

	Fertilizers		Seed		Irrigation	
	1962*	1985	1962*	1985	1962*	1985
Africa south of Sahara	14.2	180.4	295.0	412.1	—	—
Asia	335.0	5,180.9	868.6	1,258.7	750.7	1,186.0
Latin America	218.3	1,861.3	276.4	355.7	479.6	896.9
Near East <sup>1</sup>	78.7	470.7	108.1	145.7	264.4	350.8
North Africa <sup>2</sup>	18.0	145.0	51.4	72.1	—	—
Total	664.2	7,838.3	1,599.5	2,244.3	1,494.7	2,433.7

\*1961-1963 average.

<sup>1</sup>10 countries only, excluding Kuwait and Yemen Arab Republic.<sup>2</sup>1962\* = 1965\* (1964-1966 average).<sup>3</sup>Same quantities used also for livestock.<sup>4</sup>South America only.

**Figure 4-31** Value of agricultural inputs in 1962 and proposed levels for 1985, selected developing regions (millions of 1962 dollars)  
Source: FAO 1970a, p. 180.

**Agricultural Inputs per Hectare AIPH** The intensity of use of agricultural inputs is the important determinant of land yield. To measure the average intensity of use (the agricultural inputs per hectare AIPH), the variable AI must be divided by the arable land AL over which the inputs are used.

We assumed in World3 that a certain fraction of AI is not used to obtain immediate increases in land yield but is instead spent on land maintenance, or the conservation of land fertility LFERT. The purpose of this expense is to secure a high land yield for the future. This fraction allocated to land maintenance FALM, the equation for which is described under loop 6, includes resources spent on crop rotation, drainage, and similar practices. The annual average global use of productive agricultural inputs per hectare AIPH is then given as

$$AIPH = AI \cdot E \cdot (1 - FALM) / AL$$

AIPH = AGRICULTURAL INPUTS PER HECTARE (DOLLARS/HECTARE-YEAR)  
 AI = AGRICULTURAL INPUTS (DOLLARS/YEAR)  
 FALM = FRACTION OF INPUTS ALLOCATED TO LAND MAINTENANCE (DIMENSIONLESS)  
 AL = ARABLE LAND (HECTARES)

Global figures for agricultural inputs per hectare in terms of money equivalents are difficult to find. Figure 4-31 gives total values of the different agricultural inputs in the developing world for 1962 and proposed values for 1985. On the basis of these values and data on the arable land in these countries, one can arrive at the estimates of agricultural inputs per hectare AIPH values given in Figure 4-32. The estimate of AIPH in nonindustrialized areas of the order of 10 dollars per hectare-year is compatible with the scant information available on other countries (U.S.D.A. 1965, p. 77). The value of AIPH in the industrialized areas of the world is undoubtedly much higher.

Crop Protection		Mechanization <sup>3</sup>		Total Inputs		Total Input as Percent of Crop Output	
1962*	1985	1962*	1985	1962*	1985	1962*	1985
13.6	309.0	27.0	101.2	349.8	1,002.7	6.4	9.1
20.4	1,215.8	200.9	1,153.9	2,175.6	9,995.3	9.8	18.9
110.0 <sup>4</sup>	397.2 <sup>4</sup>	438.5	1,031.8	1,522.8	4,542.9	17.1	25.7
25.0	116.4	36.7	117.3	512.9	1,200.9	18.6	19.2
11.0	38.5	94.0	206.0	174.4	461.6	20.3	25.2
180.0	2,076.9	797.1	2,610.2	4,735.5	17,203.4	11.8	19.2

**Figure 4-31** (continued)

**Land Yield Multiplier from Capital LYMC** The ability of agricultural inputs to enhance the yield from each hectare of land is expressed by a variable called the land yield multiplier from capital LYMC. This factor multiplies the yield that would otherwise be expected, given the basic land fertility, by an amount that varies as the use of agricultural inputs per hectare AIPH varies. The value of LYMC is always 1.0 or larger; it is assumed that the application of agricultural inputs never decreases the yield that might have been obtained on the same land by traditional methods.

The increases in grain yields over time in various parts of the world are shown in Figures 4-3, 4-33, and 4-34. Since the primary agricultural change in these areas over the period was the introduction of modern agricultural inputs, these figures give a rough idea of the range over which the land yield multiplier from capital LYMC has varied.

As an estimate of the inherent land fertility ILF, which is defined as the land yield when no modern agricultural inputs are employed in the production process and when the land fertility is not impaired by earlier misuse of the soil, we chose 600 vegetable-equivalent kilograms per hectare-year. Since this value seemed to be the lower bound of most yield data we reviewed, we assumed that it could be considered

Region	Arable Land (billion hectares)		Agricultural Inputs per Hectare (dollars per hectare-year)	
	1962	1985	1962	1985
Africa south of the Sahara	0.15	0.19	2.3	5.3
Asia	0.21	0.22	10.4	44.9
Latin America	0.13	0.17	11.4	26.7
Near East and Northwest Africa	0.07	0.08	9.8	21.3
Total	0.56	0.66	8.4	26.0

**Figure 4-32** Agricultural inputs per hectare for selected developing regions, 1962, and proposed levels for 1985  
Source: Data from FAO 1970a, p. 52.