# SIG para AP

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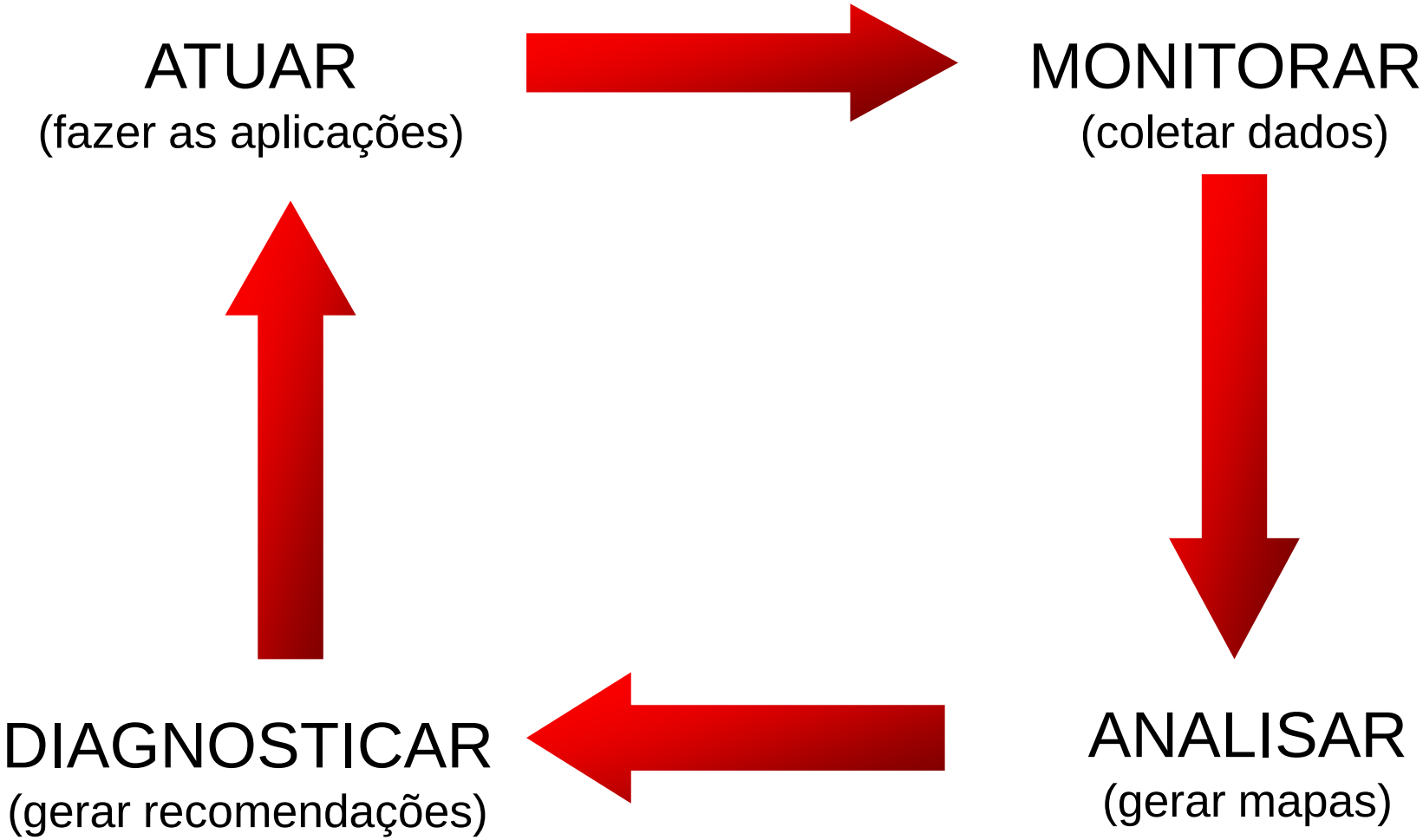
Laboratório de Agricultura de Precisão

www.agriculturadeprecisao.org.br

# Objetivo

Abordar conceitos básicos de SIG e uma visão de mercado sobre SIG dedicados à agricultura de precisão

# Ações


ATUAR
(fazer as aplicações)
MONITORAR
(coletar dados)
ANALISAR
(gerar mapas)
DIAGNOSTICAR
(gerar recomendações)

# Sistema de Informação Geográfica – SIG (GIS)

- SIG é software
- Essencialmente permite trabalhar com dados georreferenciados:
  - organização
  - edição
  - análise
  - visualização
  - armazenamento

