Brazilian market aspects
Brazilian import and domestic production of NPK 2012

Source: ANDA and SIACESP, AMABrasil
Soybean and corn are responsible for 54% of Brazilian's fertilizer consumption.

## Table: Estimated delivery of fertilizers in Brazil (by crop)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Plantation area (1000 ha)</th>
<th>Total deliveries (1000 ton of products)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffe</td>
<td>2.347</td>
<td>2.359</td>
</tr>
<tr>
<td>Cotton</td>
<td>8.07</td>
<td>1.401</td>
</tr>
<tr>
<td>Forests</td>
<td>6.826</td>
<td>6.973</td>
</tr>
<tr>
<td>Rice</td>
<td>2.818</td>
<td>2.760</td>
</tr>
<tr>
<td>Trigo</td>
<td>2.431</td>
<td>2.178</td>
</tr>
<tr>
<td>Bean</td>
<td>4.172</td>
<td>3.900</td>
</tr>
<tr>
<td>Fumo</td>
<td>451</td>
<td>447</td>
</tr>
<tr>
<td>Pasture</td>
<td>1.921</td>
<td>1.962</td>
</tr>
<tr>
<td>Orange</td>
<td>984</td>
<td>1.000</td>
</tr>
<tr>
<td>Potato</td>
<td>138</td>
<td>152</td>
</tr>
<tr>
<td>Banana</td>
<td>539</td>
<td>507</td>
</tr>
<tr>
<td>Sorghum</td>
<td>770</td>
<td>745</td>
</tr>
<tr>
<td>Tomato</td>
<td>65</td>
<td>66</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>70.458</strong></td>
<td><strong>71.734</strong></td>
</tr>
<tr>
<td><strong>Outras</strong></td>
<td>4.855</td>
<td>5.134</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>75.313</strong></td>
<td><strong>76.868</strong></td>
</tr>
</tbody>
</table>

Source: LSPA - IBGE/CEPAGRO e ANDA
Growth rate 2005-2012 = 16% per year

2012 = 10% consumption of NPK fertilizers in Brazil

Prepared by Polidoro (2013)
Map of availability and restrictions of PEAT in Brazil

Mining restrictions in the areas of expansion of the OMF sector

Planted area with sugarcane – 2010.

**Source:** CanaSat.
Chickens - 2007
(Units)

Poultry distribution in Brazil

Fonte: IBGE
EMBRAPA SUINOS E AVES / NTOP
Santos Filho, Coldebele, Garagorry & Chaib Filho (2008)
Swine distribution in Brazil

Pigs - 2007 (Units)

Fonte: IBGE
EMBRAPA SUINOS E AVES / NTOP
Santos Filho, Coidebela, Garagorry & Chaib Filho. (2008)
Question

Is there enough raw material to meet the demand for the production of "organic fraction" of the fertilizer in Brazil?
IBGE (2010) – 38.4 millions of swines

Content of NPK residues of swines in Brazil

3.7 kg N m$^3$  3.3 kg P$_2$O$_5$ m$^3$  1.9 kg K$_2$O m$^3$

390,000 t N  348,000 t P$_2$O$_5$  201,000 t K$_2$O

IBGE (2010) – 5.8 billions de aves

2010 - 8 millions of tons of poultry litter

<table>
<thead>
<tr>
<th>Substance</th>
<th>Amount (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>240000</td>
</tr>
<tr>
<td>P$_2$O$_5$</td>
<td>256000</td>
</tr>
<tr>
<td>K$_2$O</td>
<td>352000</td>
</tr>
</tbody>
</table>

Content de NPK residues of poultry in Brazil

Other possible raw material

- Bone meal
- Brewery sludge
- Residue: grams, twigs and other organic wastes
- Resíduo de jardimagem
- Industrial restaurants wastes
- Bovine rumen

Other possible raw material
- 2006: Prohibited the use of chicken manure to feed ruminants (mad cow disease)

- Restrictions on poultry litter use in fertilization of pastures (Normative Instruction, N.º 25, July 2009 - MAPA): allowed to use when performed incorporation into the soil and grazing only after 40 days
Nitrogen losses by volatilization

Surface application of poultry litter promoted loss of 10.1 kg / ha of NH₃ at the end of 296 hours, this loss was 105 % higher than the loss in the other treatments.
Suitable raw materials

**Market**
- Peat
- Poultry litter
- Cakes in general (Castor bean, filter etc)

**Research and Development**
- Residues of swines
- Agroindustrial wastes (bone meal, Rumen etc)
IMPACTS EXPECTED BY THE USE OF ORGANOMINERAL FERTILIZERS:

• Increased domestic production of organo-mineral fertilizers.

• Decrease by at least 10% to 25% in 2020, the external demand for NPK in Brazil.

• Reduction of environmental pollution risks of pig farming activities, poultry, cattle and sugarcane cutting activities.

• Increased agronomic efficiency of fertilizer by at least 20% in the crops that use organo-mineral fertilizers.

• Diversify and decentralize the economic and regional fertilizer production in Brazil.

