FERTILIZERS TECHNOLOGY

CHEM 0905554

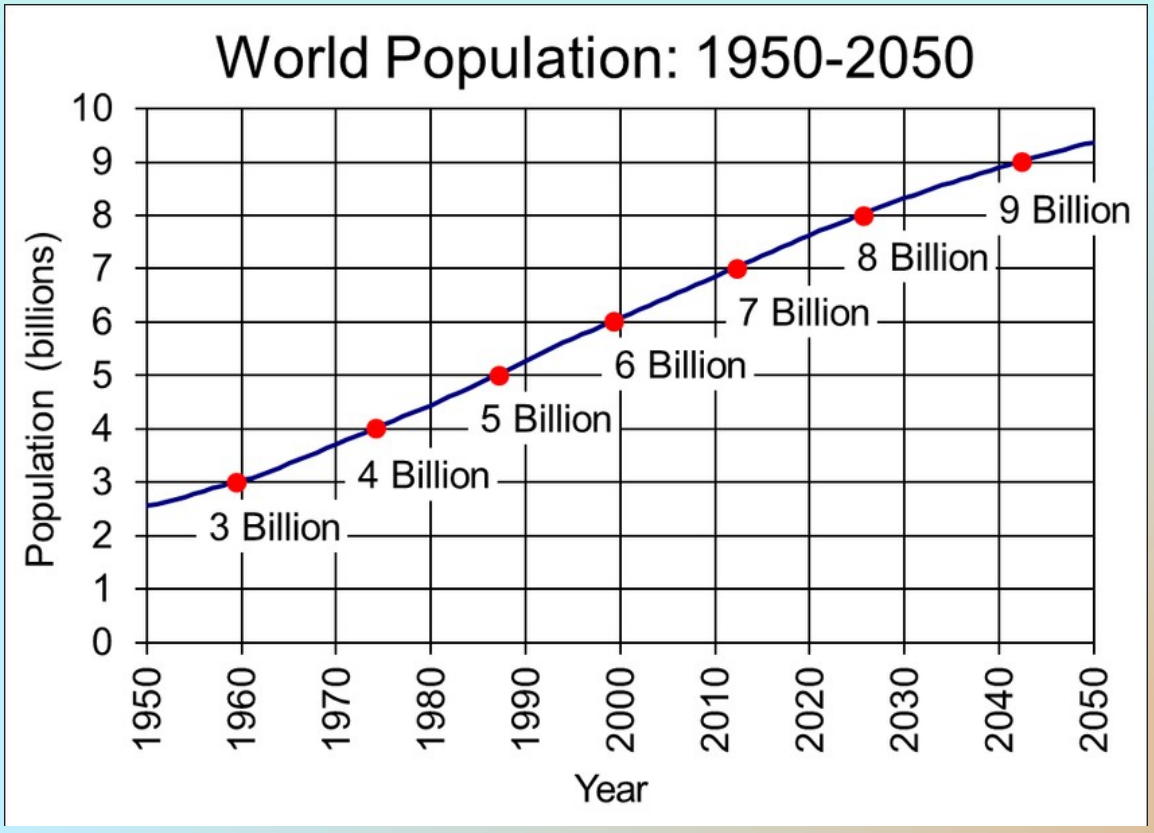
Second Semester 22/23

CHAPTER 2
HISTORY OF FERTILIZERS

INTRODUCTION

- 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.

WORLD POPULATION

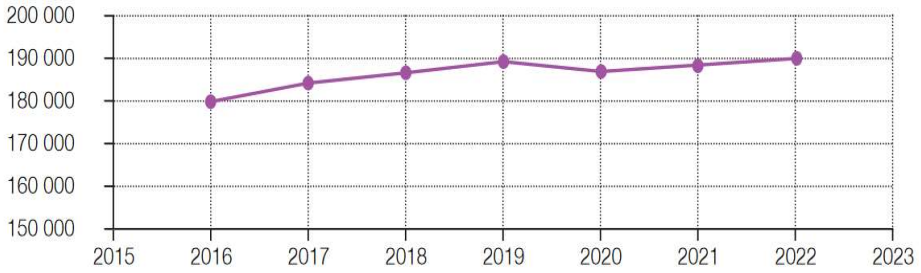


Soil Fertility

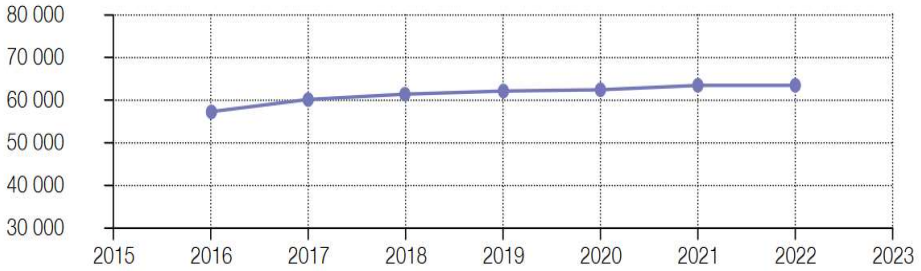
Crop	Yield (t/ha)	N	P_2O_5	K_2O	S
		(kg/ha)			
Rice	6	100	50	160	10
Wheat	6	170	75	175	30
Maize	6	120	50	120	25
White Potato	40	175	80	310	20
Banana	40	250	60	1000	15
Cotton	1	120	45	90	20

WORLD CAPACITY FOR PRODUCTION (Thousand Tones)