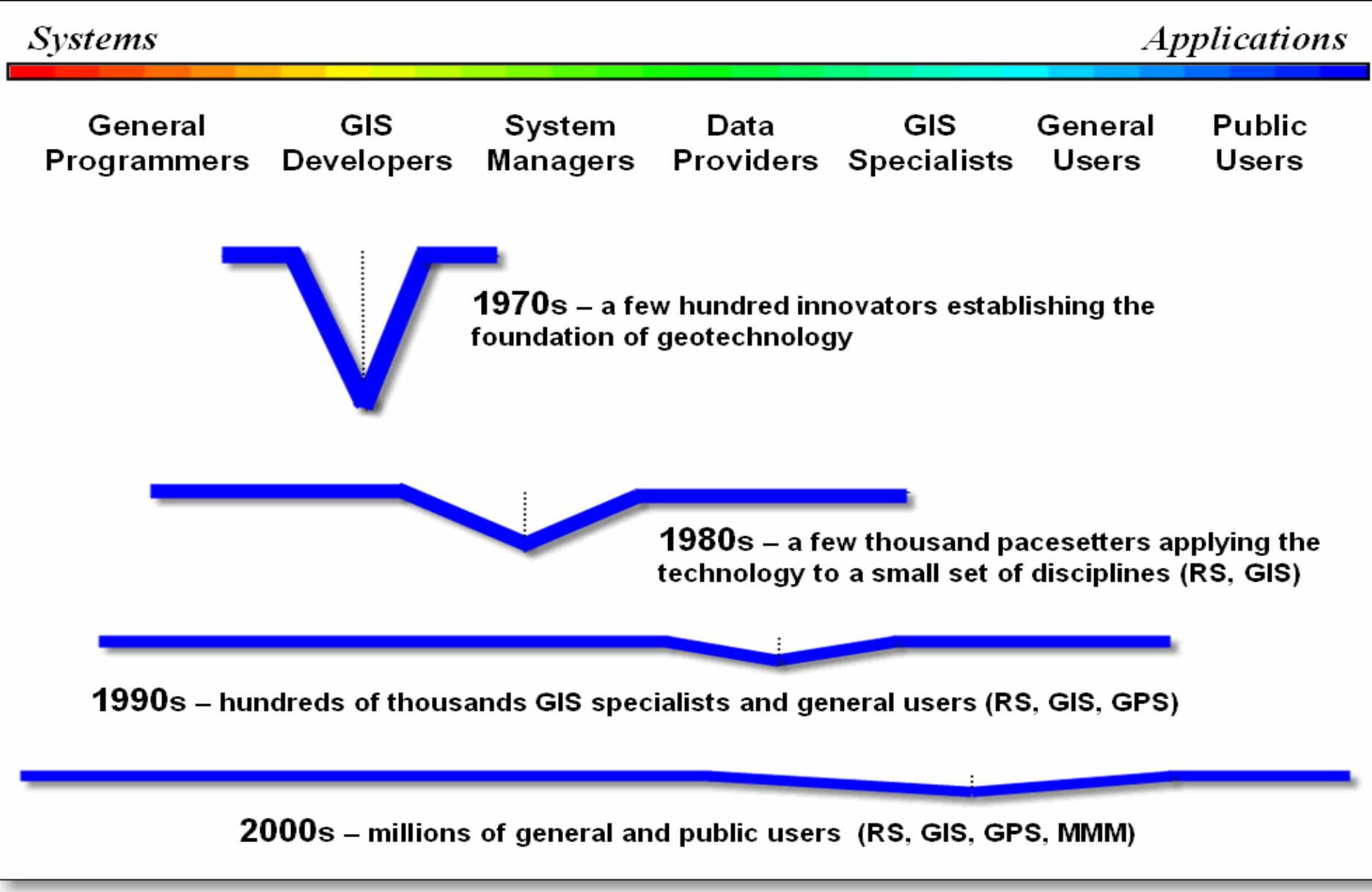
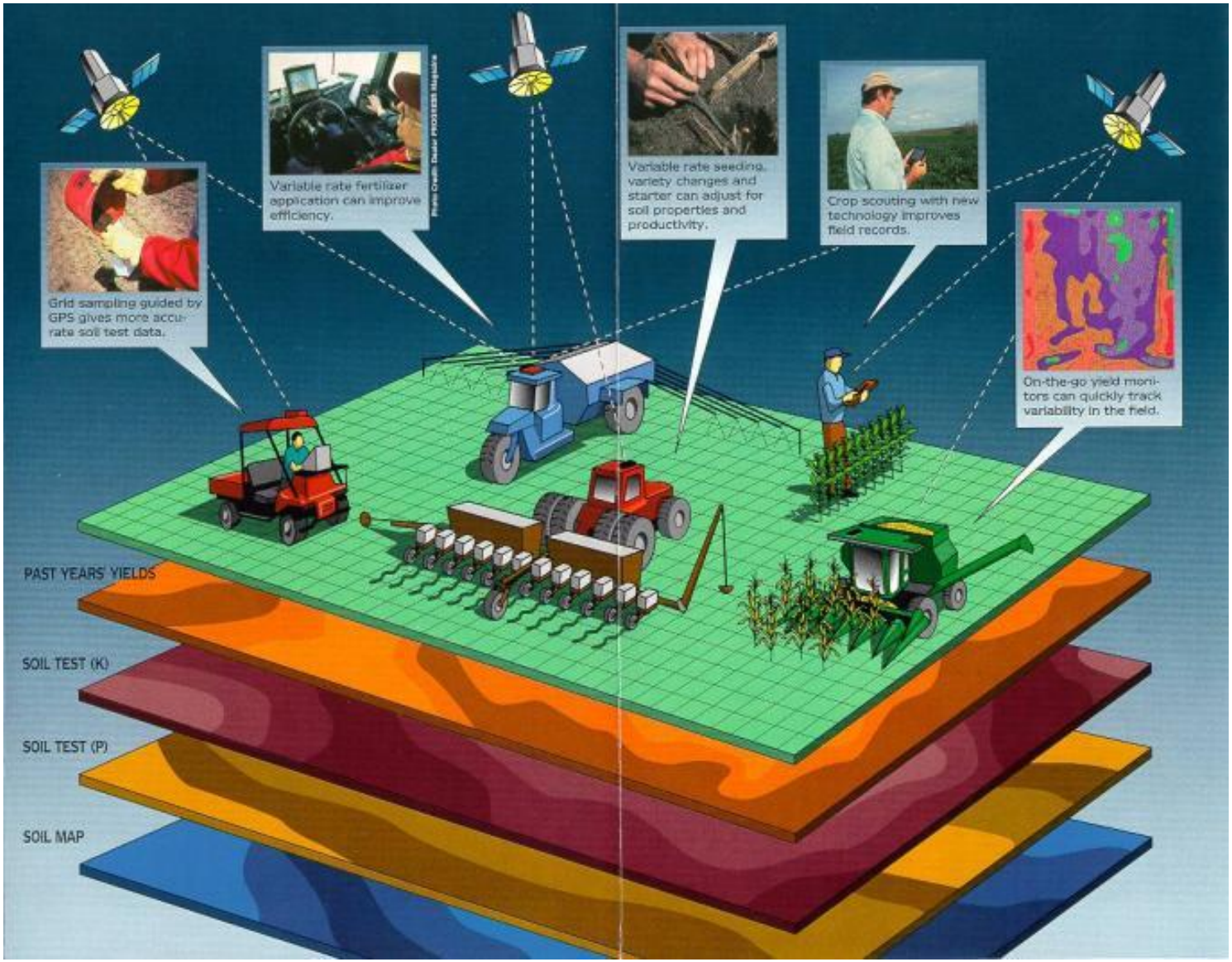
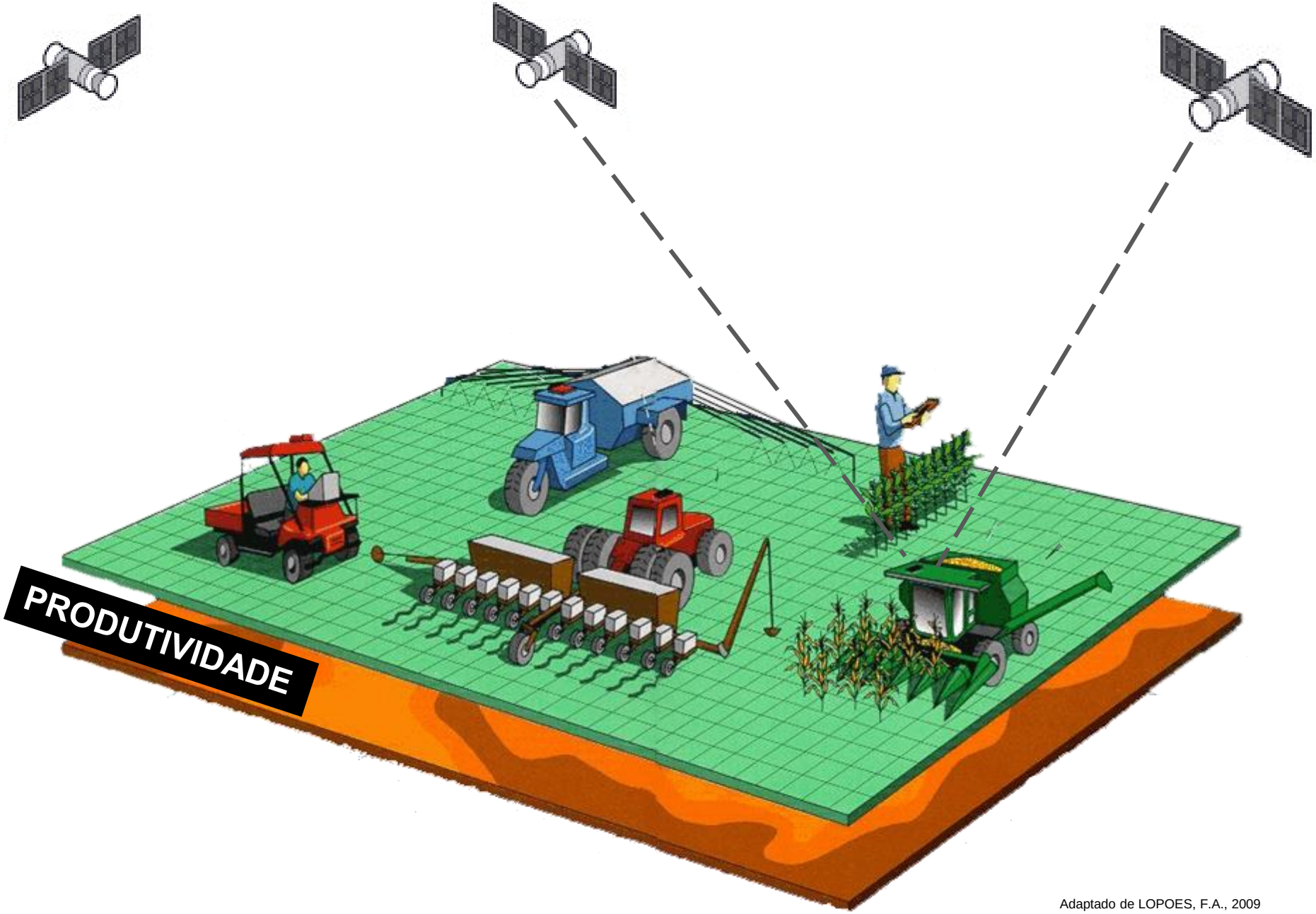



Figure 41.1. The evolution of the Geotechnology Community has broadened its membership in numbers, interests, backgrounds and depth of understanding.

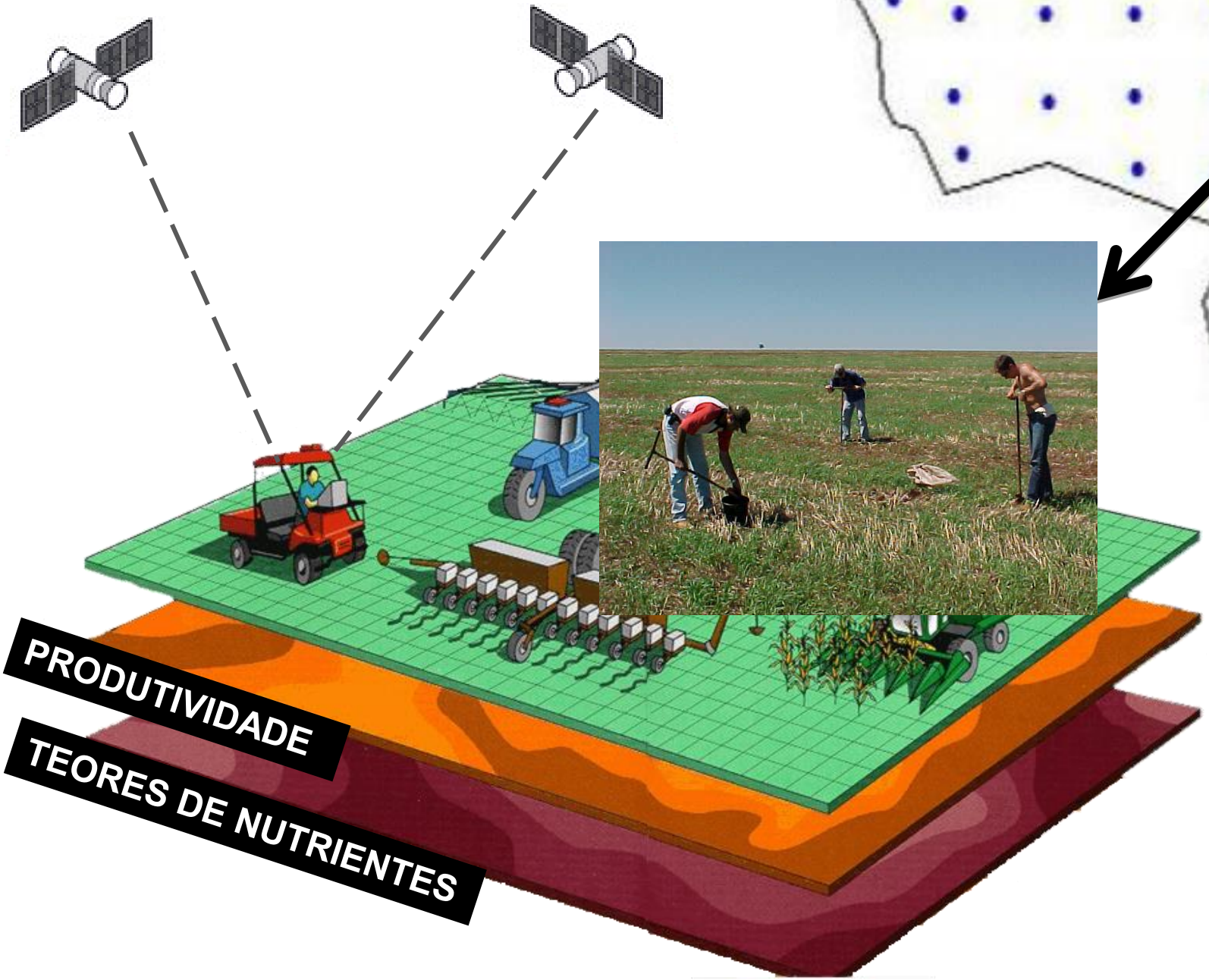
# SIG para AP


Grid sampling guided by GPS gives more accurate soil test data.
Variable rate fertilizer application can improve efficiency.
Variable rate seeding, variety changes and starter can adjust for soil properties and productivity.
Crop scouting with new technology improves field records.
On-the-go yield monitors can quickly track variability in the field.
PAST YEARS' YIELDS
SOIL TEST (K)
SOIL TEST (P)
SOIL MAP

