

Section Chapter 18: Agriculture for Development

1 Agriculture of Development: Growth, poverty reduction, and resource preservation

We can think of agriculture's relevance for development through the following three channels:

1. *Agriculture's impact on growth*: reducing cost of feeding industrial labor, creation/taxation of capital, ag exports as source of foreign exchange reserves, ag. production demand creates market for intermediate goods, growth multiplier through downstream food processing and servicing, etc.
2. *Poverty reduction*: Income generation for farmers, demand for on-farm and off-farm rural labor, reduce cost/deficit of poor household food consumption
3. *Resource preservation*: Reduce negative environmental impacts of ag. (deforestation, use of ground water, etc.) through improved of farming

2 State of the World of Ag:

- *Poverty in mostly rural*: 75% of global poverty is in rural communities
- *Hunger exists and is getting worse in some regions*: “An estimated 1 billion people remain in chronic undernourishment, and this number has been rising as a consequence of the food and financial crises (FAO, 2008). This is 1 out of every 6 people in developing countries (17%), 1 out of 3 in Sub-Saharan Africa, and 2 out of 3 in poor countries such as Burundi. Undernourishment is particularly high and devastating on children (Gross and Webb, 2006): 26% of children in the world, 28% in Sub-Saharan Africa, 48% in South Asia, and 50% in Guatemala suffer from wasting. One third of deaths of children under the age of five, totaling some 3 to 5 million/year, is due to malnutrition, a human cost that could be avoided.”
- *Prices rising, yield growth slowing*: Food prices started rising steeply in 2006 and with lower growth of yields over time
- *Aftermath of 2008 Food Crisis*: Crisis generated from sudden demand increase due to OECD biofuel mandate, high price of oil and fertilizer, extreme weather events (Australia, Vietnam, etc.), and long-term neglect of ag.policy post Washington Consensus

3 Determinants of Ag Output Growth/Advancement: Price, technology, sustainability

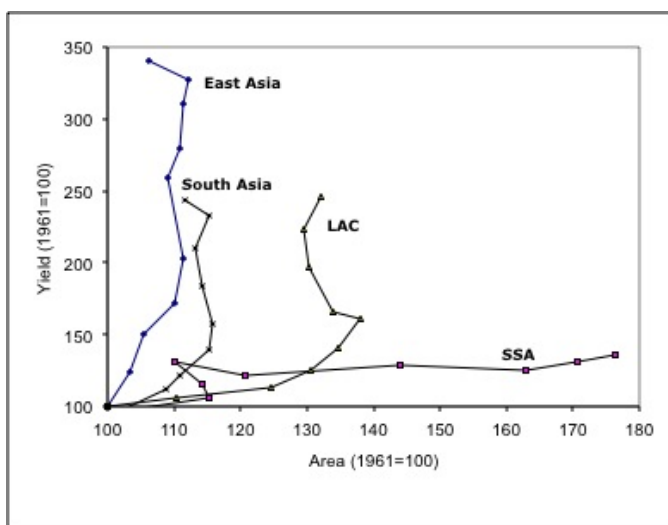
3.1 Price / Market incentives

- Small farmers are poor but efficient and respond to price signals

- Urban biases ag policies in development world, protectionist tariffs, revenue generating export taxes, etc. often distort prices in ways detrimental to small famers
- Growth of integrated global ag. value chains rewards high-value specialization (over food security) and may disproportionately prefer large scale landholders, though there may be ways to integrate small holders into global supply chains through coops, etc.
- There is a fundamental tension between producers and consumers when formulating ag. price policies

3.2 Technology: Generation, Adoption, Diffusion

Growth in agricultural output can come from **horizontal expansion (extensive)** and **vertical expansion (intensive)** but horizontal expansion is restricted by geographical limits.



5 basic types of ag. technology: land saving/yield increasing, labor-saving/cost-reducing, risk-reducing, quality-improving, externality-reducing