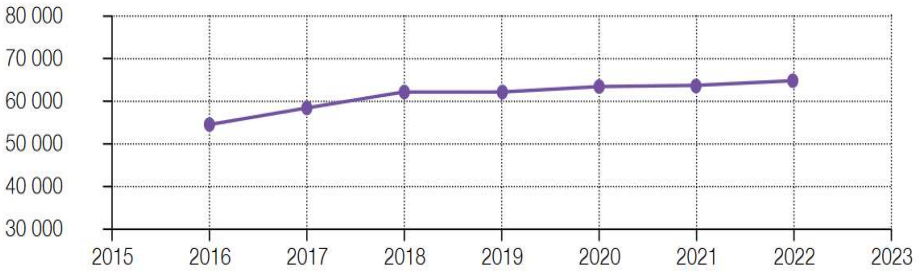
(a) Ammonia, as N



(b) Phosphoric acid, as P_2O_5

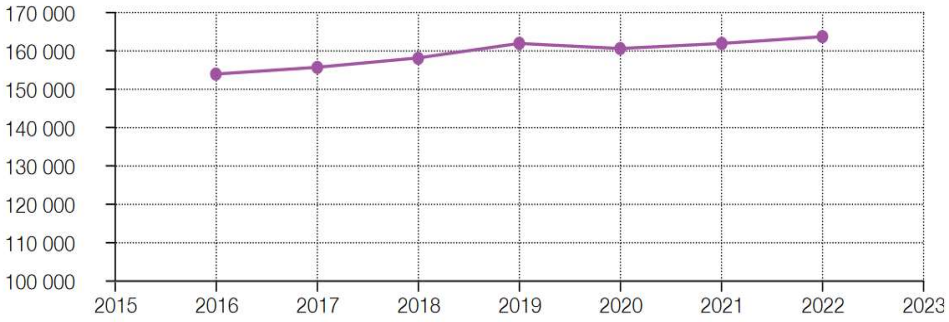


(c) Potash, as K_2O

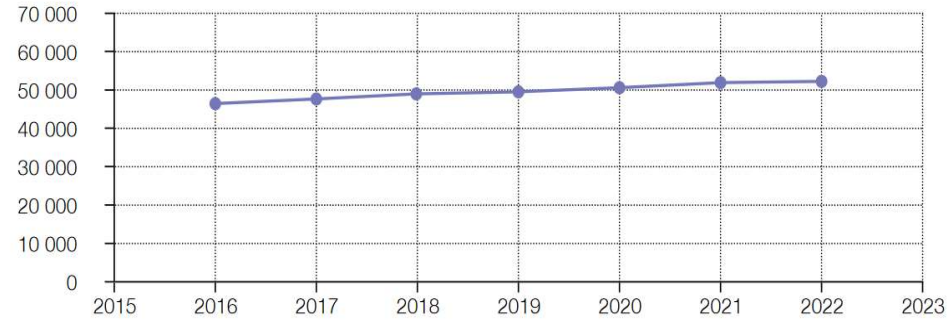


WORLD SUPPLY (Thousand Tones)

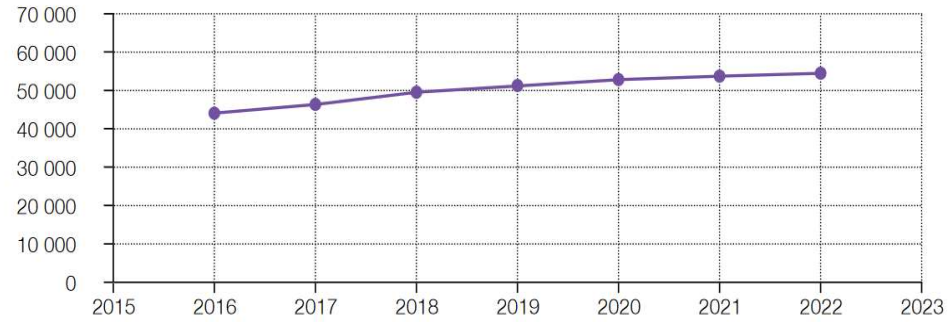
(a) Ammonia, as N



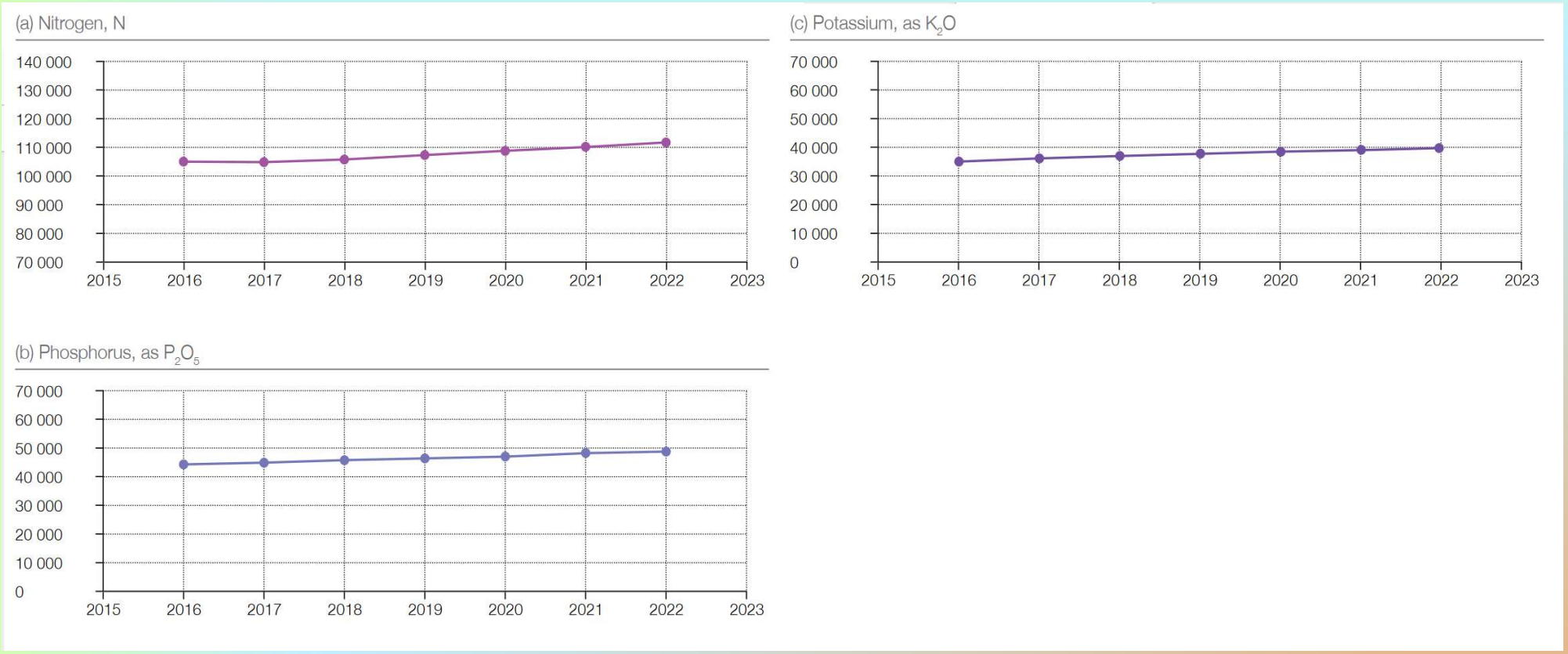
(b) Phosphoric acid, as P_2O_5



(c) Potash, as K_2O

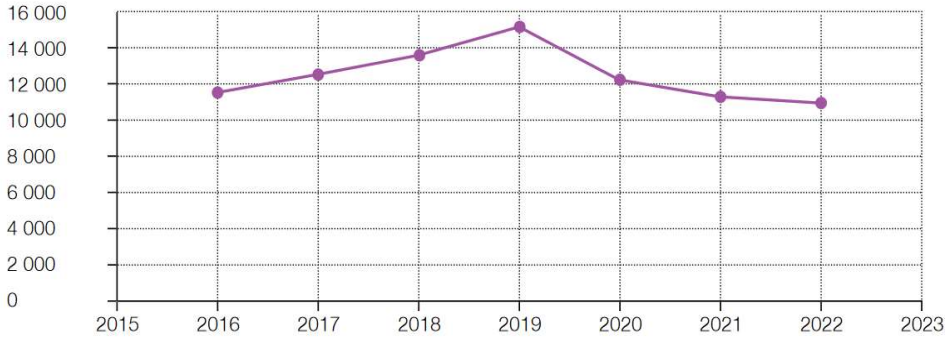


WORLD DEMAND (Thousand Tones)