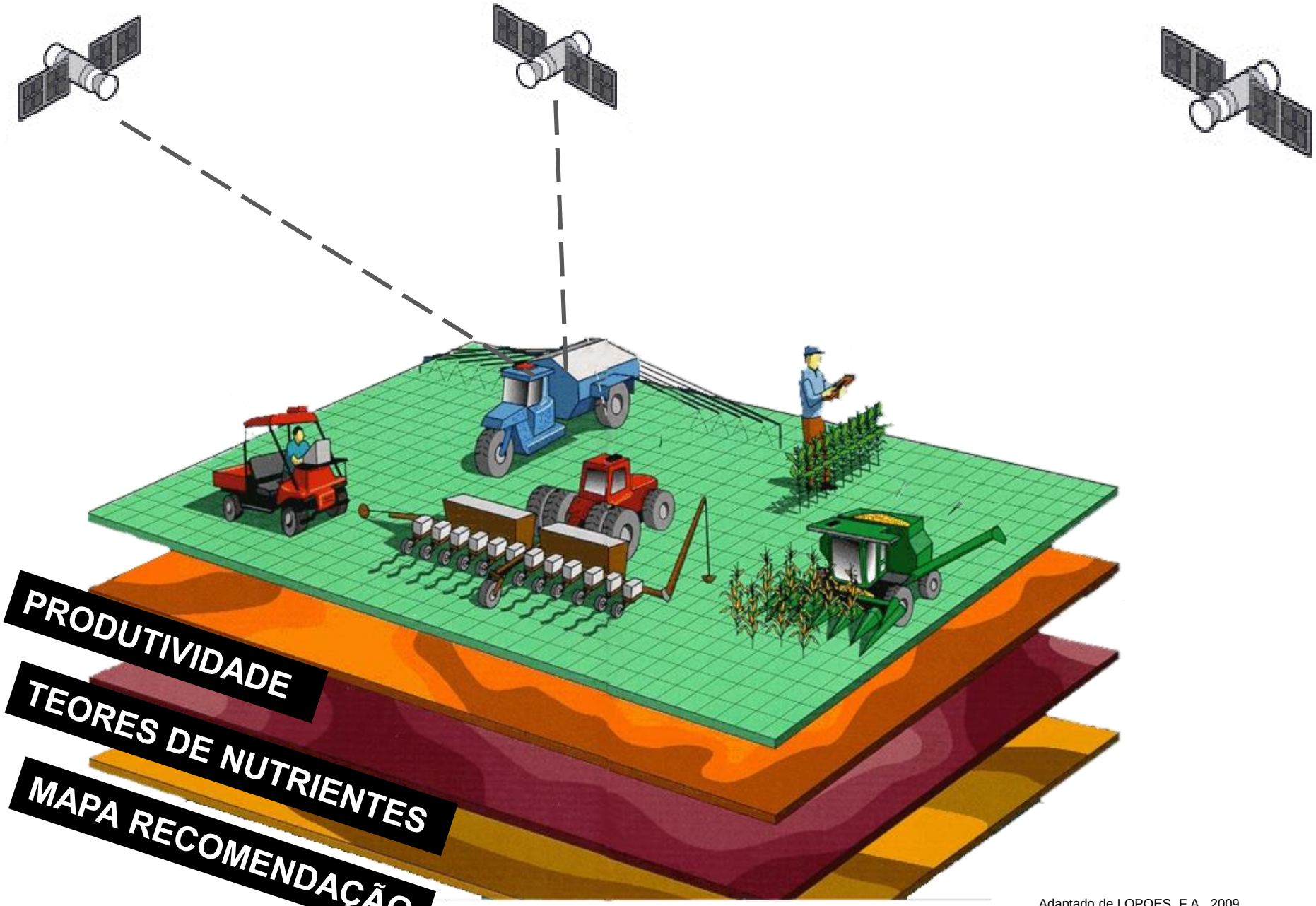
Adaptado de LOPOES, F.A., 2009




Adaptado de LOPOES, F.A., 2009



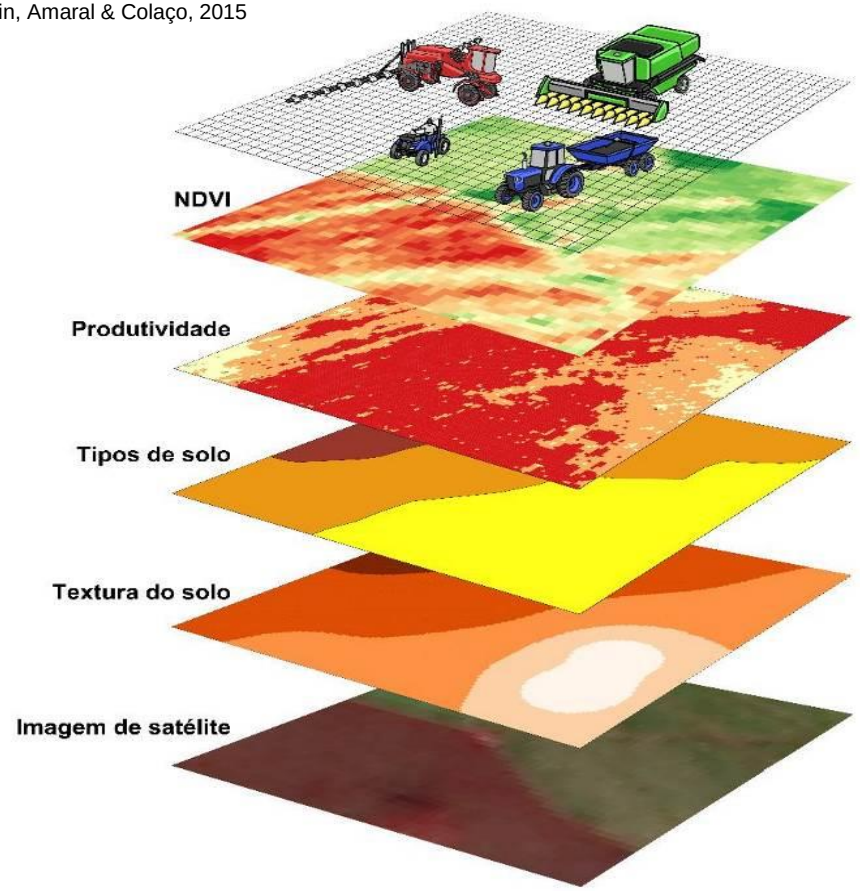

Adaptado de LOPOES, F.A., 2009



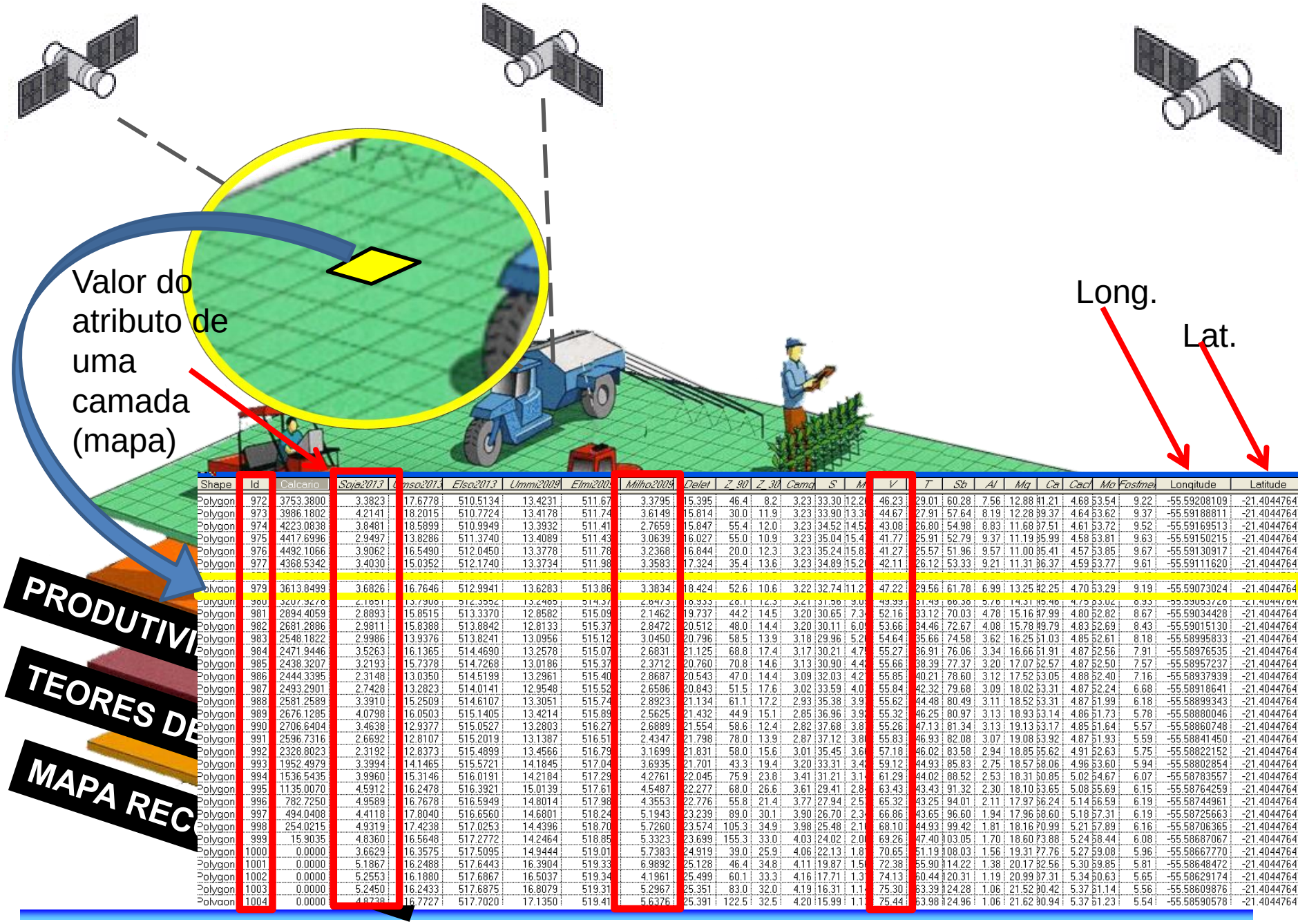

Adaptado de LOPOES, F.A., 2009

Molin, Amaral & Colaço, 2015

As informações virtualmente são organizadas em camadas para análises e operações matemáticas

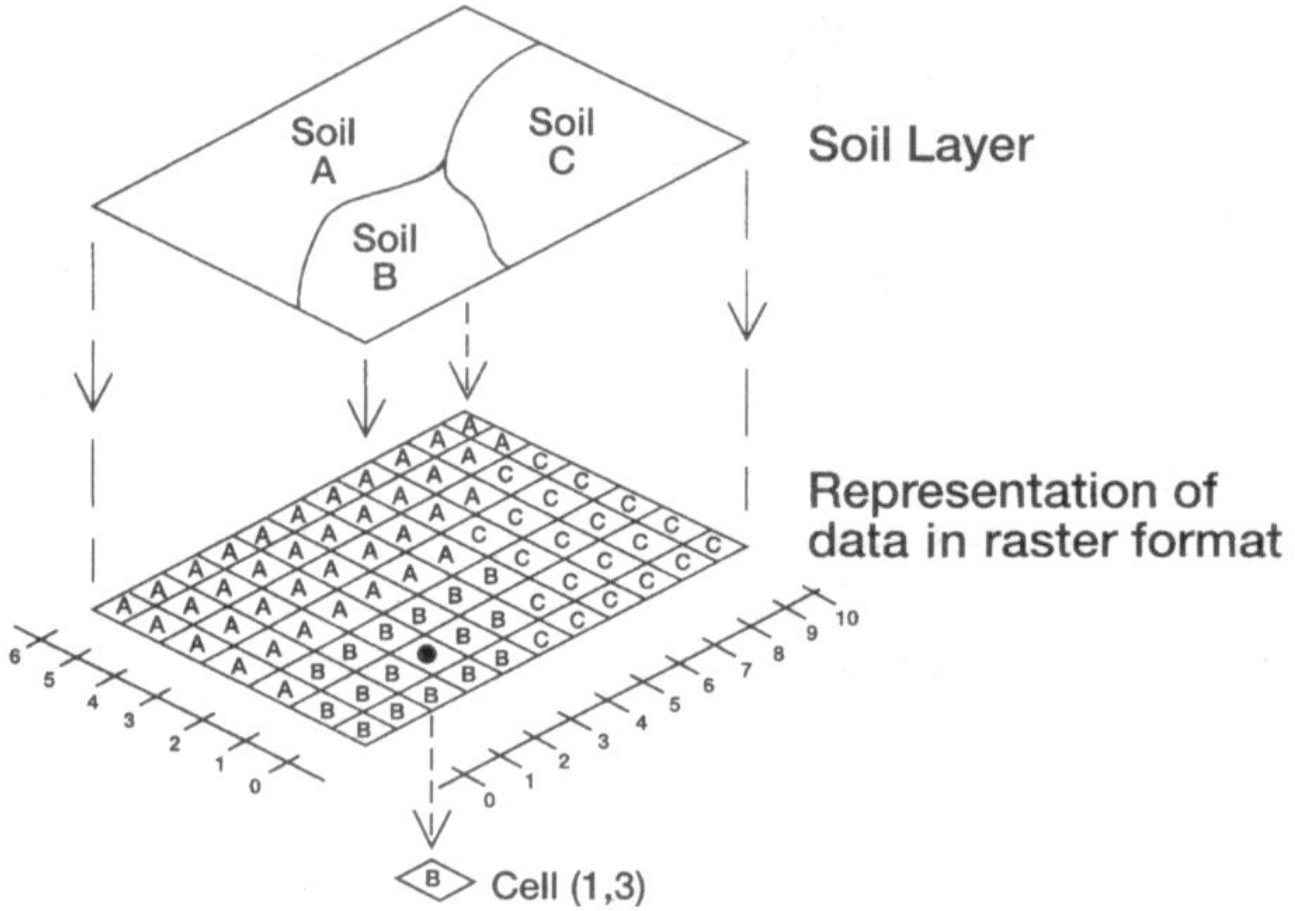



| Pixel ID | Longitude | Latitude | NDVI | Produtividade | Tipo de solo | Textura | Estágio da vegetação |
|---|---|---|---|---|---|---|---|
| 1 | -48,76788 | -21,53682 | 0,256 | 3525 | PVe | 388 | Inicial |
| 7 | -48,76957 | -21,53790 | 0,236 | 3985 | PVe | 382 | Inicial |
| 18 | -48,80212 | -21,54530 | 0,369 | 4502 | PVe | 406 | Intermediário |
| 26 | -48,82565 | -21,54981 | 0,345 | 4105 | PVe | 395 | Intermediário |
| 32 | -48,78892 | -21,55361 | 0,368 | 3950 | PVe | 369 | Intermediário |
| 66 | -48,77752 | -21,55789 | 0,372 | 4921 | LVAd | 264 | Inrermediário |
| 105 | -48,79289 | -21,57411 | 0,252 | 3211 | LVAd | 316 | Inicial |
| 115 | -48,81532 | -21,58369 | 0,569 | 5690 | LVAd | 307 | Final |
| 129 | -48,80145 | -21,58991 | 0,695 | 6100 | LVAd | 310 | Final |
| 167 | -48,81798 | -21,59311 | 0,495 | 5230 | LVAd | 257 | Intermediário |
| 198 | -48,77711 | -21,59723 | 0,574 | 5812 | LVAd | 254 | Final |
| 214 | -48,79369 | -21,60002 | 0,542 | 5345 | LVe | 538 | Final |
| 253 | -48,76969 | -21,61525 | 0,563 | 5625 | LVe | 594 | Final |
| 307 | -48,78521 | -21,61913 | 0,612 | 6023 | LVe | 580 | Final |



