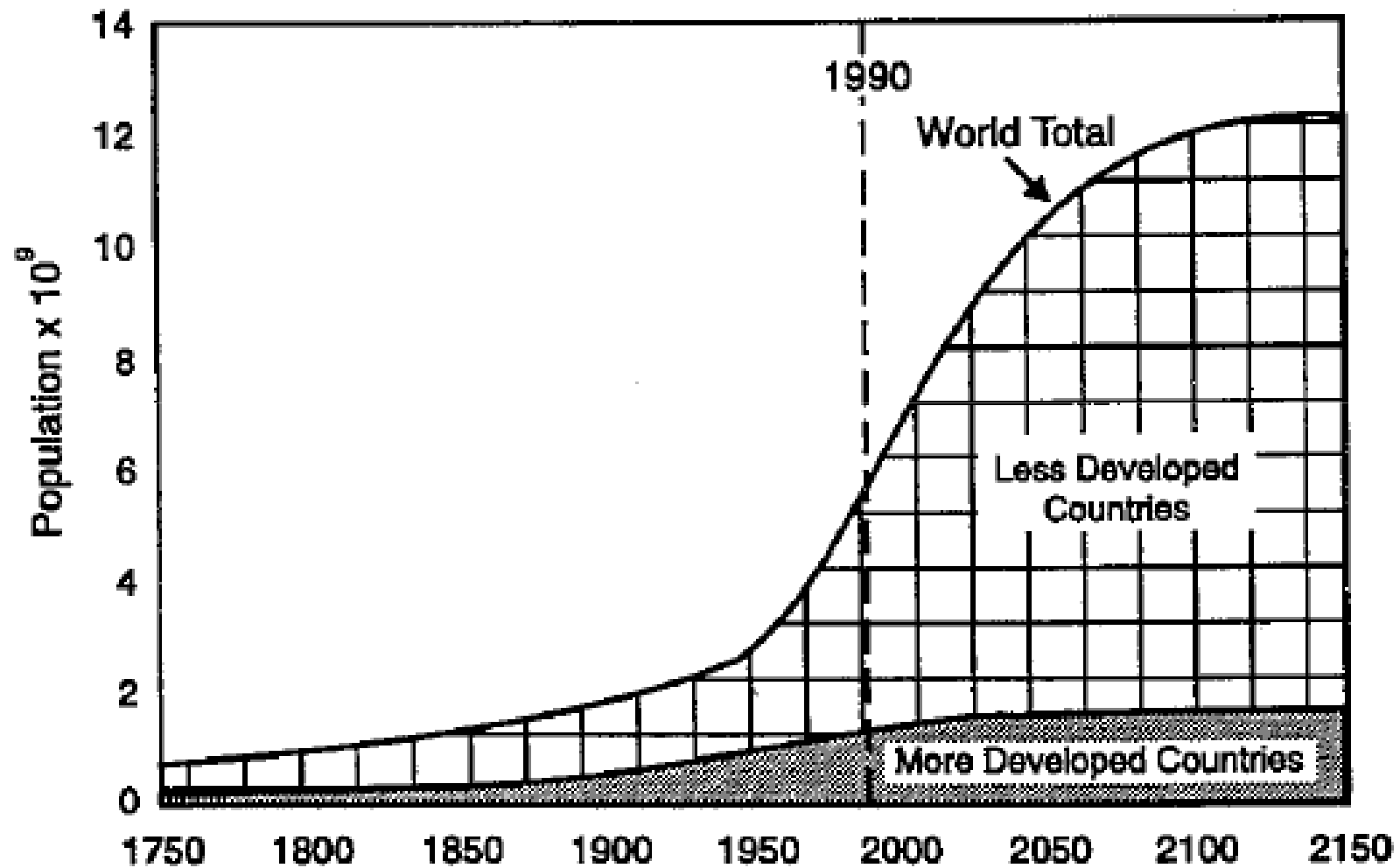


# *Chapter 2*

## *History of*

## *Fertilizers*

# *World Population*



- **The rapid increase in the world's population is the main driving force for the growing demand for agricultural products in the form of food.**
- **As this demand has increased, so has the demand for nutrients to support plant growth.**
- **Since there is little scope for opening more land for crop production, future demand can be met mainly by increased production on existing cropland.**
- **The failure to maintain soil nutrients has led to the downfall of many ancient societies.**