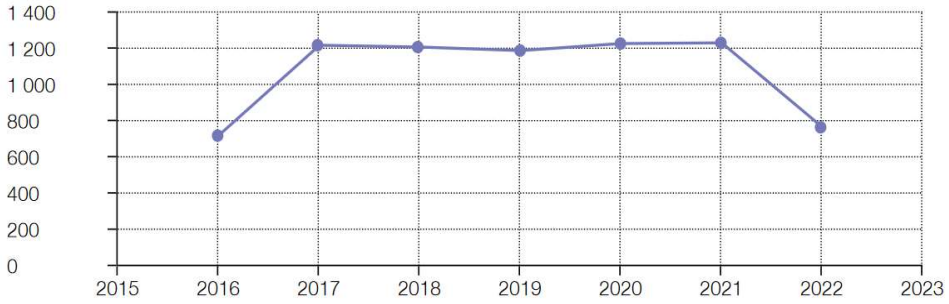


POTENTIAL WORLD BALANCE (Thousand Tones)

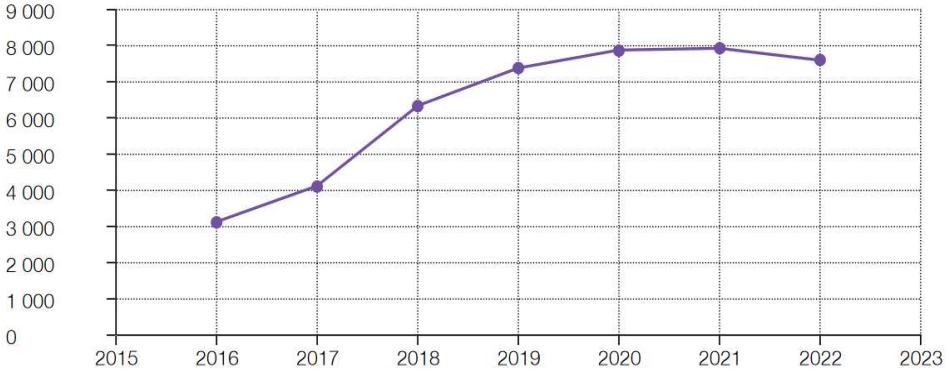
(a) Nitrogen, N



