Commodity and Country	Seed Status[a] (rating)	Proportion of Crop Area In Improved Varieties (percent)	Yields per Hectare 1948–1952	1960–1962	Change (percent)
			(100 kilograms per hectare-year)		
Rice					
Japan	1	100	40.0	50.5	26
Taiwan	1	95	19.1	25.4	33
Venezuela	2	90	11.4	15.1	33
Chile	3	65	29.0	27.0	-7
United Arab Republic	3	35	37.9	52.8	39
Pakistan	4	5	13.8	15.9	15
Iran	4	3	19.3	19.6	2
Wheat					
Japan	1	100	18.5	26.1	41
Netherlands	1	100	36.5	43.8	20
Mexico	1	85	8.8	16.7	90
Chile	2	80	11.9	13.7	15
Pakistan	2	7	8.7	8.1	-7
United Arab Republic	3	30	18.4	25.1	36
Colombia	3	20	7.2	9.1	26
Iran	3	10	9.0	7.8[b]	-13
Jordan	4	15	7.0	5.4	-23
Maize					
Venezuela	2	20	11.4	11.0	-4
Pakistan	2	8	9.8	10.0	2
Chile	3	50	13.8	20.7	50
Colombia	3	20	10.7	11.2	5
United Arab Republic	3	7	20.9	24.1	15

[a]Index of present efficiency in the chief factors influencing development, production, distribution, and use of better seeds, using rating of 1 to 4 with quality highest for rating of 1.
[b]1960–1961.

Figure 4-40 Yield and proportion of crop in improved varieties 1948–1952 and 1960–1962
Source: U.S.D.A. 1965, p. 49.

But new seed does not lead to such phenomenal results without costs: to perform well, the new crop varieties need considerably more fertilizer, pesticides, and water than traditional varieties. Further expansion in their use will probably be constrained by the amount of adequately irrigated land than can be made available. Currently, only 11 percent of the world's arable land is irrigated (PSAC 1967, vol. 2, p. 440), and it is estimated that about 10 percent of this land, or 16 million hectares is already planted with high-yield varieties (Shaw 1970, p. 11).

The Mexican wheats have a pronounced yield advantage over local wheat only when they are grown under irrigated or high rainfall conditions. Under dry land farming conditions, where little or no fertilizers can be used, they offer little if any advantage. . . . Expansion of the area planted to high-yielding wheats is already slowing somewhat in both India and Pakistan, for example, as the additional land with suitable water supply diminishes. [Brown 1970, p. 21]

The expansion of the world's irrigated land area is expected to be small, amounting to an increase of about 50 percent in irrigated area in the developing world by 1985 (FAO 1970a, Vol. 1, p. 58). One important reason for the slow expansion is the high cost of getting water to the plants: "About one half the water provided for irrigation is lost in transportation, and less than half the water that reaches the fields is utilized by plants" (Revelle 1962).

Consequently, although the land yield can be increased significantly by introducing high-yielding seed varieties, this approach requires increasing amounts of capital to provide adequate irrigation, fertilizer, and pesticides. Diminishing returns thus seem to be active also with respect to the use of new seed varieties.

Finally, Figure 4-41 indicates decreasing returns to farm mechanization measured as horsepower employed per hectare. The relationship between agricultural yield and mechanization differs from that between yield and fertilizer. First, more horsepower does not necessarily result in higher yields. Second, mechanization is not a prerequisite for raising the productivity of farming as, for example, small landholdings in Asia illustrate. However, the importance of timely sowing, the elimination of fallow in sufficiently irrigated areas, and narrowing the interval between harvests by more intensive crop rotation schemes indicates that farm mechanization normally will be accompanied by increased yields.

How can increases in agricultural inputs per hectare be linked quantitatively to increases in yield through the land yield multiplier from capital LYMC? We began to answer this question by estimating how many times the 1963 world agricultural inputs per hectare AIPH must be increased to achieve a doubling or a tripling of world average yields, using the information from the figures already presented here as a base. The first step was to obtain the world average values of fertilizer use per hectare, pesticide use per hectare, and horsepower per hectare for 1963.
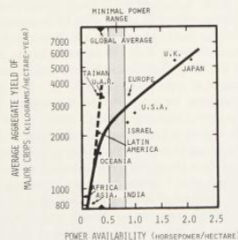

Figure 4-41 Yield and power availability
Source: PSAC 1967, vol. 3, p. 180.