## *Soil Fertility*

<b>Crop</b>	<b>Yield (t/ha)</b>	<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O</b>	<b>S</b>
		(kg/ha)			
Rice	6	100	50	160	10
Wheat	6	170	75	175	30
Maize	6	120	50	120	25
White potato	40	175	80	310	20
Banana	40	250	60	1000	15
Cotton	1	120	45	90	20

# *Phosphate Fertilizers*

- **The first phosphate fertilizer as such – ground bones- was used widely in Europe during the early part of the 19<sup>th</sup> century.**
- **When the supply of animal bones was short, human bones were gathered from battlefields or burial places.**
- **Treatment of bones with sulfuric acid began about 1830 and soon became a common practice.**
- **Dilute acid was used, and the product was a slurry, which was distributed in wooden casks.**

# *Phosphate Fertilizers*



# *Phosphate Fertilizers*

- In about 1840 treatment of phosphate rock with sulfuric acid yielded an effective phosphate fertilizer, which was called superphosphate.
- The first successful commercial superphosphate production was started in England in 1842.
- The history of production of concentrated or triple superphosphate is associated with the production of phosphoric acid.
- The first known commercial production occurred in the 1870s in Germany.

## *Phosphate Fertilizers*

- **Triple superphosphate did not become an important fertilizer until the 1950s.**
- **Development of nitrophosphate fertilizer was started in Europe in the 1930s.**
- **Although ammonium phosphate had long been known to be an effective fertilizer and small quantities had been produced in several countries from time to time, it did not become a popular fertilizer until the 1960s.**



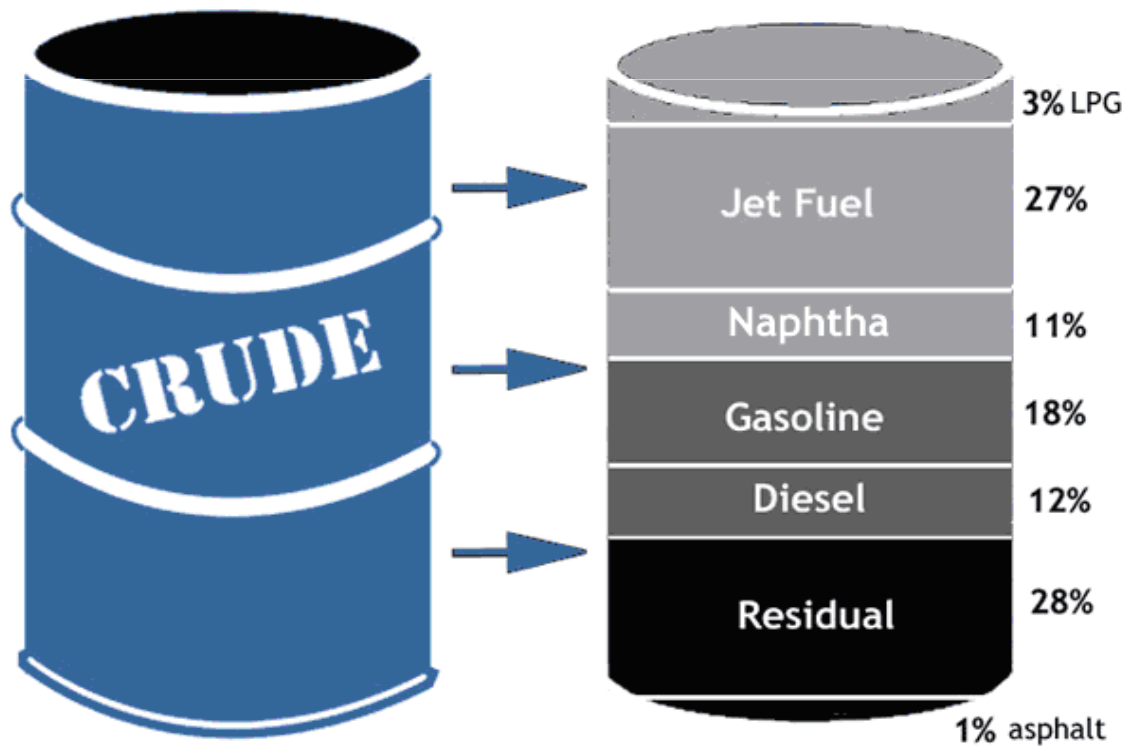
# *Phosphate Fertilizers*

- **Ammonium phosphates (diammonium phosphate and monoammonium phosphate) are now the leading form of phosphate fertilizer in the world.**
- **Several processes were developed, and subsequent improvements have added to their efficiency and improved the quality of the product.**
- **Early sources of phosphate rock were small deposits in England, Ireland, Spain, France, Germany and USA.**