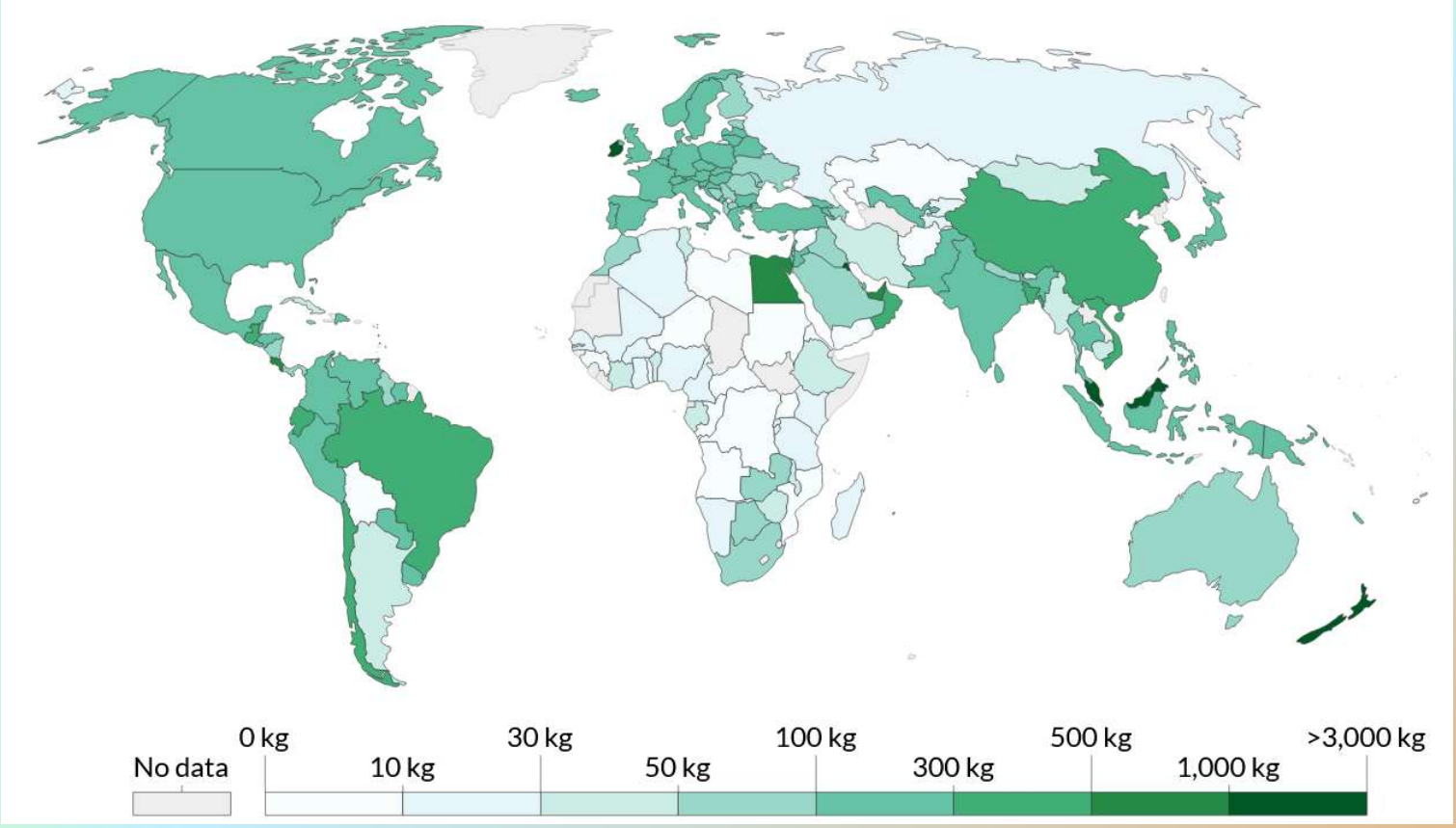
(b) Phosphorus, as P_2O_5



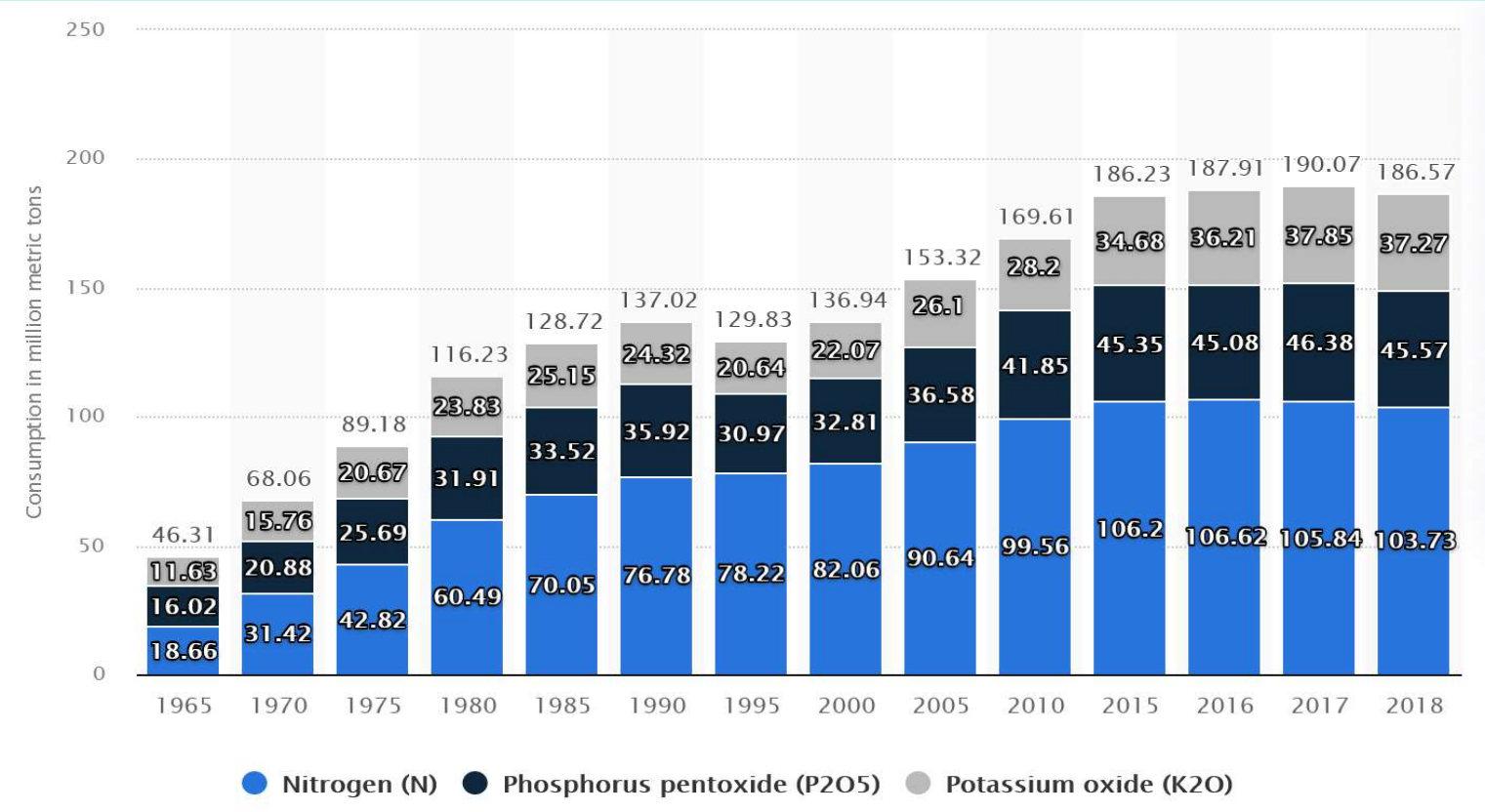
(c) Potassium, as K_2O