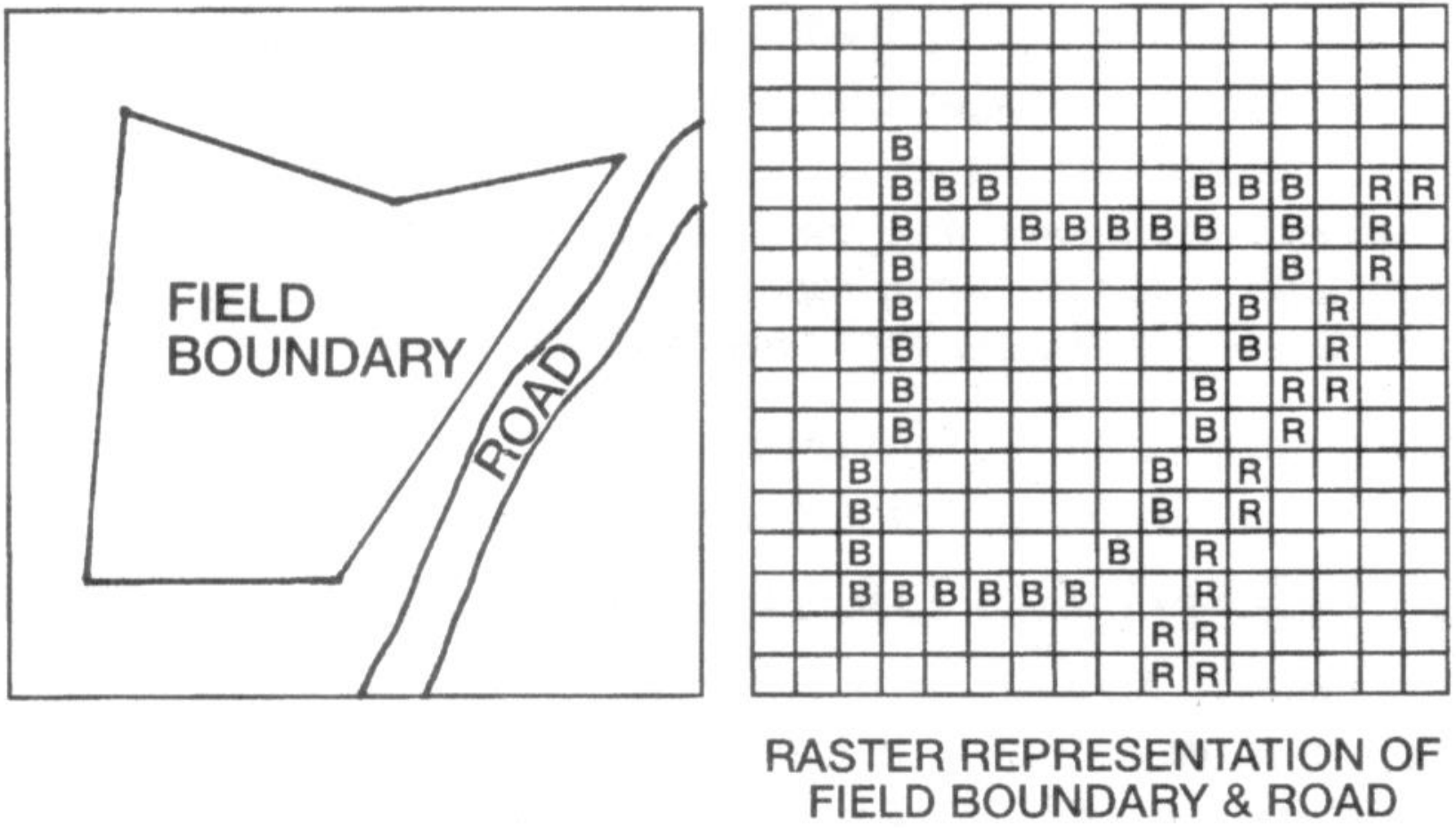

| Shape | Id | Calcario | Soja2013 | Milho2004 | Delet | Z_90 | Z_30 | V | Longitude | Latitude |
|---|---|---|---|---|---|---|---|---|---|---|
| Polygon | 972 | 3753.3800 | 3.3823 | 3.3795 | 15.395 | 46.4 | 8.2 | 46.23 | -55.59208109 | -21.4044764 |
| Polygon | 973 | 3986.1802 | 4.2141 | 3.6149 | 15.814 | 30.0 | 11.9 | 44.67 | -55.59188811 | -21.4044764 |
| Polygon | 974 | 4223.0838 | 3.8481 | 2.7659 | 15.847 | 55.4 | 12.0 | 43.08 | -55.59169513 | -21.4044764 |
| Polygon | 975 | 4417.6996 | 2.9497 | 3.0639 | 16.027 | 55.0 | 10.9 | 41.77 | -55.59150215 | -21.4044764 |
| Polygon | 976 | 4492.1066 | 3.9062 | 3.2368 | 16.844 | 20.0 | 12.3 | 41.27 | -55.59130917 | -21.4044764 |
| Polygon | 977 | 4368.5342 | 3.4030 | 3.3583 | 17.324 | 35.4 | 13.6 | 42.11 | -55.59111620 | -21.4044764 |
| Polygon | 979 | 3613.8499 | 3.6826 | 3.3834 | 18.424 | 52.6 | 10.6 | 47.22 | -55.59073024 | -21.4044764 |
| Polygon | 981 | 2894.4059 | 2.8893 | 2.1462 | 19.737 | 44.2 | 14.5 | 52.16 | -55.59034428 | -21.4044764 |
| Polygon | 982 | 2681.2886 | 2.9811 | 2.8472 | 20.512 | 48.0 | 14.4 | 53.66 | -55.59015130 | -21.4044764 |
| Polygon | 983 | 2548.1822 | 2.9986 | 3.0450 | 20.796 | 58.5 | 13.9 | 54.64 | -55.58995833 | -21.4044764 |
| Polygon | 984 | 2471.9446 | 3.5263 | 2.6831 | 21.125 | 68.8 | 17.4 | 55.27 | -55.58976535 | -21.4044764 |
| Polygon | 985 | 2438.3207 | 3.2193 | 2.3712 | 20.760 | 70.8 | 14.6 | 55.66 | -55.58957237 | -21.4044764 |
| Polygon | 986 | 2444.3395 | 2.3148 | 2.8687 | 20.543 | 47.0 | 14.4 | 55.85 | -55.58937939 | -21.4044764 |
| Polygon | 987 | 2493.2901 | 2.7428 | 2.6586 | 20.843 | 51.5 | 17.6 | 55.84 | -55.58918641 | -21.4044764 |
| Polygon | 988 | 2581.2589 | 3.3910 | 2.8923 | 21.134 | 61.1 | 17.2 | 55.62 | -55.58899343 | -21.4044764 |
| Polygon | 989 | 2676.1285 | 4.0798 | 2.5625 | 21.432 | 44.9 | 15.1 | 55.32 | -55.58880046 | -21.4044764 |
| Polygon | 990 | 2706.6404 | 3.4638 | 2.6889 | 21.554 | 58.6 | 12.4 | 55.26 | -55.58860748 | -21.4044764 |
| Polygon | 991 | 2596.7316 | 2.6692 | 2.4347 | 21.798 | 78.0 | 13.9 | 55.83 | -55.58841450 | -21.4044764 |
| Polygon | 992 | 2328.8023 | 2.3192 | 3.1699 | 21.831 | 58.0 | 15.6 | 57.18 | -55.58822152 | -21.4044764 |
| Polygon | 993 | 1952.4979 | 3.3994 | 3.6935 | 21.701 | 43.3 | 19.4 | 59.12 | -55.58802854 | -21.4044764 |
| Polygon | 994 | 1536.5435 | 3.9960 | 4.2761 | 22.045 | 75.9 | 23.8 | 61.29 | -55.58783557 | -21.4044764 |
| Polygon | 995 | 1135.0070 | 4.5912 | 4.5487 | 22.277 | 68.0 | 26.6 | 63.43 | -55.58764259 | -21.4044764 |
| Polygon | 996 | 782.7250 | 4.9589 | 4.3553 | 22.776 | 55.8 | 21.4 | 65.32 | -55.58744961 | -21.4044764 |
| Polygon | 997 | 494.0408 | 4.4118 | 5.1943 | 23.239 | 89.0 | 30.1 | 66.86 | -55.58725663 | -21.4044764 |
| Polygon | 998 | 254.0215 | 4.9319 | 5.7260 | 23.574 | 105.3 | 34.9 | 68.10 | -55.58706365 | -21.4044764 |
| Polygon | 999 | 15.9035 | 4.8360 | 5.3323 | 23.699 | 155.3 | 33.0 | 69.26 | -55.58687067 | -21.4044764 |
| Polygon | 1000 | 0.0000 | 3.6629 | 5.7383 | 24.919 | 39.0 | 25.9 | 70.65 | -55.58667770 | -21.4044764 |
| Polygon | 1001 | 0.0000 | 5.1867 | 6.9892 | 25.128 | 46.4 | 34.8 | 72.38 | -55.58648472 | -21.4044764 |
| Polygon | 1002 | 0.0000 | 5.2553 | 4.1961 | 25.499 | 60.1 | 33.3 | 74.13 | -55.58629174 | -21.4044764 |
| Polygon | 1003 | 0.0000 | 5.2450 | 5.2967 | 25.351 | 83.0 | 32.0 | 75.30 | -55.58609876 | -21.4044764 |
| Polygon | 1004 | 0.0000 | 4.8738 | 5.6376 | 25.391 | 122.5 | 32.5 | 75.44 | -55.58590578 | -21.4044764 |

# SIG – Sistema de Informação Geográfica




No formato RASTER o espaço é dividido em células, cada célula tem um valor e este valor define a forma da apresentação visual.

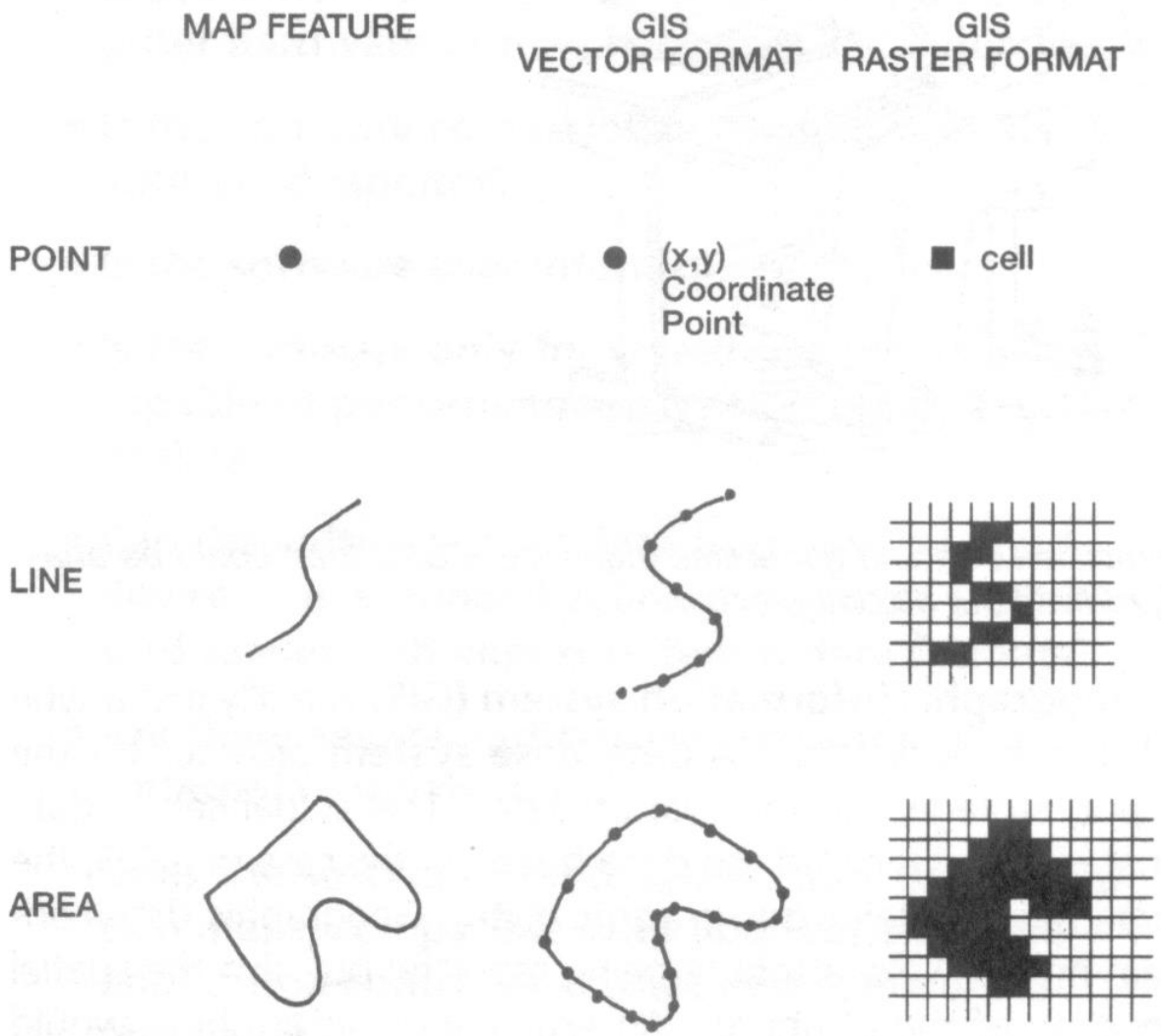
# SIG – Sistema de Informação Geográfica




