



Figure 4-42 Global use of fertilizers (million tons per year)

Source: Georg Borgstrom, *Too Many: A Story of Earth's Limitations*, rev. ed. (New York: Macmillan Publishing Co., 1970), p. 27. (Copyright © 1969, 1971 by Georg Borgstrom. Copyright © 1969 by Macmillan Publishing Co., Inc.)

Our estimate of the global average fertilizer use of 28 kilograms per hectare-year was obtained by dividing the 1963 total of 39 million tons per year (Figure 4-42) by the estimated 1.4 billion hectares of cultivated arable land AL (PSAC 1967, vol. 2, p. 434). The estimated global pesticide use of 0.53 kilogram per hectare-year was obtained in a similar way from Figure 4-43 by taking the grand total of 750,000 tons and again dividing by the arable land. Finally, the global average horsepower consumption is given as 0.36 horsepower per hectare in Figure 4-44.

These global average values were then used to define the reference points on the graphs in Figures 4-6, 4-35, 4-36, and 4-41; using these reference points we then inferred how many times the respective inputs must be increased to obtain a doubling or a tripling of the reference yield. The results are shown on the right-hand side of Figure 4-45. On the basis of Figure 4-40, we assumed that to double the 1963 yield would require 6 times the 1963 agricultural inputs, and to triple the yield would require 20 times the amount of inputs used in 1963.

The overall development scenario for the developing world given by the President's Science Advisory Committee (PSAC 1967, vol. 3, pp. 95-174), summarized in Figure 4-46, arrives at conclusions similar to ours. As can be seen from the figure, that study found that to achieve a doubling of the average land yield LY in the nonindustrialized countries (from the 1966 value of 1,300 vegetable-equivalent kilograms per hectare-year) on 0.7 billion hectares of arable land would require 11 times the 1966 input of fertilizer (8.6 kilograms per hectare-year) and 6 times the 1966 input of pesticides (0.17 kilogram per hectare-year). In addition, significantly improved new seeds would be required. On the basis of this information about the developing world, we assumed that their (lower than global average) land yield would double in response to a tenfold increase in agricultural inputs per hectare.

Pesticide—Class and Type	Asia (except mainland China)	Africa	Latin America	Oceania	Europe (except U.S.S.R.)	United States	Class and Type Totals
Insecticides:							
Chlorinated hydrocarbons	27,052	8,278	6,038	114	15,733	64,375	121,590
Organophosphorus compounds	4,004	2,258	2,105	4	12,106	34,437	54,914
Arsenicals	3,283	n	286	200	952	4,950	9,671
Mineral oils and dinitro compounds	8,888	619	246	500	8,759	—	19,012
Botanical insecticides	153	178	6	22	141	2,490	2,990
Total insecticides	43,380	11,333	8,681	840	37,691	106,252	208,177
Fungicides:							
Sulfur and compounds	21,185	17,540	2,971	540	109,739	78,250	230,225
Copper compounds	13,617	48	3,210	1,850	74,724	15,974	109,423
Mercury compounds	1,691	—	18	12	2,775	884	5,380
Carbamates and others	3,300	73	4,526	150	35,527	3,854	47,430
Total fungicides	39,793	17,661	10,725	2,552	222,765	98,962	392,458
Fumigants	7,704	14	48	84	1,621	7,890	17,361
Herbicides	37,767	934	887	784	16,832	62,644	119,848
Rodenticides	798	n	2	8	2,569	—	2,781
Other pesticides and dips	202	3,038	830	2,656	2,434	—	9,756
Area totals	129,644	32,980	21,173	6,924	283,912	275,748	750,381

n = negligible quantity (500 kg or less).

Figure 4-43 Pesticide usage in metric tons of active ingredients, by class and geographic area, 1963
Source: PSAC 1967, vol. 3, p. 144.