FERTILIZERS IN SOUTH AMERICA

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Like others living beings, the vegetals need food. The substances and/or products that provides essential nutrients to the vegetal growth and productivity are called fertilizers.

The components of the fertilizers can be listed in three fundamental categories: primary macronutrients [nitrogen (N), phosphorus (P) and potassium (K)]; secondary macronutrients [calcium (Ca), sulphur (S), and magnesium (Mg)] and the micronutrients [boron (B), chlorine (Cl), cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn)]. While the macronutrients, especially the primary, are used in greater proportions, in the order of kilogrames per hectare, the micronutrients, as indicates, are measured by grams per hectare.

Since men start to cultivate plants, observed that some additions, as grinded bones, living beings excrements and wood ashes are excellent auxiliaries in the agricultural production, although there weren't, until the XVIII century, any kind of secure research.

There are historical registers showing that systematic use of calcinated bones (basically calcium phosphate) as agricultural fertilizer started in the XVIII century (1770) in Sheffield and Yorkshire in England. Later, in France (Thiers and Puy-de-Dôme) and in Germany (Solingen), were used animals bones with the same purpose, but without previous grinding.(UNIDO 1980)

In the XIX century (1820), in England, besides the huge protests of German Justus Von Liebig, considered the father of the agricultural chemistry, started the importation of human skeletons from the Napoleonic wars, and even, from old cemeteries and catacombs. At the same age in France was discovered that calcinated animal bones(dark animal), were excellent as fertilizer in vegetables.

Meanwhile, the Incas, before the arrival of the Spaniards, used the guano (from huano, excrement in quichua language) as fertilizer; the same is made of excrement and residues of fishes and marine birds, transformed under dry climate in the coast island, as in Peru. Guano's contains 16% to 25% of urea and ammoniac; 16% to 20% of calcium phosphate and ammonia, and until 9% of sodium and potassium sulphate. Since 1860, guano started to be treated with sulphuric acid, with the objective to made it more avaliable in phosphorus for the agricultural use.

So it's possible to say, that the fertilizer industry had begun with guano and grinding bones, growing, particularly in Europe, at the half of XIX century, with the solubilisation of these raw materials with sulphuric acid.

Nitrogen used as fertilizer (before the discover of it's fixation from atmospheric air) had as principal source the sodium nitrate, abundant in Chile. The ammonium sulphate was a subproduct of the coal process. Another sources of nitrogen, although expensive, are the potassium and the ammonium nitrate. The other alternative is the calcium nitrate, that presents one advantage, because it's make more permeable the soil.

The potassium fertilizers are constituted by potassium chloride and sulphate, practically a monopoly of Germany, until the WWI. Since then, new mineral deposits, of this elements, were discovered, plus new methods were used to obtain it, as the burning of certain algas of the Pacific coast, recovery of certain gases form the chimneys of certain foundries and the utilization of certain metal slags.

From the three macronutrients (N, P and K), only phosphorus is obligationally obtained towards pre-existent sources, by mining them. The nitrogen can be obtained by fixation of atmospheric air. The potassium can be obtained from controlled crystallization of brines.

The phosphate rocks containing apatite (tricalcium phosphate) are the principal natural source of phosphorus, but to recover this element, from them, is necessary to change the original structure. This modification can be made by humid or dry process, liberating phosphorus for further applications.In the humid process, the phosphate rock (traditional name of the phosphatic concentrate) is initially attacked by inorganic acids - mainly the sulphuric acid - resulting in phosphoric acid and, from this latter, producing triple superphosphate (TSP) and ammonium phosphates (MAP and DAP), these two latter through reaction with ammonia. The dry process uses as soluble route the thermic treatment. The fusion of phosphatic concentrates in hot slags resulting from the production of iron alloys, for example, followed by a quick refrigeration (quenching), originated the fused thermophosphate, that is an excellent phosphate fertilizer.

In terms of consumption of N-P-K Latin America represents 7.9% of the world consumption, according to the last available data (year 1998); being included in Íbero-America the consumption of Spain this number arises at 9.5%.

According to the economic blocks, the following distribution exists (to see Table 1) of the world consumption of fertilizers, measured in thousands of tons of nutrients (N-P-K), regarding the year 1998.

Table 1- Consummate World of Fertilizers for Economic Blocks.

Economic block	Consumption in 10^3 t of nutritious	Participation
Socialist Asia	35,437	26.3%
North America	22,921	17.0%
South Asia	20,244	15.0%
Western Europe	17,998	13.3%
Latin America	10,673	7.9%
East Asia	8,939	6.6%
West Asia	5,592	4.1%
Ex-URSS	4,205	3.1%
Central Europe	3,554	2.6%
Oceania	2,911	2.2%
Africa	2,550	1.9%
TOTAL WORLD	135,024	100.0%

Reference: IFA *apud* ANDA.