RASTER REPRESENTATION OF
FIELD BOUNDARY & ROAD

No formato VECTOR (ou Lattice), a unidade básica são pontos ou linhas com coordenadas x e y (latitude e longitude).

# SIG – Sistema de Informação Geográfica




Representações gráficas de Vector (Lattice) e Raster.

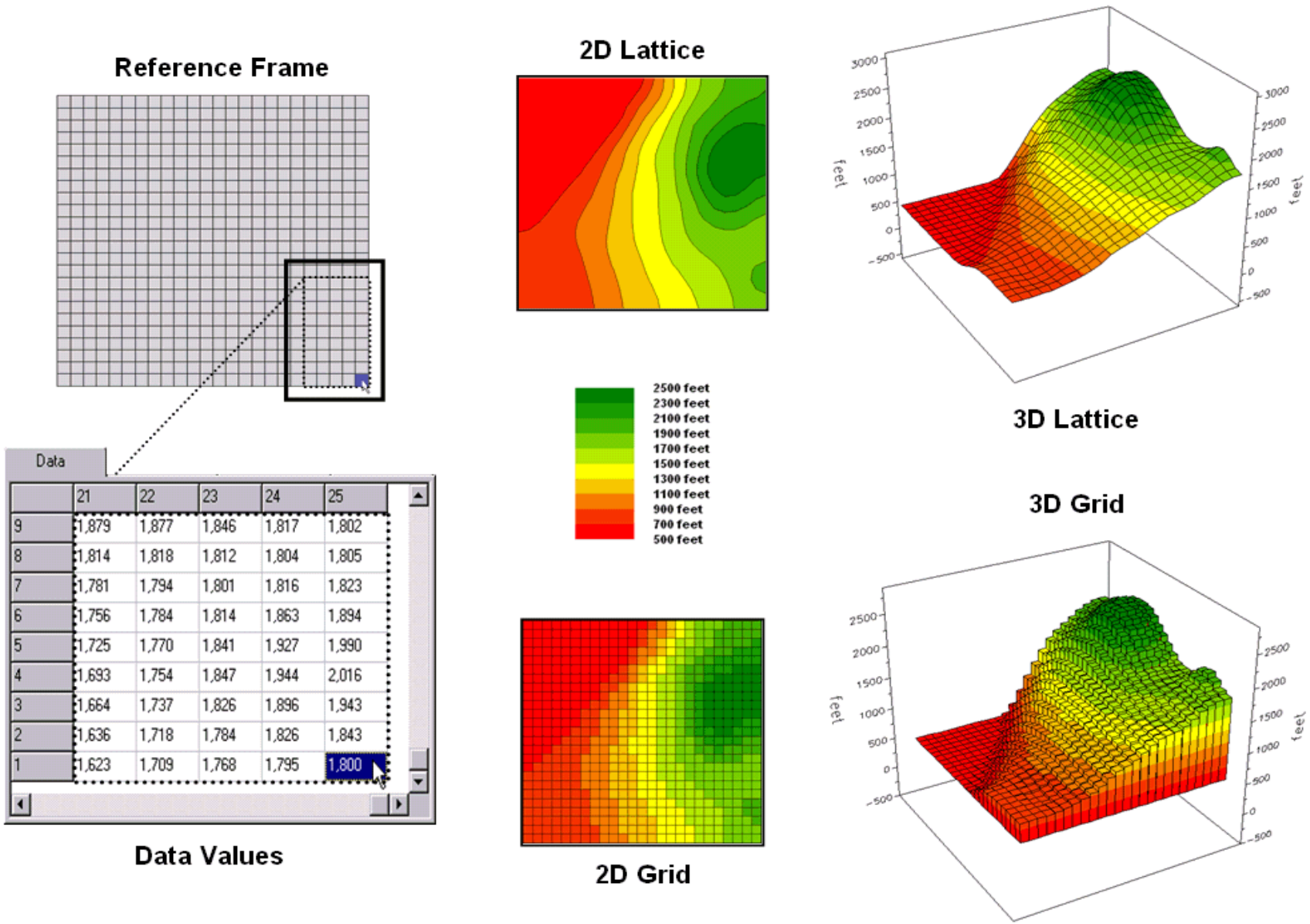



Figure 1.1. Grid-based data can be displayed in 2-D/3-D lattice or grid forms.