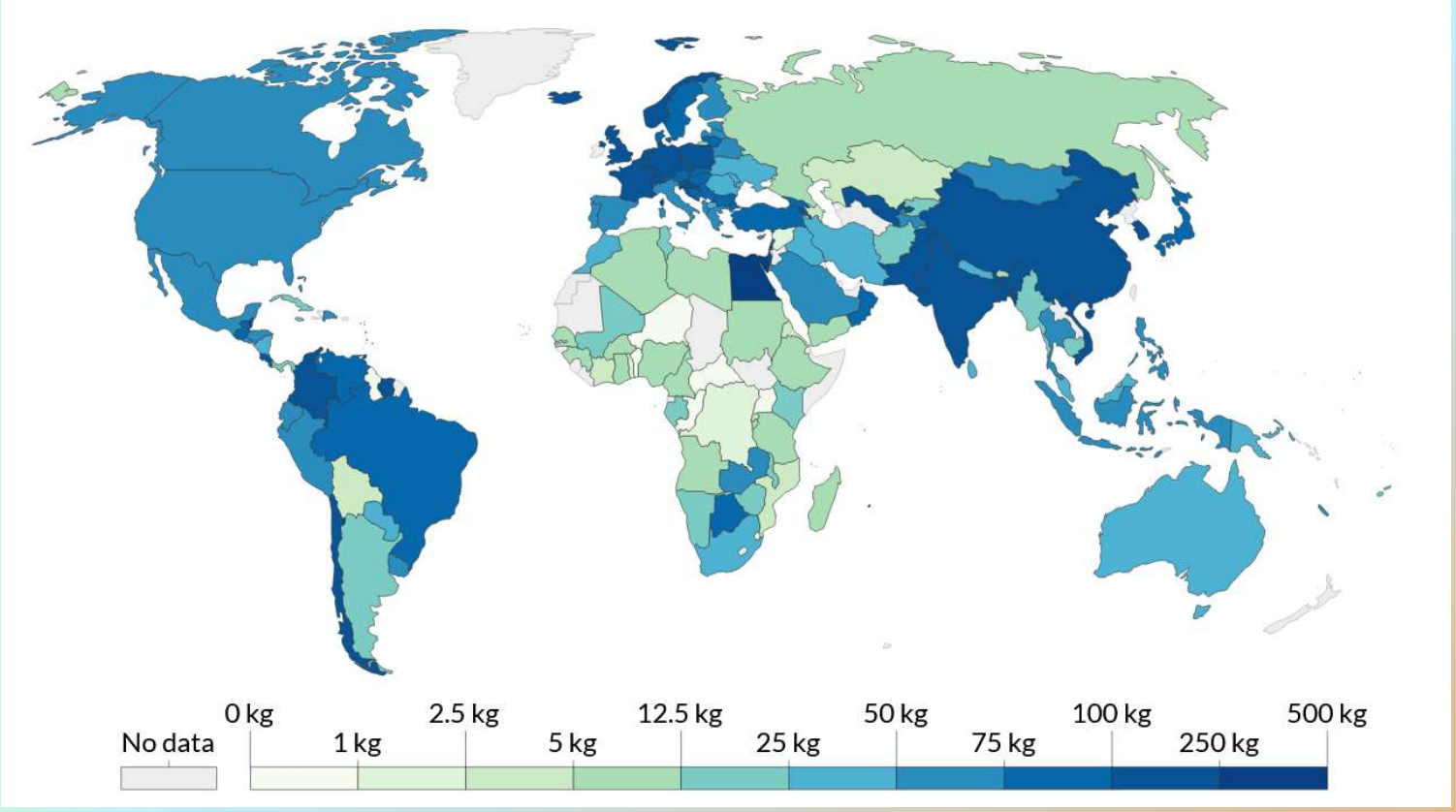
FERTILIZER USE PER HECTARE



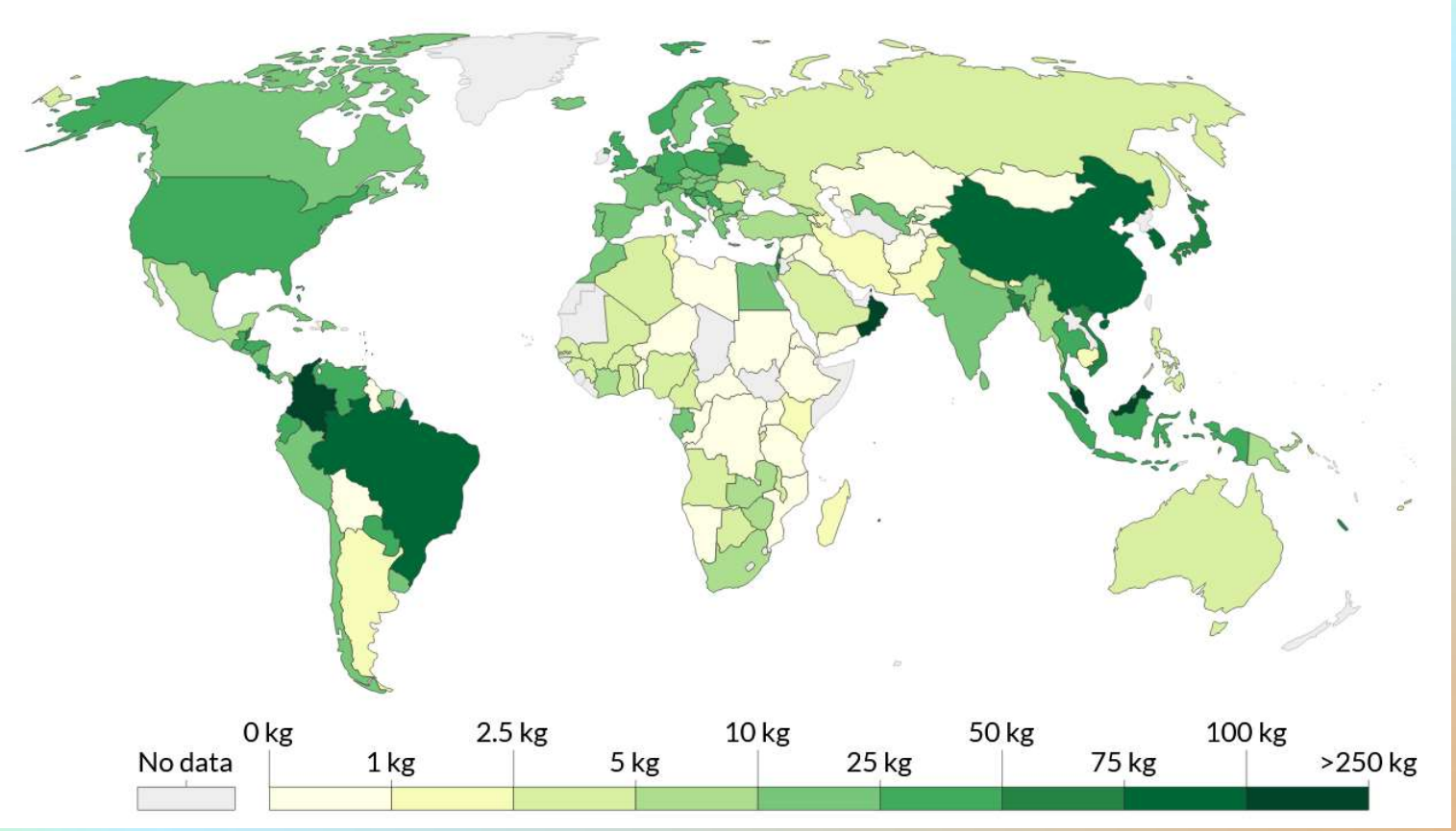
GLOBAL CONSUMPTION OF AGRICULTURAL FERTILIZER



