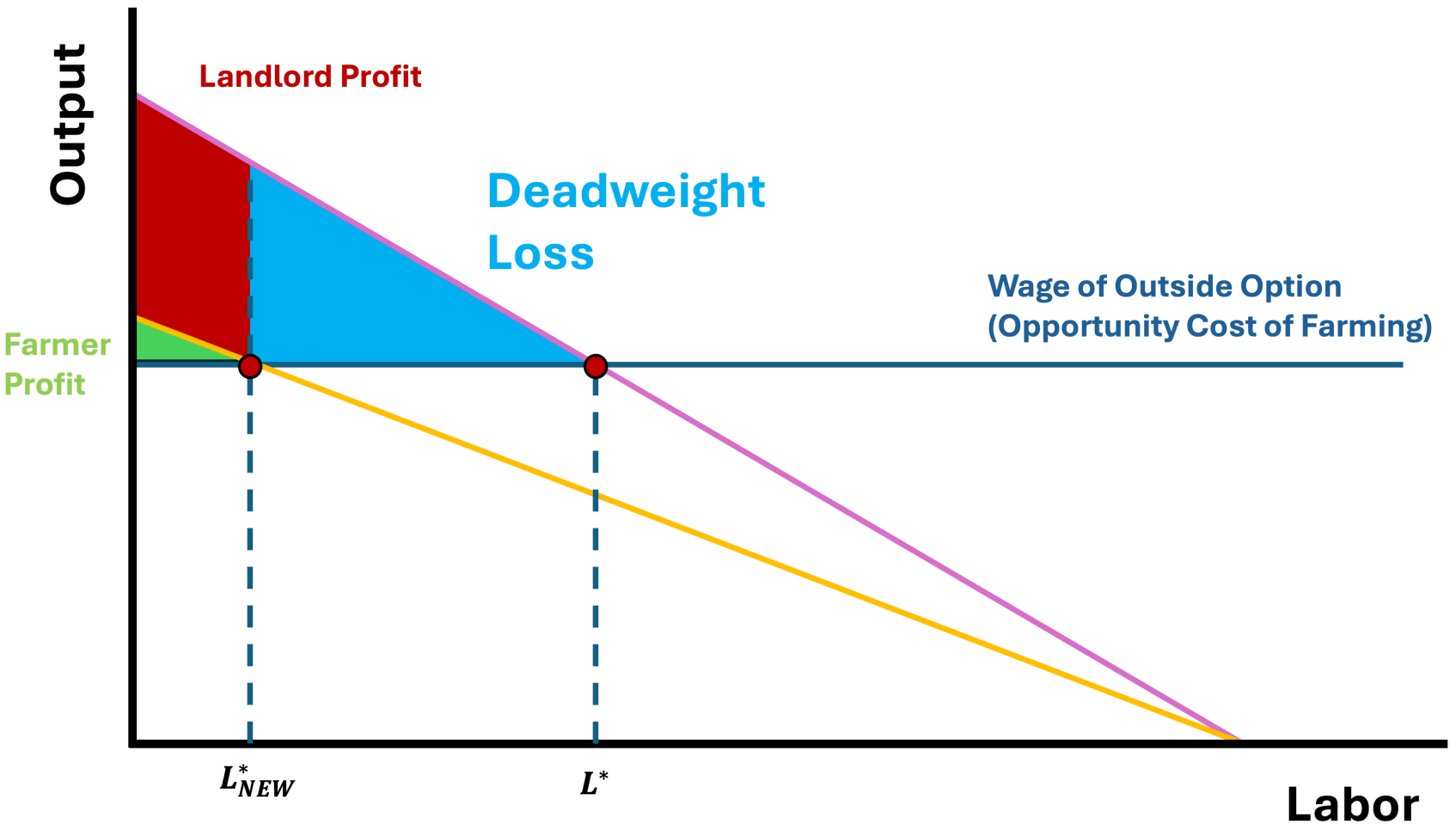
Sharecropping Impact

Under sharecropping, the **farmer only gets profit** while the **landlord gets profit**



Sharecropping Impact

Which leaves the awkward space known as **deadweight loss from sharecropping**



Sharecropping Impact

The existence of Deadweight Loss means that it is inefficient

- But if it is **inefficient**, why do we observe it in the world?
- Let's think of the other alternatives:
  - The **landlord** pays the **farmer** a **wage** to farm the land
  - The **farmer** pays the **landlord** a **fixed-rent** to lease the land

Are the Alternatives Better?

Landlord pays a wage to the farmer

- The **landlord** pays the **farmer** but **monitoring the farmer is difficult**
- The **farmer's** income is **guaranteed**, regardless of output
- But output remains **uncertain** due to weather, pests, etc.
- So the **landlord** **bears all the risk** of low-yields or crop failure
- Even more important, the **farmer** has an **incentive to neglect working**
  - Income does not depend on output **leads to a moral hazard situation**

So Moral Hazard + Full risk on the landlord makes this more inefficient

Are the Alternatives Better?

Farmer pays a fixed-rent to the landlord

- The **farmer** keeps all profits from the farm (after paying the fixed-rent)
- So the **farmer** bears all the **production risks**
- If **output was low**, the farmer may lose income or not be able to pay rent
- For a **risk-averse farmer**, this is very costly and makes them not want to take action
- The **landlord** avoids all risk, but **the farmer's welfare suffers**

Full risk being being on the farmer means that this is more inefficient

Summary

Sharecropping is the compromise

- If both the **landlord** and the **farmer** are **risk-averse**, then share cropping is as close as we can get to efficiency
  - If the **farmer** just payed **fixed rent** to the **landlord**, the **farmer** would bears all the risk of a poor crop
  - If the **landlord** simply paid a **wage** to the **farmer**, the **landlord** bears all the risk of a poor crop
- Sharecropping **splits both the risk and income**

Core Requirements for Ag Development

1. **Changing Incentives to Promote Small/Medium Farmers**
2. **Pricing Policies for Agricultural Output**
3. **Supportive Policies for Integrated Rural Development**

Core Requirements for Ag Development

1. Changing Incentives to Promote Small/Medium Farmers

- Institutional Incentives like Crop Insurance
- Scale-neutral Technological Advances: Leads to higher output for all size farms (better seeds, fertilizers, etc.)

2. Pricing Policies for Agricultural Output

3. Supportive Policies for Integrated Rural Development

Core Requirements for Ag Development

1. Changing Incentives to Promote Small/Medium Farmers

2. Pricing Policies for Agricultural Output

- More employment in urban areas leads to increased demand for food
- Increased demand for food leads to better prices for farmers' output
  - Smaller/Medium farmers benefit from their efforts

3. Supportive Policies for Integrated Rural Development

Core Requirements for Ag Development

1. Changing Incentives to Promote Small/Medium Farmers

2. Pricing Policies for Agricultural Output

***3.* Supportive Policies for Integrated Rural Development**

- Rural institutions being stronger (Banks, Seed and Fertilizer Distributors, Technical and Educational Programs, etc.)
- Rural insfractructure (Storage and Marketing Facilities, Rural Transport and Feeder Road Quality, etc.)