# *Phosphate Fertilizers*

- **Most of these deposits are no longer mined because of their low grade.**
- **Present supplies are mainly from other areas of the USA, Russia, Morocco.**
- **Smaller outputs from Egypt, Tunisia, Algeria, Brazil, South Africa, Togo, Jordan, Senegal, and the Pacific Island.**

# *Nitrogen Fertilizers*



r. Mubarak

# *Nitrogen Fertilizers*

- **Coal contains about 1% nitrogen, about half of which is evolved as ammonia in byproduct coke ovens.**
- **Starting in the latter part of the 19<sup>th</sup> century, nitrogen became an increasing source of fertilizer nitrogen.**
- **Most of it was in the form of ammonium sulfate.**
- **Direct synthesis of ammonia from nitrogen and hydrogen was first carried out successfully on a commercial scale in Germany in 1913.**

# *Nitrogen Fertilizers*

- **Plants were built in several other countries after World War 1.**
- **Most of these plants derived their hydrogen-nitrogen synthesis mixtures from the reactions of coke with steam and air.**
- **The first ammonia plants were quite small, 25-50 tpd and the costs remained high.**
- **Much of the ammonia was used to produce explosives or industrial chemicals.**
- **Fertilizer use remained small because chemical nitrogen was too expensive for.**

# *Nitrogen Fertilizers*

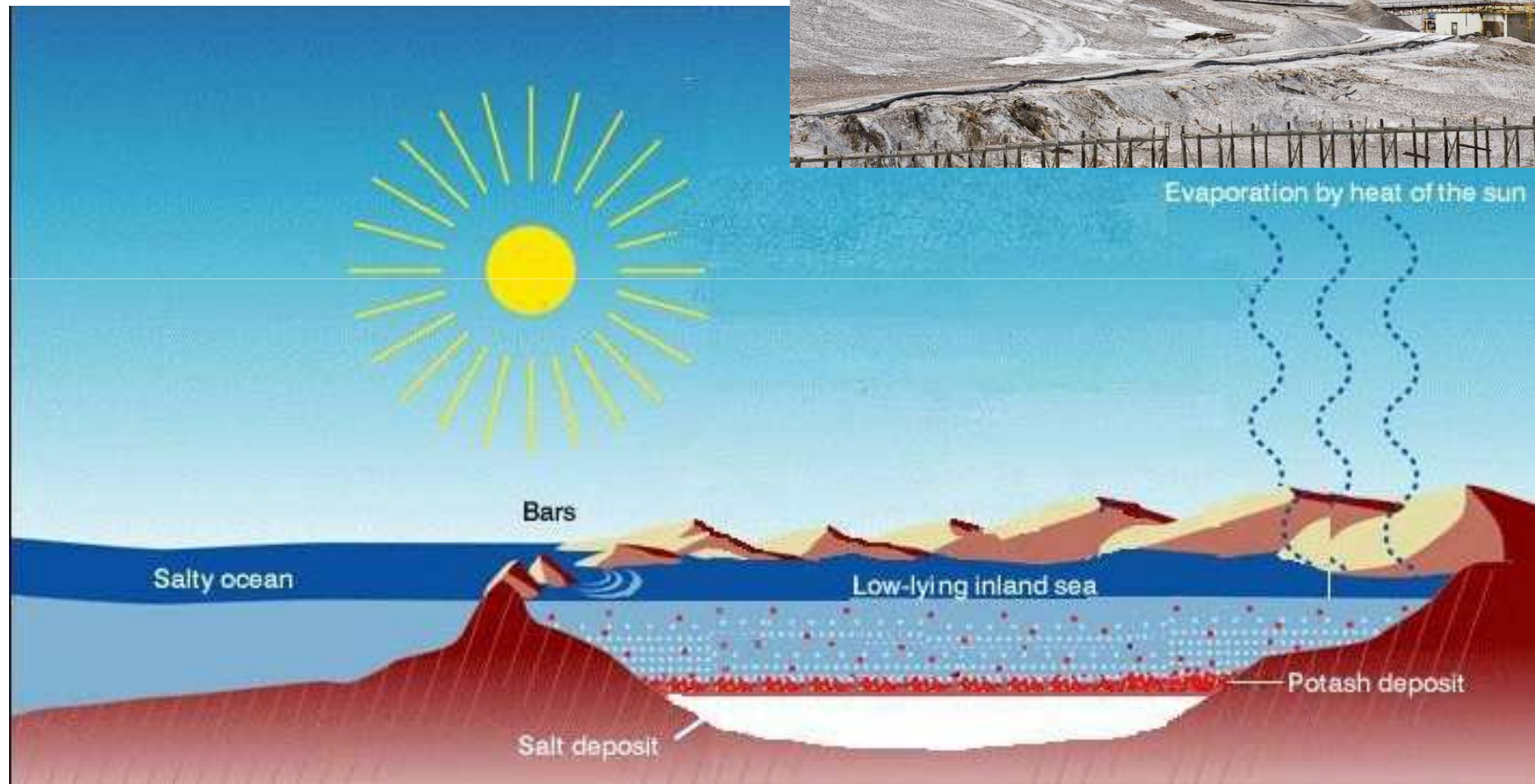
- **During the latter half of the 20<sup>th</sup> century, successive improvements in ammonia production have lowered the cost to the point that its liberal use in crop production is economically attractive.**
- **Notable among these improvements was perfection of processes for reforming natural gas or naphtha to supply the hydrogen-nitrogen synthesis gas and to increase the scale of operation.**