Inside of Íbero-America the statistics shows Brazil (4th world place), Spain (12nd world place) and Mexico (20th world place) as the largest consumers of fertilizers being responsible, respectively, for 4.1%, 1.6% and 1.1% of the world consumption.

In terms of Brazil it deserves to be pointed out that the relationship N: P: K is 1: 1.48: 1.72, while the world relationship is 1: 0.40: 0.27. There is in Brazil a great relative consumption of phophorus and potassium, when compared its consumptions with the world average.

In Spain that relationship is 1: 0.52: 0.42, enhancing a variation above the average, although not very expressive, in the phophorus and potassium consumption.

With relationship to Mexico the relationship is 1: 0.24: 0.13 demonstrating a larger relative consumption of nitrogen and a tiny phophorus and potassium consumption, with relationship to the world average. The different relationships of consumption of N-P-K not just say respect to the soil type and climate of an area, as, still, to the crop type to which the fertilizer is destined.

For a consumption of N-P-K in the amount of 10,673 tons (Latin America), Brazil and Mexico together sums 6,948 tons, or around, 65% of the total consume. Spain already consumes about 12% of the fertilizers used in Western Europe.

The others Ibero-American countries, including Portugal, have smaller participation in the consumption of fertilizers. The Table 2, to proceed, shows that other countries out of Ibero-America, in spite of many times to possess inferior territorial extension to the one of Ibero-American countries, they have a larger consumption of fertilizers.

Table 2 - World consumption of fertilizers by Countries.

Country	Consumption in 10^3 t of nutrients	Participation
China	33,709	24.9%
United States	20,203	15.0%
India	16,195	12.0%
Brazil	5,492	4.1%
France	4,989	3.7%
Germany	2,857	2.1%
Canada	2,718	2.0%
Pakistan	2,659	2.0%
United Kingdom	2,316	1.7%
Indonesia	2,258	1.7%
Australia	2,184	1.6%
Spain	2,171	1.6%
Turkey	1,825	1.4%
Italy	1,815	1.3%
Poland	1,604	1.2%
Russian Federation	1,550	1.1%
Vietnam	1,544	1.1%
Japan	1,505	1.1%
Thailand	1,479	1.1%
Mexico	1,456	1.1%
Others	24,495	18.2%
TOTAL	135,024	100.0%

Reference: IFA *apud* ANDA.

If in the world production will be considered some raw materials and intermediate products for the production of fertilizers, such as ammonia, sulphur, sulphuric acid, phosphate rock and potassium, few countries of Ibero-America reach percentage that allows its exclusion of the general title of "Others". The Table 3, to proceed, supplies the data on the subject, considering the statistical ones more recent (year 1998).

Table 3 - Participation of Ibero-America countries in the production of raw materials and intermediate products for the production of fertilizers.

Producers / Products	World Production		Brazil Production		Chile Production		Mexico Production		Spain Production	
	In 10^3t	%	In10^3t	%	In 10^3 t	%	In 10^3 t	%	In 10^3 t	%
Ammonia (1)	104,943	100	949	0.9	-	-	1,449	1.4	-	-
Elementary Sulphur (2)	39,815	100	-	-	-	-	922	2.3	-	-
Sulphuric Acid (3)	155,108	100	4,506	2.9	2,900	1.9	4,221	2.7	2,984	1.9
Phosphate Rock (4)	137,895	100	4,421	3.2	-	-	-	-	-	-
Potassium (5)	25,470	100	315	1.2	-	-	-	-	-	-

Reference: IFA *apud* ANDA.

(1) - Measured in tons of N
(2) - Measured in tons of S
(3) - Measured in tons of H_2SO_4
(4) - Measured in tons of phosphatic concentrate
(5) - Measured in tons of K_2O

It still deserves prominence the production of sodium nitrate, in Chile, with total annual about 1 million metric tons and used as source of N, although of more restricted application due to the possibility of soil lixiviation.

It is obvious that the local absence of natural resources, compatible with the production of fertilizers, it interferes in the capacity of internal production of the same ones. The consumption restriction, even so, it is more determined by the largest or smaller agricultural expression and by the economic capacity of the countries.

Also of course the local production, when possible, allows a decrease of the use of strong money in the import of fertilizers.

This way, the first stage of a national program of fertilizers should be the geological knowledgement of the available resources, being followed the evaluation of the existent infrastructure that will interfere in the costs of the product and it can define advantages and disadvantages of the binomial production versus import.

In Brazil, for example, the production of phosphatic concentrates, starting from apatitic ore, contained in alkaline chimneys, is usually more expensive than the obtaining of concentrates starting from phosphorites (for example U. S. A. and North Africa).

Considering, however, that locations of the Brazilian deposits are close to the domestic agricultural border, becomes viable its use, besides for using national technology.

The imported product, although cheap in the origin, it joins not only the international marine freight, as, still, the port costs of import, besides the land freight until the use places inside the country.

The determination of the viability of a mining explotation depends therefore of local conditions that need study case by case.

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