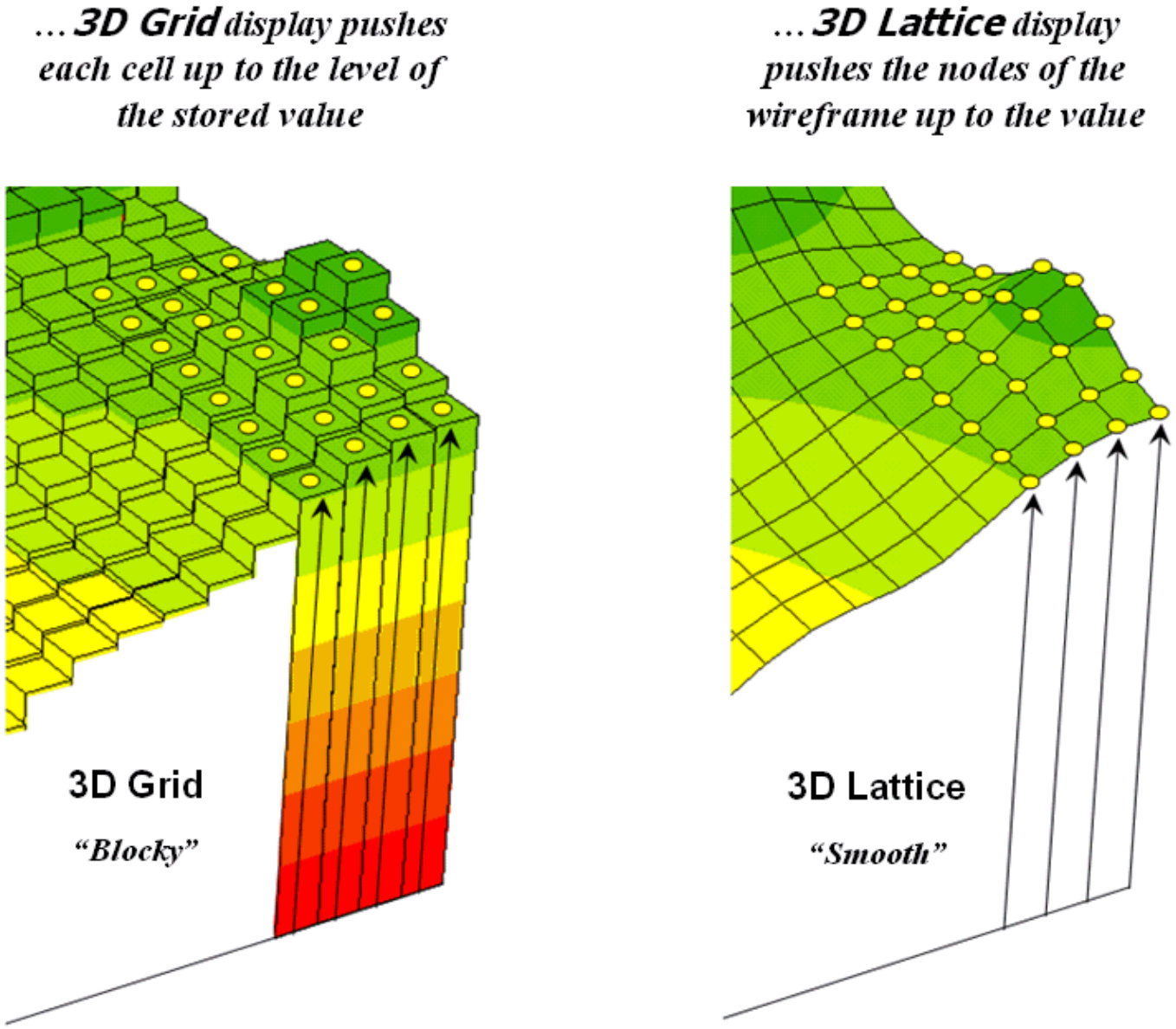
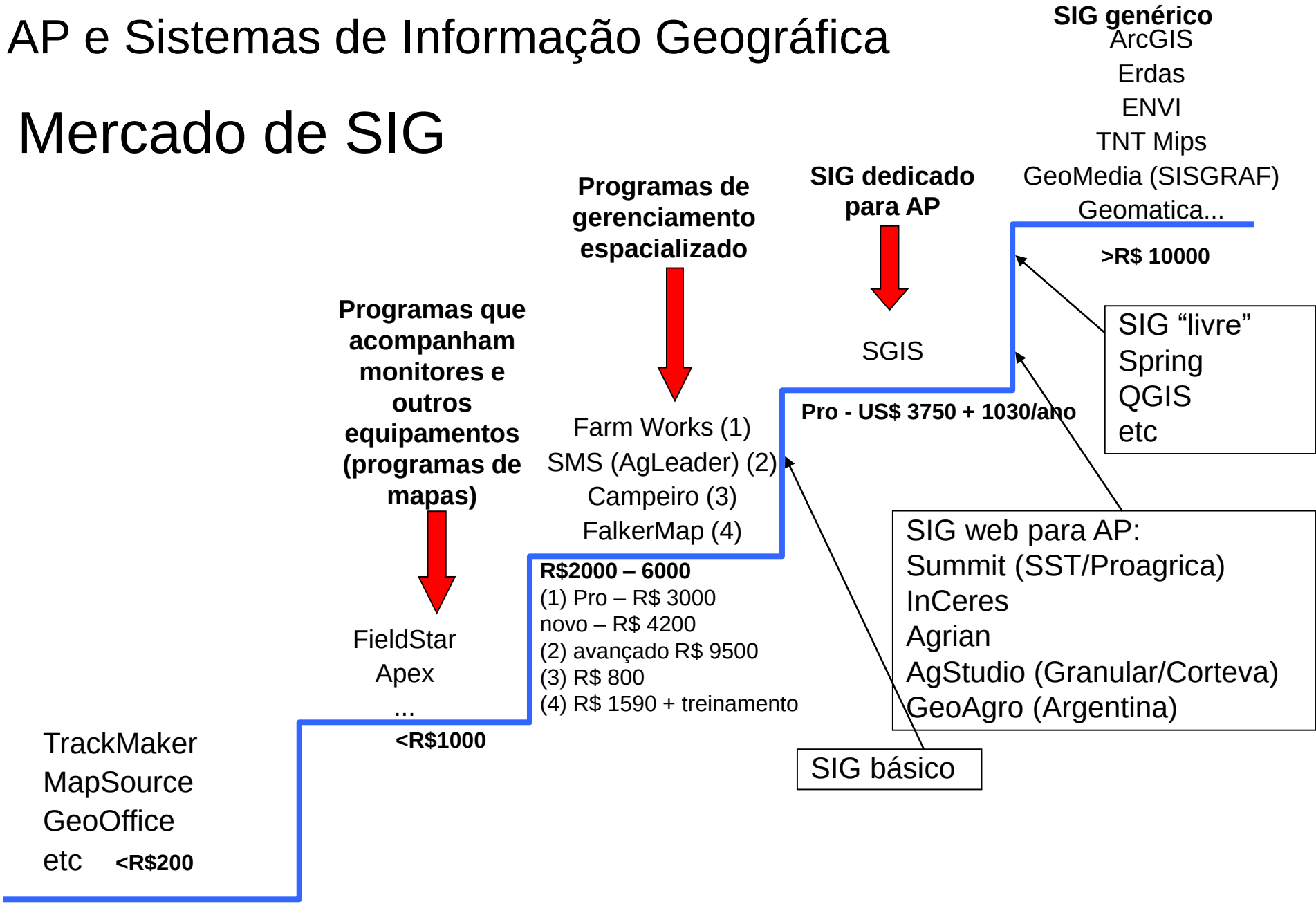
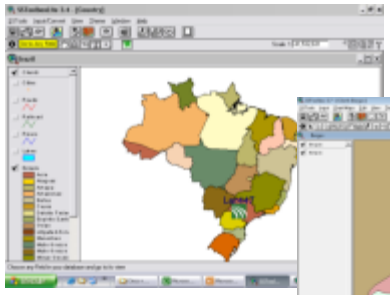



Figure 1.3. 3-D display "pushes-up" the grid or lattice reference frame to the relative height of the stored map values.

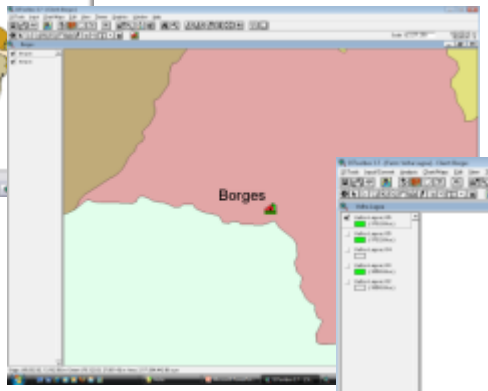
# Mercado de SIG



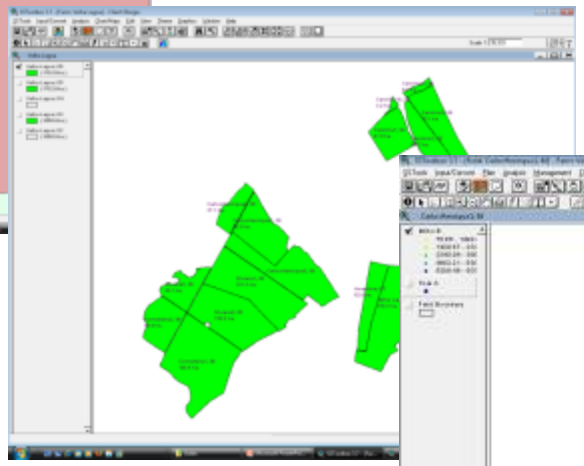
# Organização hierárquica dos dados facilita a geração de informação para o gerenciamento