# *Nitrogen Fertilizers*

- **At first the final products- ammonium sulfate, calcium nitrate, sodium nitrate were all low-analysis materials (15 to 21% N).**
- **Ammonium nitrate (34% N) began to be an important fertilizer material in the 1940s.**
- **More recently, urea production (46% N) has grown rapidly and is now the world's leading form.**
- **Direct application of ammonia (82% N) to the soil, is popular in the USA, Canada, and Australia.**



# *Potash Fertilizers*





## *Potash Fertilizers*

- Early sources of potash were wood ashes, sugar beet wastes, and saltpeter.
- The salt deposits in Germany were opened in 1860 and dominated the world market for 75 years.
- Low-grade, unrefined ores such as manure salts (20-25%  $K_2O$ ) and kainite (19%  $K_2O$ ) were the first products.
- The development of refining methods gradually increased the grade of commercial products

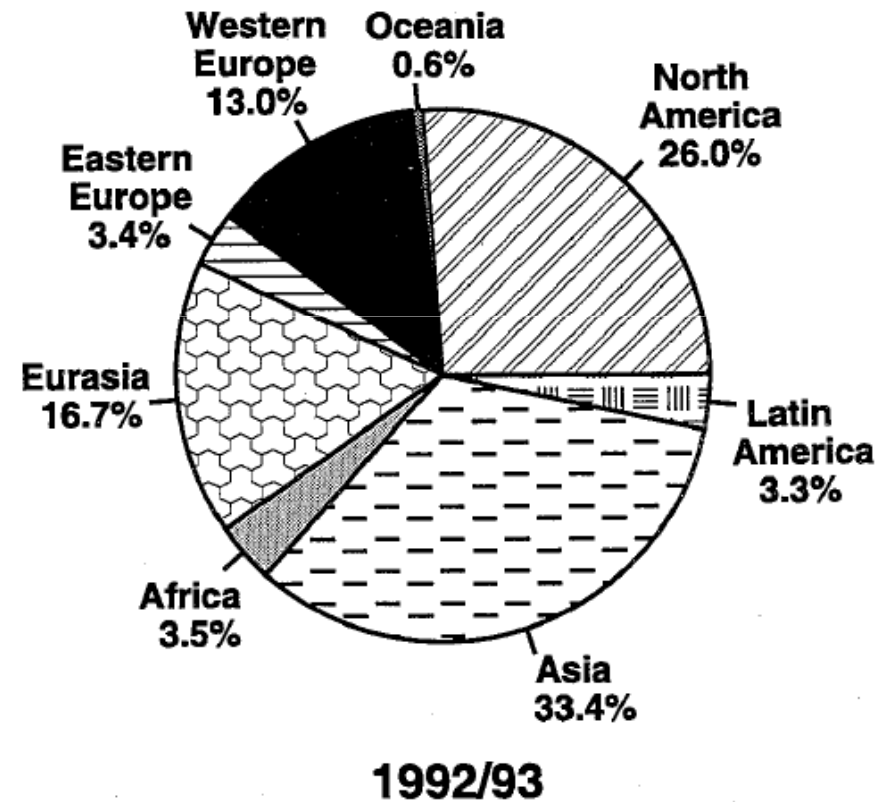
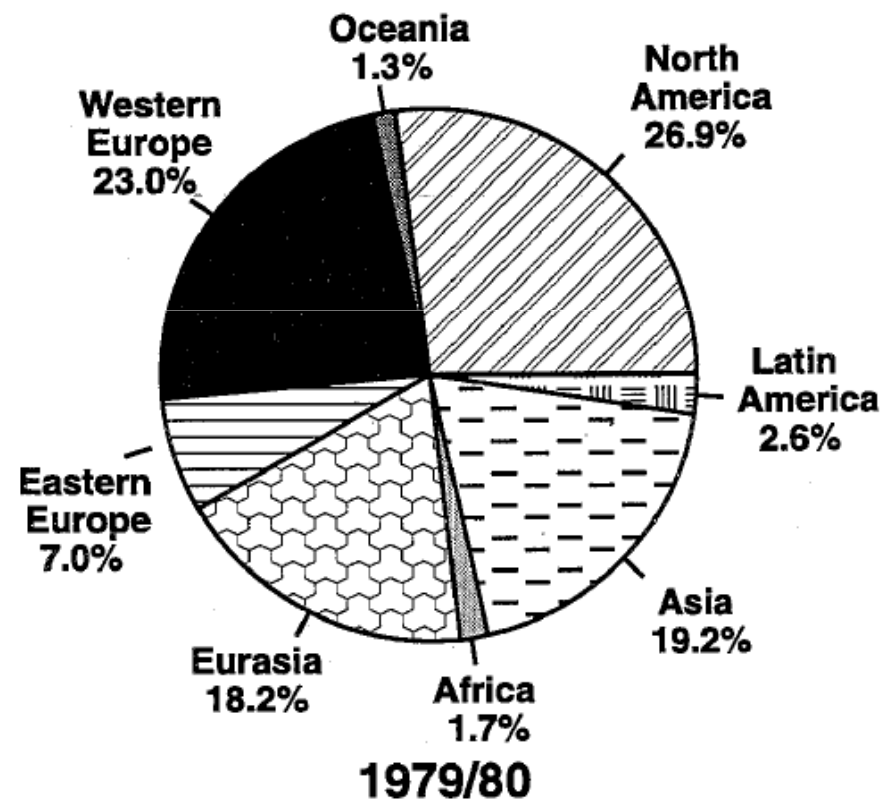
## *Potash Fertilizers*

- **High-grade potassium chloride (60-62%  $K_2O$ ) is now the main product.**
- **Potassium sulfate, and potassium nitrate are the principal nonchloride potash fertilizers.**
- **They are more expensive and hence are used primarily on crops or soils for which the chloride is unsuited.**
- **Important potash deposits were found in France, Spain, Russia, USA, Canada, and Dead Sea.**