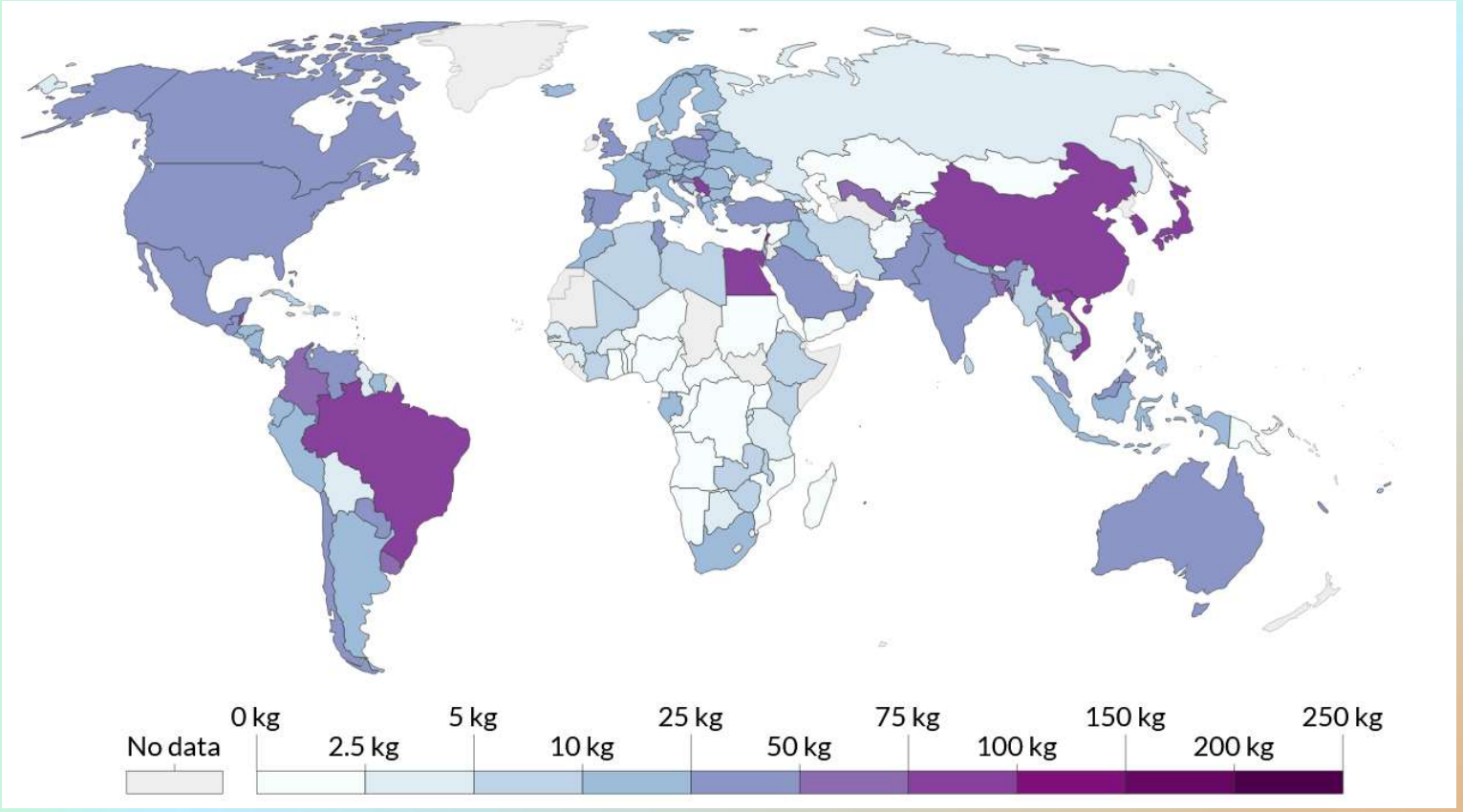
NITROGEN FERTILIZERS USE PER HECTARE



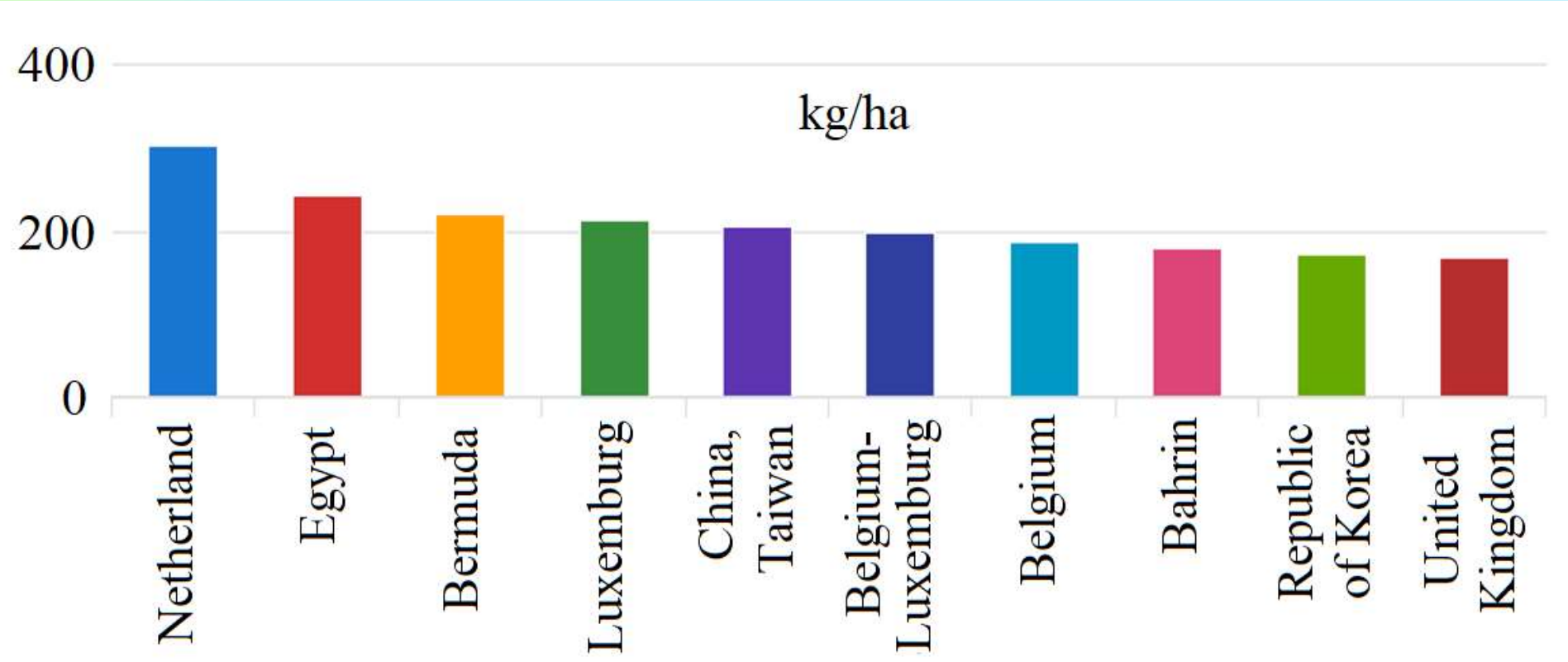
POTASH FERTILIZERS USE PER HECTARE



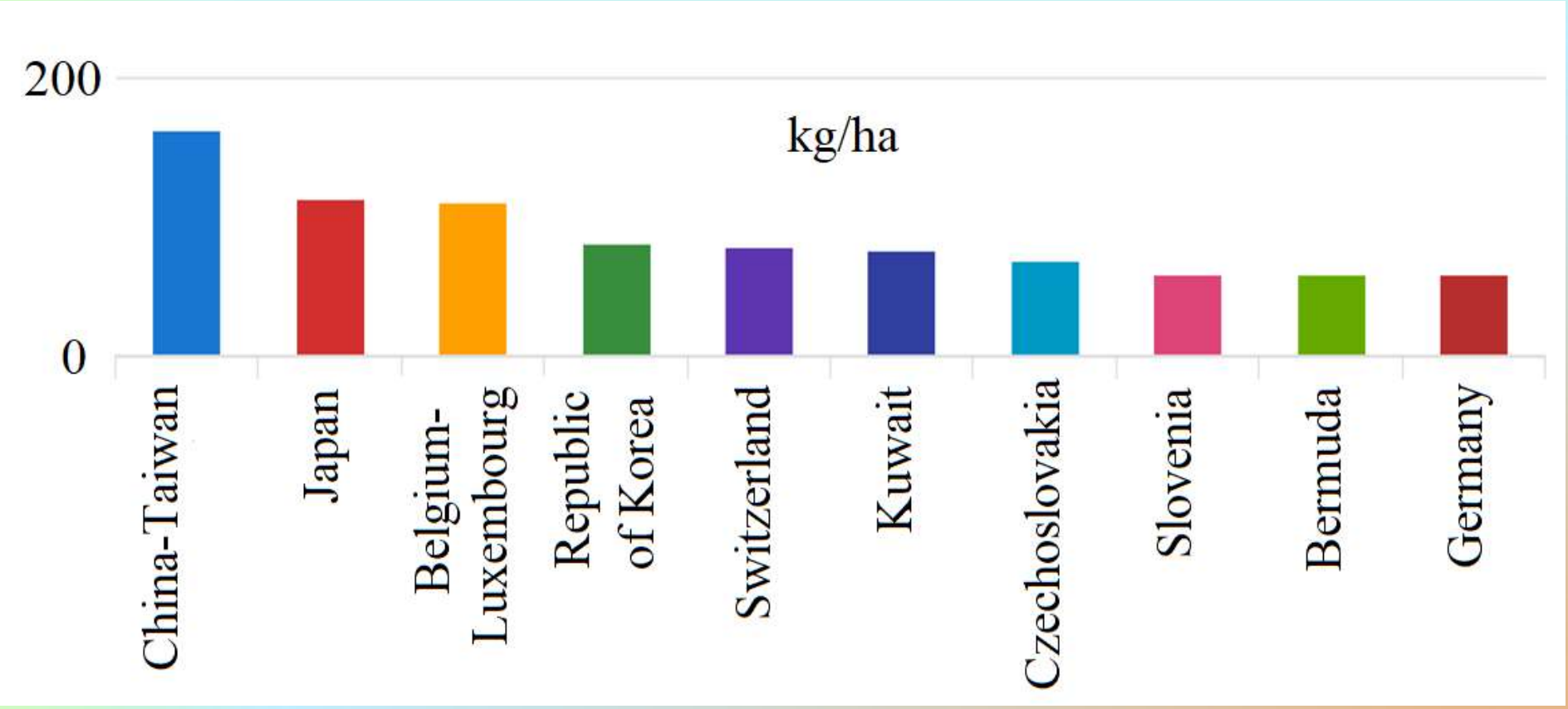
PHOSPHATE FERTILIZERS USE PER HECTARE



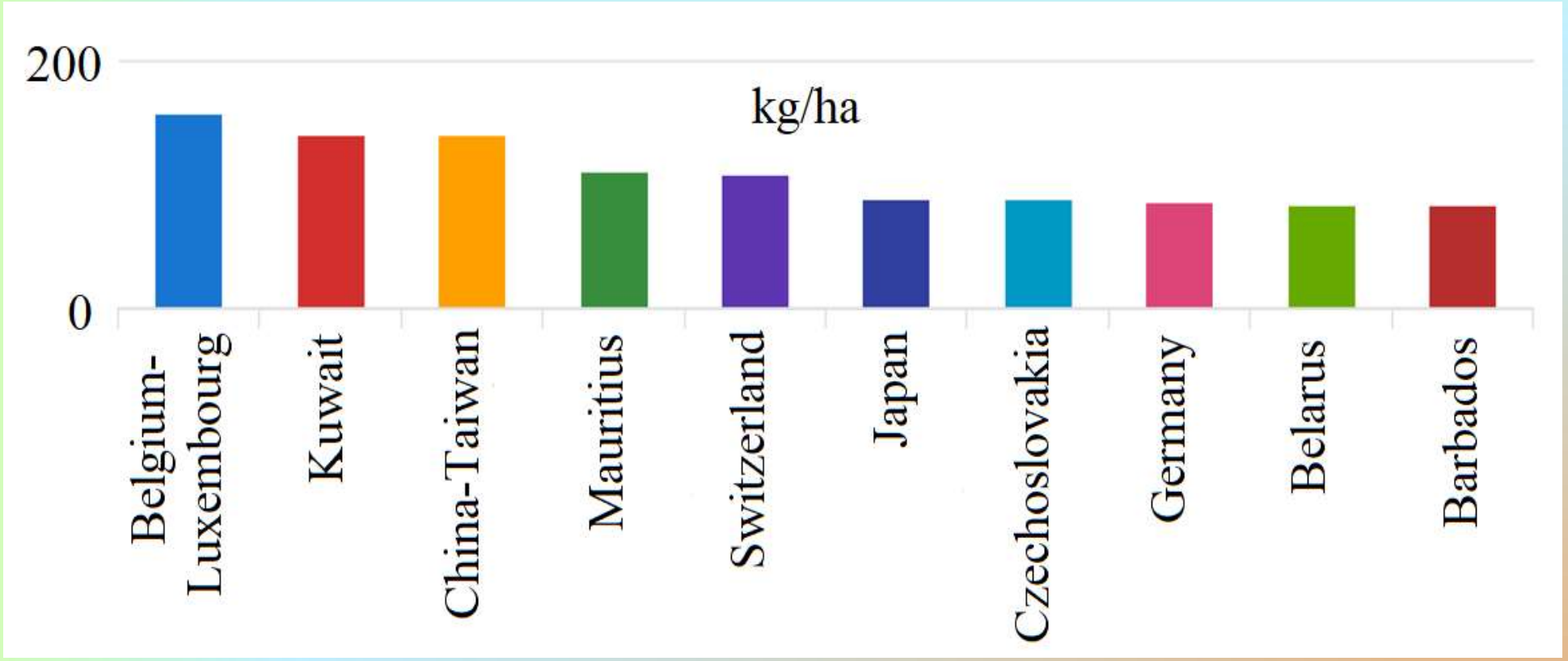
WORLD NITROGEN CONSUMPTION BY COUNTRY



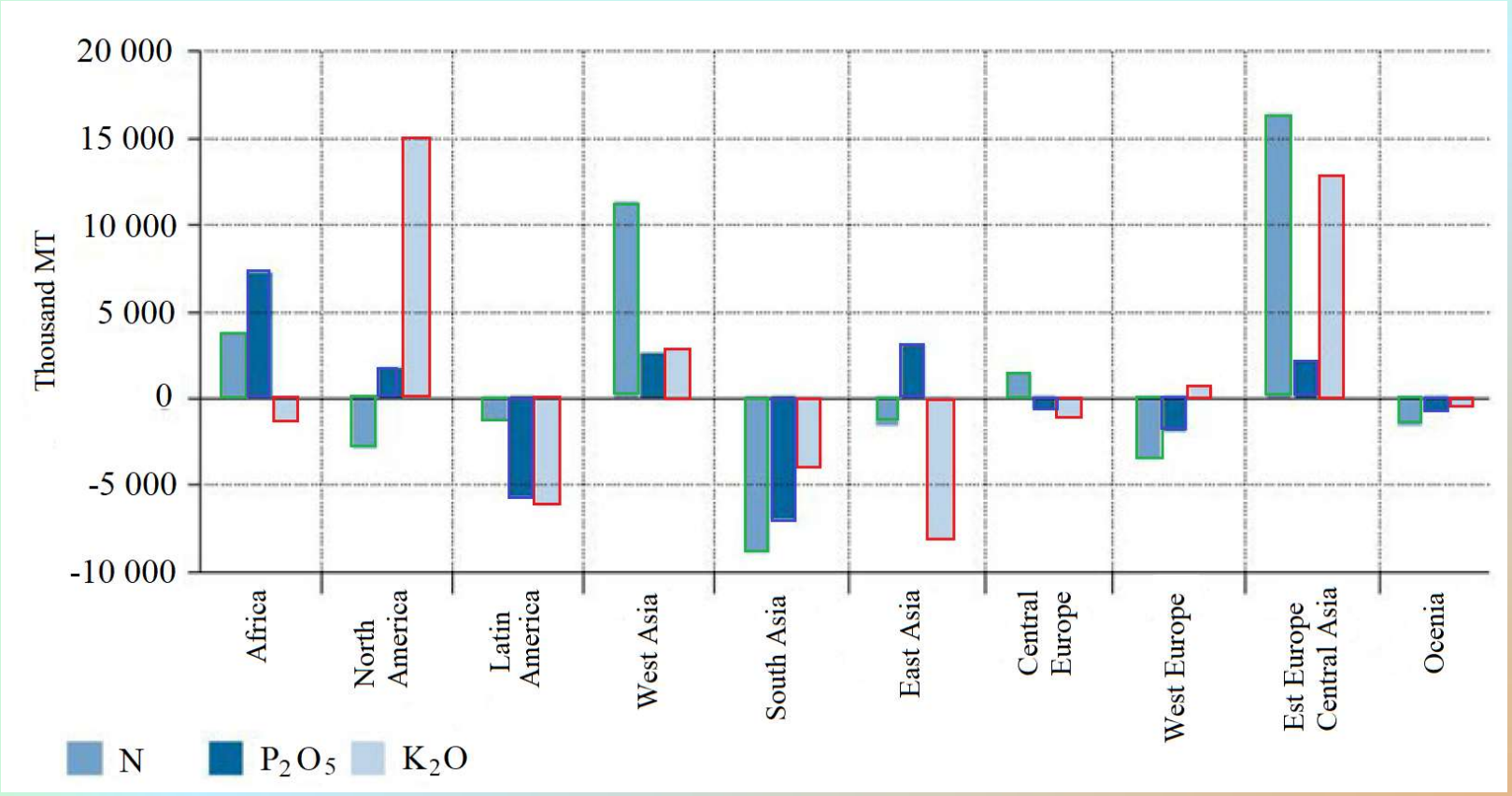
WORLD PHOSPHATE CONSUMPTION BY COUNTRY



WORLD POTASH CONSUMPTION BY COUNTRY



NUTRIENT BALANCES FOR THE WORLD



JORDAN - NITROGEN FERTILIZER PRODUCTION

PHOSPHATE FERTILIZERS

- The first phosphate fertilizer as such – ground bones - was used widely in Europe during the early part of the 19th 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 ROCKS DEPOSITS

- Early sources of phosphate rock were small deposits in England, Ireland, Spain, France, Germany and USA.
- 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.
- Jordan's proven reserves of phosphates stand at 1.5 billion tons, enough to last for the foreseeable future.

PHOSPHATE ROCKS

SUPERPHOSPHATE