3.2.1 Technology Generation: Theory of induced technological innovation:

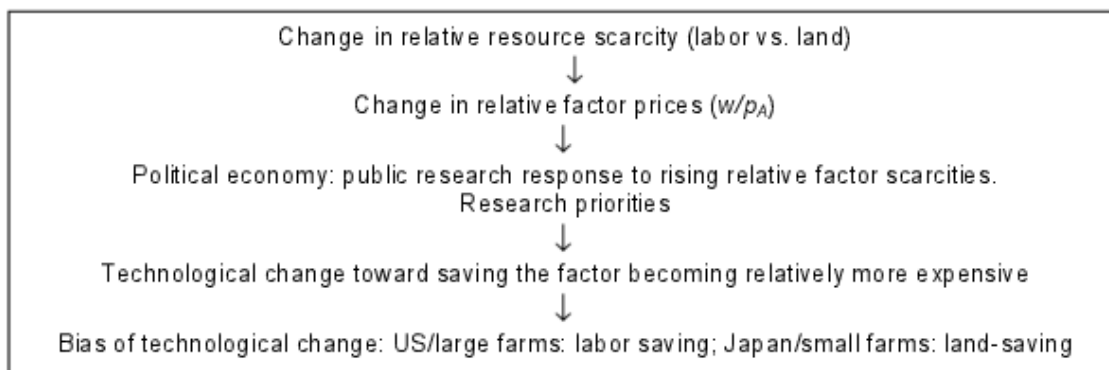
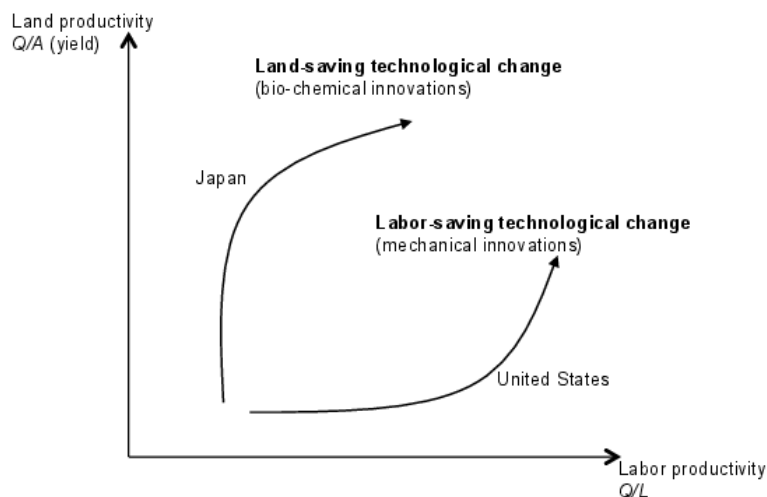


Figure 14. Logical sequence in induced technological innovations

The types of technological change needed in agriculture is related to the relative factor scarcity.

1. Where **land is scarce and labor plentiful**, the price of land will rise relative to the price of labor so (w/p_A) **goes down**. Innovations will be **land-saving**, seeking to raise yields through technological change in seeds, farming systems, chemicals, and water management. As a consequence, **land productivity (q/A) will rise**. This path of technological change has been followed by countries where land is scarce, such as **Japan** (and other countries in Asia, and well as in Europe).
2. Where **land is plentiful and labor is scarce**, the price of labor will rise relative to the price of land so (w/p_A) **goes up**. Innovations will be **labor-saving**, seeking to raise the productivity of labor through innovations in mechanization (harvesters, tractors) and labor saving chemicals. As a result **labor productivity (q/L) will rise**. This path of technological change has been followed by countries such as the **US**, Australia and Canada.



The bias of innovations in agriculture (land saving or labor saving) is thus “induced” by price signals that guide the allocation of resources to research priorities in public agricultural research stations. This is the Hayami and Ruttan *“theory of induced technological innovations”*.

In the Solow tradition, the generic production function for agriculture is:

$$q = t f(K, L, A)$$

where K is capital, L is labor, A is land and t is TFP. Technological change is factor neutral as it shifts the whole production function and is not tied to a particular factor of production. In order to incorporate the theory of induced technological innovations where technological change can instead be land-saving or labor-saving, the model is slightly modified:

$$q = t f [f_L(L, t_l K_l), f_A(A, t_A K_A)]$$

where K_l are capital goods that substitute for labor and t_l represents labor-saving technological change. Similarly, K_A are capital goods that substitute for land and t_A is land-saving

technological change. The function f_L represents the labor (and labor-saving) contribution to production and f_A represents the land (and land-saving) contribution.

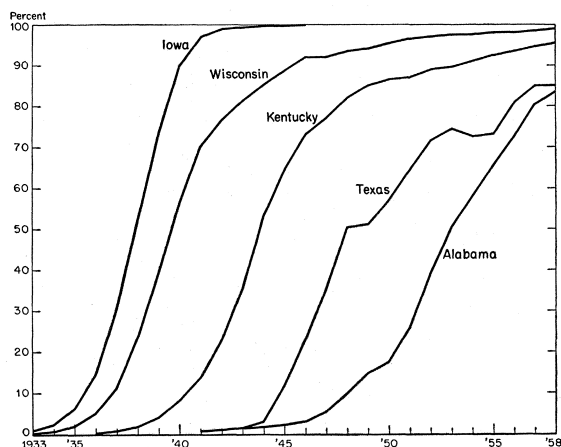
There is high substitution within each sub-function between technology and the input, but not between the two sub-functions. Intuitively, this is because crops biologically need certain space to grow and certain operations (i.e. planting and harvesting) to be performed. Technology can decrease the land area needed per unit of output by increasing the yield (more grains per plant), or by decreasing the labor needed to perform the operations (tractors and harvesters).