# World Fertilizers Production

Year	Developing Countries <sup>a</sup>				Developed Countries <sup>b</sup>			
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	NPK	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	NPK
	----- (millions of nutrient tonnes) -----				----- (millions of nutrient tonnes) -----			
1960 <sup>c</sup>	0.74	0.44	0.18	1.19	8.49	9.34	8.69	26.52
1965	2.07	1.10	0.60	3.22	15.58	13.97	12.13	41.68
1970	3.87	2.17	0.87	6.13	26.36	18.19	16.57	61.12
1975	7.82	4.24	3.01	12.36	34.62	22.94	23.10	80.66
1980	17.72	6.20	0.40	23.96	41.90	27.06	25.81	94.78
1981	19.69	7.69	0.43	27.42	43.09	26.83	27.41	97.33
1982	20.61	7.46	0.48	28.12	41.68	24.23	25.61	91.51
1983	22.16	7.81	0.56	30.03	41.26	24.30	24.36	89.93
1984	23.65	8.59	2.20	32.46	44.17	26.51	27.68	98.36
1985	26.77	9.02	3.47	36.13	47.74	27.47	28.33	103.55
1986	26.92	8.90	5.70	36.39	46.18	25.74	27.72	99.63
1987	29.16	10.34	6.97	40.20	48.26	27.03	28.06	103.36
1988	31.94	11.48	7.97	44.21	50.34	27.66	30.02	108.03
1989	34.06	13.01	8.90	47.96	51.66	28.37	30.27	110.29
1990	35.46	12.17	9.76	48.60	49.19	27.56	27.35	104.11
1991	35.90	12.87	9.57	49.72	46.00	26.11	25.75	97.87
1992	36.49	13.67	10.54	51.22	44.13	24.94	23.93	93.00
1993	37.73	13.26	10.60	52.04	42.21	21.56	22.45	86.22
1994	38.02	12.42	11.53	51.60	41.35	19.34	19.34	80.04
1995	40.30	14.01	13.28	55.64	40.10	18.77	21.92	80.79

# *World Fertilizers Production*



# World Fertilizers Consumption

Year	Developing Countries <sup>a</sup>				Developed Countries <sup>b</sup>			
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	NPK	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	NPK
	----- (millions of nutrient tonnes) -----				----- (millions of nutrient tonnes) -----			
1960	1.67	0.76	0.30	2.73	7.87	8.99	7.83	24.68
1961	1.97	0.92	0.41	3.30	8.51	9.31	8.01	25.83
1962	2.19	1.06	0.41	3.67	9.39	9.87	8.25	27.51
1963	2.65	1.19	0.44	4.27	10.49	10.42	8.79	29.71
1964	3.11	1.44	0.55	5.10	11.64	11.48	9.45	32.58
1965	3.66	1.61	0.58	5.84	12.82	12.88	10.34	36.04
1966	4.42	1.93	0.65	7.00	14.67	13.87	11.46	40.00
1967	5.69	2.48	0.78	8.95	16.49	14.93	11.96	43.38
1968	5.71	2.48	0.96	9.16	18.50	15.66	12.96	47.12
1969	6.51	2.61	1.22	10.33	19.74	16.43	13.31	49.48
1970	7.52	3.08	1.28	11.88	20.95	16.72	13.93	51.60
1971	8.82	3.52	1.45	13.79	22.94	17.60	14.99	55.52
1972	9.44	4.02	1.54	15.00	24.10	18.41	15.80	58.31
1973	10.74	4.65	1.82	17.21	25.41	19.36	16.72	61.49
1974	11.63	5.45	2.22	19.31	27.58	20.42	18.18	66.17
1975	10.93	5.34	2.29	18.55	27.50	18.65	17.25	63.39
1976	13.68	5.73	2.16	21.57	30.74	19.87	19.21	69.83
1977	13.94	6.20	2.34	22.49	31.32	21.12	20.51	72.95
1978	17.51	7.31	2.87	27.70	31.61	21.24	20.07	72.91
1979	20.68	7.40	3.29	31.37	33.57	22.64	21.17	77.39
1980	22.54	8.28	3.64	34.46	34.68	22.91	20.41	78.01
1981	25.06	9.68	4.03	38.76	35.72	22.02	20.22	77.96
1982	25.25	9.34	3.82	38.40	35.21	21.61	19.93	76.75
1983	26.62	10.07	3.79	40.48	34.57	20.79	19.20	74.56
1984	29.58	10.84	4.07	44.49	38.09	22.24	21.48	81.81
1985	31.92	11.92	4.61	48.45	38.73	22.11	21.29	82.12
1986	31.36	11.01	4.37	46.74	38.47	22.22	21.19	81.88
1987	32.34	11.96	5.06	49.36	39.15	22.70	21.04	82.89
1988	36.06	13.78	5.98	55.82	39.54	22.91	21.32	83.77
1989	39.78	15.12	6.60	61.51	39.82	22.87	21.44	84.13
1990	40.70	15.23	6.30	62.23	38.49	22.16	20.59	81.24
1991	41.97	16.21	6.92	65.10	35.27	20.06	17.61	72.95
1992	42.47	17.54	7.37	67.38	33.00	17.75	16.20	66.95
1993	44.29	16.93	6.98	68.21	29.34	14.59	13.79	57.73

# *World Fertilizers Consumption*