- In about 1840 treatment of phosphate rock with sulfuric acid yielded an affective 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.
- Triple superphosphate did not become an important fertilizer until the 1950s.

SINGLE AND TRIPLE SUPERPHOSPHATE

Single Superphosphate

Triple Superphosphate

- The key difference between single superphosphate and triple superphosphate is that single superphosphate is produced from phosphate rock and sulfuric acid, whereas triple superphosphate is produced from phosphate rock and phosphoric acid.

AMMONIUM PHOSPHATE

- Development of nitro phosphate 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.
- 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.

MONO AND DIAMMONIUM PHOSPHATE

Granular MAP

Granular DAP

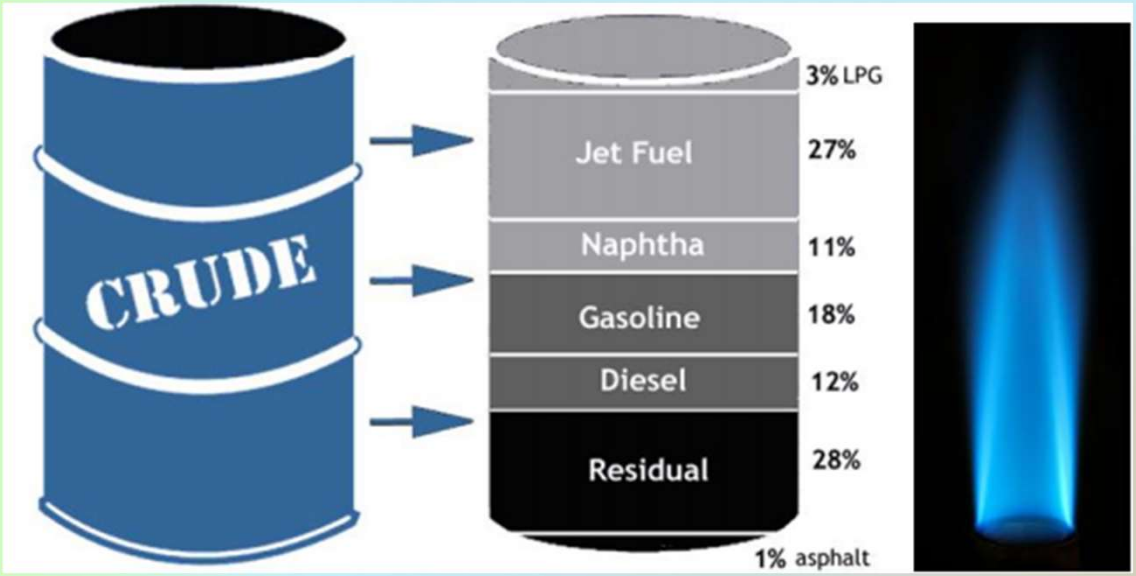
Crystalline MAP

Crystalline DAP

NITROGEN FERTILIZERS

- Nitrogen content in natural gas varies depending on the gas reservoirs.
- The nitrogen content in coal varies with rank reaching a maximum at approximately 85 wt% carbon content. This nitrogen is present virtually exclusively as organic nitrogen and typical nitrogen contents vary from 0.7 to 2.0 wt%.
- Half of the nitrogen exist in coal is evolved as ammonia in byproduct coke ovens.
- Starting in the latter part of the 19th century, nitrogen became an increasing source of fertilizer nitrogen.
- Most of it was in the form of ammonium sulfate.

NITROGEN RESOURCES



HISTORY OF AMMONIA

- Direct synthesis of ammonia from nitrogen and hydrogen was first carried out successfully on a commercial scale in Germany in 1913.
- 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.

HISTORY OF AMMONIA (Continue ..)

- During the latter half of the 20th 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.

OTHER 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.

OTHER NITROGEN FERTILIZERS

Ammonium Nitrate

Potassium Nitrate

Ammonium Sulfate

Diammonium Phosphate

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.

POTASSIUM CHLORIDE

- High-grade potassium chloride (60-62% K_2O) is now the main product.
- Potassium sulfate, and potassium nitrate are the principal non-chloride 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.

ARAB POTASH COMPANY