

Numerical Exercise 3: Economics of Technical Change and Input Use

Name: _____

Thanks to your Purdue education, you’ve just been hired by Yara, a Norwegian company that is the world’s largest manufacturer of agricultural fertilizers. Your first task for them is to help write a retrospective on why some regions of the world have experienced rapid growth in fertilizer use, while others have not, so that they can anticipate where demand might grow in the future. Luckily, from AGECEC 340 you know that farmers’ use of fertilizer depends on their input response curves, relative to their price ratios. You also know how to do a good literature review, so you find an excellent discussion of this issue in a classic textbook called *Agricultural Development* by Yuhiro Hayami and Vernon Ruttan (1985), which includes this table of data:

Fertilizer input response of early rice varieties in Asia

	<i>Nitrogen fertilizer application rates (lbs/acre)</i>	
	95	150
<u>Rice yields (lbs/acre)</u>		
with “Batak” seeds	5,445	5,875
with “Kamenoo” seeds	5,417	6,077
with “Norin” seeds	6,352	7,700

Hayami and Ruttan’s textbook explains that Batak was a traditional variety in use for many years. Kamenoo is a farmer-selected variety that spread widely across Japan from 1905 to 1925, and Norin was developed in Japan through scientific breeding and released to farmers in 1935.

Using these data, on a piece of graph paper or using a spreadsheet please draw simplified input response curves for these three varieties, showing the output of paddy rice produced (in lbs/acre, on the vertical axis) using different levels of nitrogen fertilizer input (95 or 150 lbs/acre, on the horizontal axis). Note that only the relevant part of the curves matter: on the horizontal axis you need only two points: 95 and 150, and on the vertical axis, you need a scale with various points from about 5,000 to about 8,000. For simplicity please draw straight lines up to the point at 95 lbs/acre and between the points at 95 and 150, then horizontally thereafter.

To predict farmers’ choices you will need to compute the slope of each line, and compare it to relative prices. If the price of fertilizer were 200 cents/lb, and the price of rice varied between low (8 cents/lb), medium (10 cents/lb) and high (20 cents/lb), draw the “profit” or relative-price lines through the profit-maximizing points to answer to the questions below, using a solid line if the rice price were high, a dashed line if it were medium and a dotted line if it were low. To check your answers, you may want to compute the levels of profit in each case, where profit is just the price times quantity of rice minus price times quantity of fertilizer used. Then write your answers in the space below, and staple your graph to this sheet before handing in.

Price of Rice (cents/lb)
Low(8) Med.(10) High(20)

Which seed variety would be chosen by a profit-maximizing farmer,

- | | | | |
|--|--------------|--------------|--------------|
| (0) before 1905 (when only Batak was available) | <i>Batak</i> | <i>Batak</i> | <i>Batak</i> |
| (1) between 1905 & 1935 (choosing between Batak & Kamenoo) | _____ | _____ | _____ |
| (2) after 1935 (choosing among all three varieties) | _____ | _____ | _____ |

Using the profit-maximizing seed variety, which level of fertilizer use is profit-maximizing (95 or 150)?

- | | | | |
|-------------------------|-------|-------|-------|
| (3) before 1905 | _____ | _____ | _____ |
| (4) between 1905 & 1935 | _____ | _____ | _____ |
| (5) after 1935 | _____ | _____ | _____ |