3.2.2 Technology Adoption

Potential barriers to tech adoption

- Profitability: It is difficult to measure profitability of a new technology in conditions with multiple market failures (i.e. high transactions costs and distorted prices) and lots of unobservable heterogeneity (i.e. in land quality)
- Information: Social learning is important- optimal fertilizer use in a new crop (pineapple) happens slowly as people get feedback from their networks (Conley and Udry)
- Credit/ insurance market failures: Recall AS/ MH issues from discussion of microfinance
- Lack of complementary assets: Secure land tenure is necessary for long-term investments; irrigation investment is an important complement for fertilizer and high-yield variety adoption
- Behavior: Long planting/harvest cycle prone to “procrastination” aka **hyperbolic discounting**; Banerjee, Kremer, & Robinson RCT: commitment device for buying fertilizer increased adoption

3.2.3 Diffusion of Technology: Tech treadmill, R&D, public goods, learning, political-economy.



Tech Treadmill: Who benefits from technological change in agriculture?

- For **non-tradable goods**: demand is inelastic and the net social gain from technological change is absorbed by the **rise in consumer surplus**. This leads to a product market treadmill of falling average costs and falling prices.
- For **tradable goods**: demand is elastic and the net social gain from technological change is absorbed by the **rise in producer surplus**.

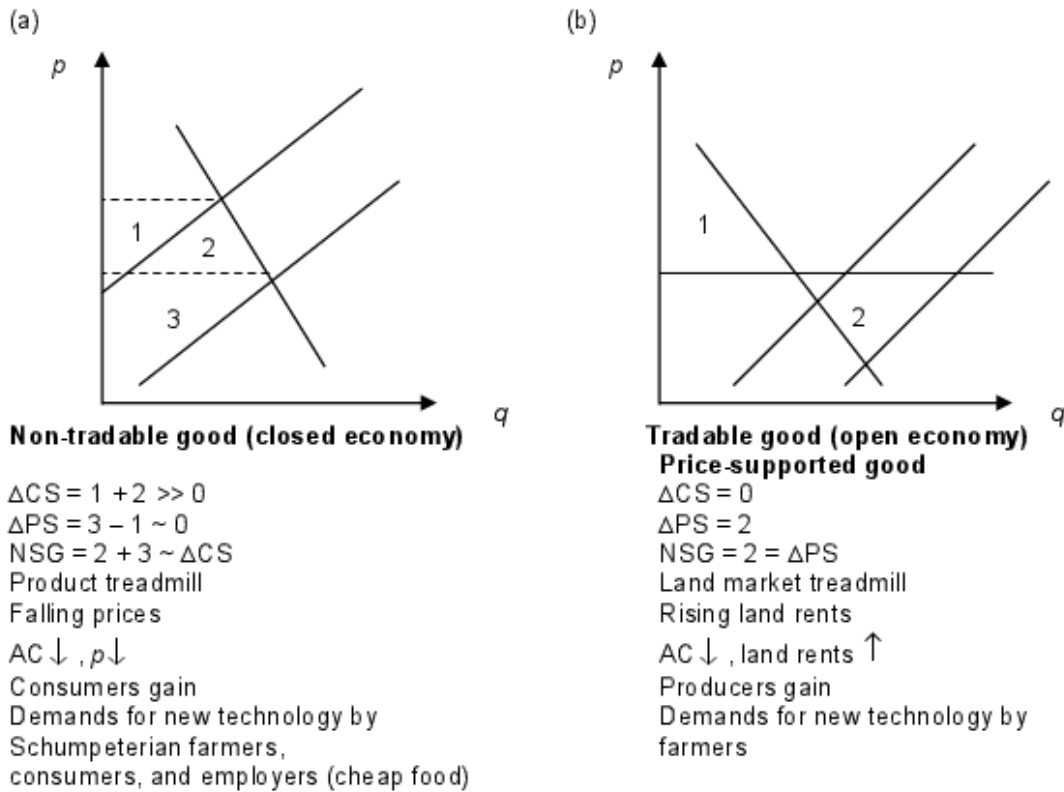


Figure 18.16 Welfare gains from technological change for a non-tradable good (product market treadmill) (a) and a tradable good (land-market treadmill) (b)

Political Economy of Tech Diffusion: If public good and public support for R&D influence ag tech diffusion, whomever controls the public budget controls the nature of the tech that is development and diffused. Whether tech benefits small or large farmers depends on the relative strength of interest groups. Political economy may explain why labor-cost saving tech generated and diffused through developed world may not be appropriate for land-saving/yield increasing needs of low-skilled ag in the developing world