OPPORTUNITY FOR THOSE WHO OWNS THE ORGANIC RAW MATERIAL, MAINLY WASTES
Technological aspects
Technological dogmas of organomineral fertilizers

- They are more effective than mineral fertilizer
- CEC increases and improves soil structure
- Promote benefits on soil microflora

Opportunities for scientific research
This scenario can lead to some inconsistent technical positions in the national market:

• Recommendation of the same dose of organomineral fertilizer in relation to the NPK fertilizer

• Ex. 450 kg/ha of NPK para sugarcane

• Formula NPK:
  • organomineral 3 – 17 - 10 + micronutrients
  • Mineral 8 – 28 - 16

Increase of approximately 50 % of agronomic efficiency of nutrients
Soybean yield, kg ha\(^{-1}\) vs. Fertilizer, kg ha\(^{-1}\)

- **Organomineral 20% P2O5**
  - Equation: \(y = -0.005x^2 + 2.4077x + 2575.7\)
  - \(R^2 = 0.87\)

- **SSP 21% P2O5**
  - Equation: \(y = 0.93x + 2577.6\)
  - \(R^2 = 0.70\)

"Economy" of 50% of fertilizer

Benites et al. (2012)
Tabela 2. Componentes de produção e produtividade de trigo, fertilizado com diferentes fontes de nutrientes

<table>
<thead>
<tr>
<th>Adubação</th>
<th>Altura de planta cm</th>
<th>Espigas por m² n°</th>
<th>Grãos por espiga n°</th>
<th>Massa de mil grãos g</th>
<th>Produtividade kg ha⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral</td>
<td>56,9 a</td>
<td>425,1 a</td>
<td>15,1 b</td>
<td>36,8 a</td>
<td>1.655 a</td>
</tr>
<tr>
<td>Orgânica</td>
<td>56,9 a</td>
<td>424,3 a</td>
<td>16,0 ab</td>
<td>37,6 a</td>
<td>1.599 a</td>
</tr>
<tr>
<td>Organomineral</td>
<td>59,2 a</td>
<td>430,2 a</td>
<td>17,6 a</td>
<td>33,9 a</td>
<td>1.684 a</td>
</tr>
<tr>
<td>CV (%)</td>
<td>2,32</td>
<td>10,45</td>
<td>6,67</td>
<td>8,99</td>
<td>11,50</td>
</tr>
</tbody>
</table>

Média seguida da mesma letra, na coluna, não diferem estatisticamente entre si pelo teste de Tukey a 5% de probabilidade.

DECREE N. 4.954,
JANUARY, 14, 2004

Organomineral Fertilizer (OM): product resulting from the physical mixture or combination of mineral and organic fertilizers

BRAZILIAN NORMATIVE N. 25,
JULY, 23, 2009
OM Garanties

**Solid organomineral fertilizer:**
- Total organic carbon: minimum of 8%
- CEC minimum: 80 mmol$_c$/kg
- NPK sum higher than 10%
- Maximum humidity 30%

**Fluid organomineral fertilizer:**
- Total organic carbon: minimum of 3%
- NPK sum higher than 3%
- Micronutrientes sum higher than 1%

**Soil application**

**Foliar application**
- Total organic carbon: minimum of 8%
- Total organic carbon: minimum of 6%
Technologies in production of solid organomineral fertilizers:

- POWDER ("Farelado")
- PELLETED BY EXTRUSION
- GRANULAR
Limitation of powder organomineral fertilizers by large-scale application
Techniques to produce organomineral fertilizer
OMF produced with agroindustrial wastes:

“Intelligent” environmental solutions and higher agronomic efficiency than the direct use of wastes in agriculture
Advantages and disadvantages of composting
There is no FAST composting
Process problem: N-NH₃ emission in composting

Recent researches for minimize losses:
- Use of urease inhibitors
- Application of natural zeolites (mineral silicate)

During the compost rolling, the emission of N-NH₃ can be greater than 5x

Source: Lourenço; Corrêa; Higarashi (2010)
Organomineral Fertilizer
Embrapa Technology

Chicken manure + MAP
KDS Micronex™ Process Flow

grinder-dryer which grinds and dries materials in a single-step process without needing any heat input.
• NPK in the granule

The mixture between the organic and the mineral portion (at least in part) should be performed at the time of processing waste (composting) or during the granulation process.

Organic matter + MAP

5 - 20 - 2

Organic matter + H$_3$PO$_4$

2 - 20 - 2

Photo: José Carlos Polidoro
Compatible with machines and implements that already exist on production systems
Conceptual model of a phosphatic organomineral fertilizer produced with filter cake, chicken manure or pig manure (organic compost)

It can be produced with soluble NPK sources and micronutrients

natural phosphates, agrominerals potassium, organic nitrogen sources, etc.

• Photo: V.M. Benites
Advantages

• The "retention" time of the raw material in fertilizer production is minimal;
• Homogeneity of the mixture;
• High granulation efficiency (>90%);
• Elimination of biological contaminants (helminth eggs and enteropathogenic microorganisms);

Disadvantages

• No production of humified organic compound in the process (possible problem with the product registration as organomineral fertilizer, CEC < 80 mmol$_c$ kg$^{-1}$)
Opportunities for technological innovation in organomineral fertilizers production

- Development of biological processes for partial solubilization of natural phosphates
- Optimization of the physical characteristics of organomineral fertilizer for compatibility with mixed mineral granules
- Agronomic efficiency evaluation in long-term experiments
- Incorporation of micronutrients in the formula
- Incorporation of functional microorganisms
- Different formulas
- Multinutrients granules
- Association of readily soluble sources and intermediate solubility
average 5 seasons

\[ y = -0.1074x^2 + 17.51x + 2597 \]
\[ R^2 = 0.8973 \]

\[ y = -0.1519x^2 + 20.389x + 2623.9 \]
\[ R^2 = 0.9543 \]

\[ y = -0.1025x^2 + 14.238x + 2682.2 \]
\[ R^2 = 0.9492 \]
Agronomic evaluation

National Network of Agronomic Experiments

84 planned field experiments

Experimentos com Fertilizantes da Rede FertBrasil

Legenda
- Fosfatados
- Nitrogenados
- Organominerais
- Insumos Biológicos
- Fontes de Enxofre e Magnésio
- Micronutrientes e Substâncias Bioativas
THANK YOU!

“Chinese View”