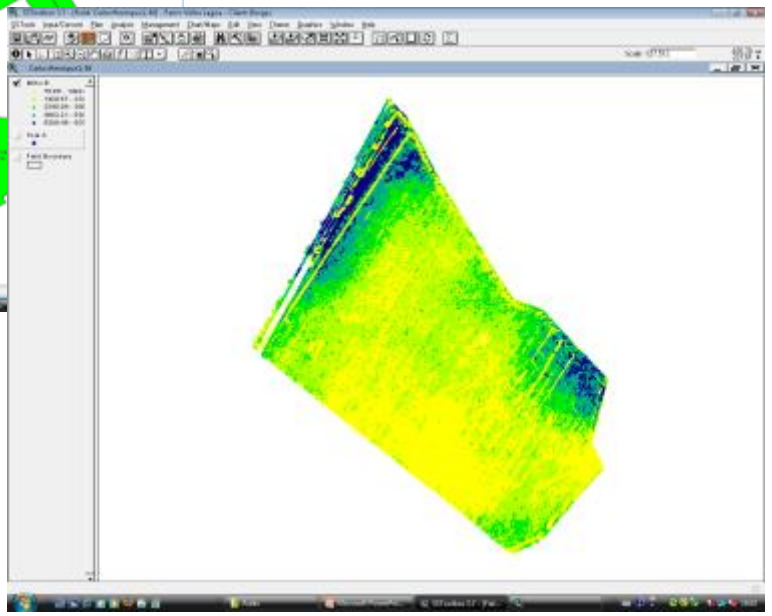
*País*



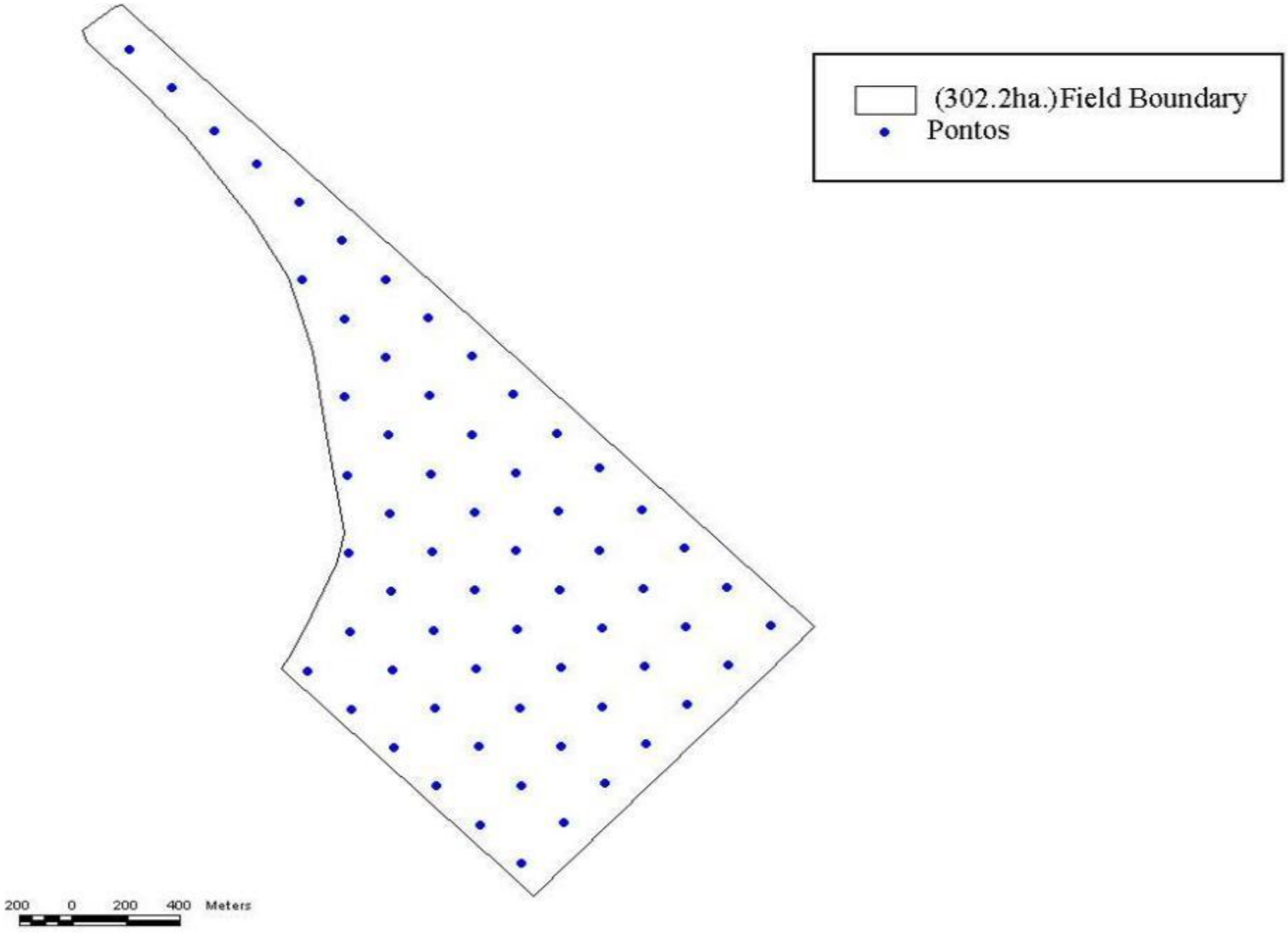

*Cliente*

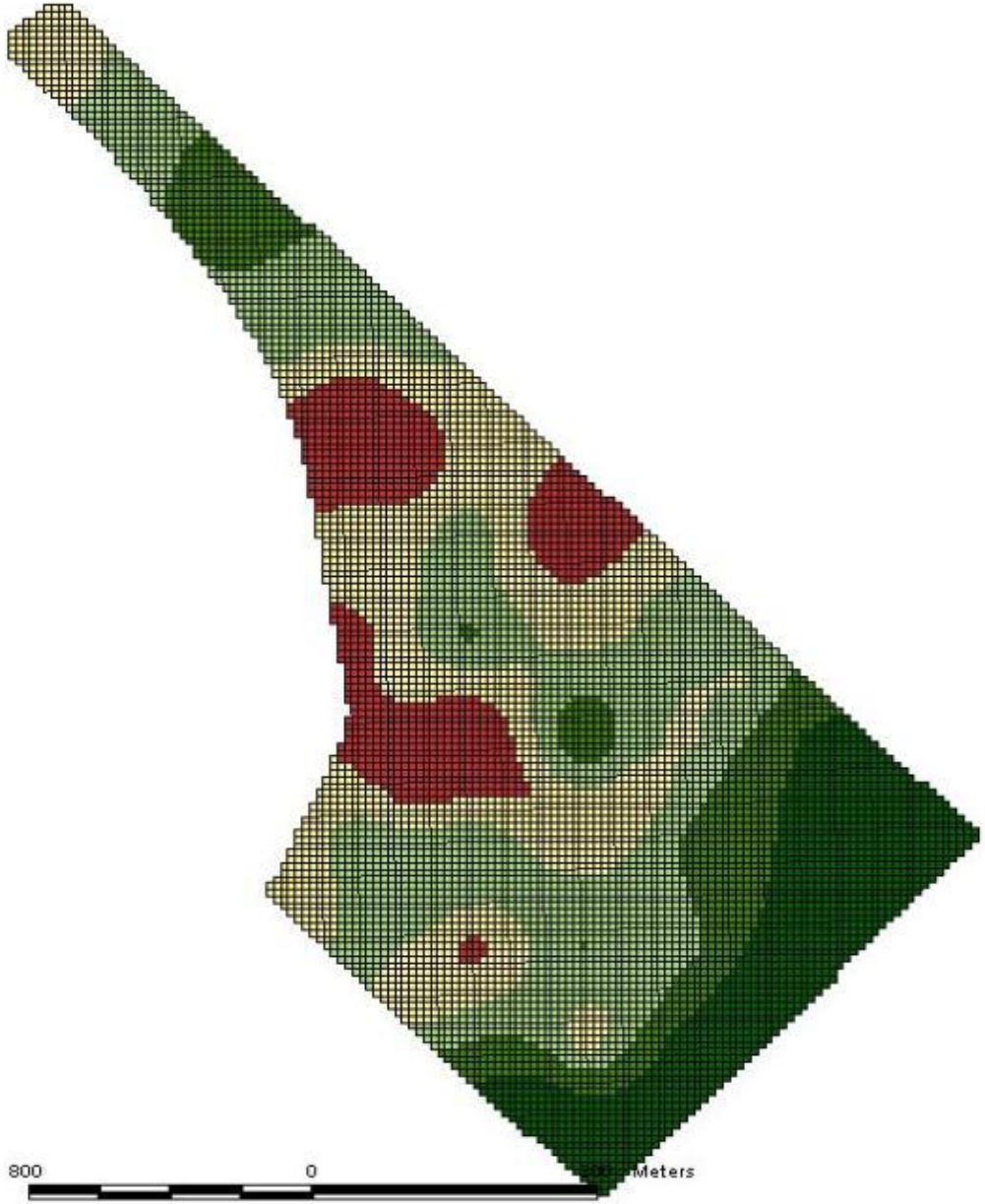


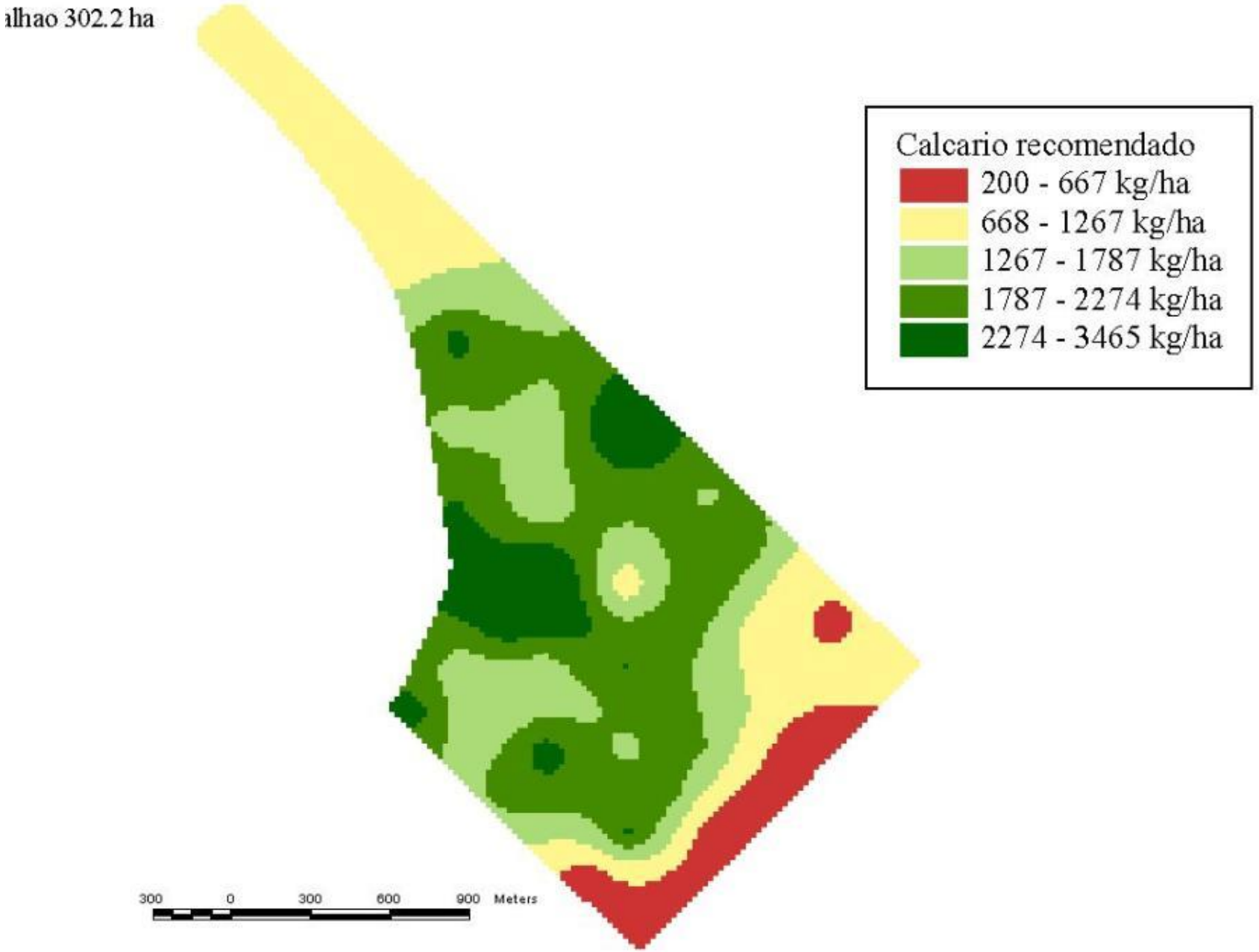
*Fazenda*



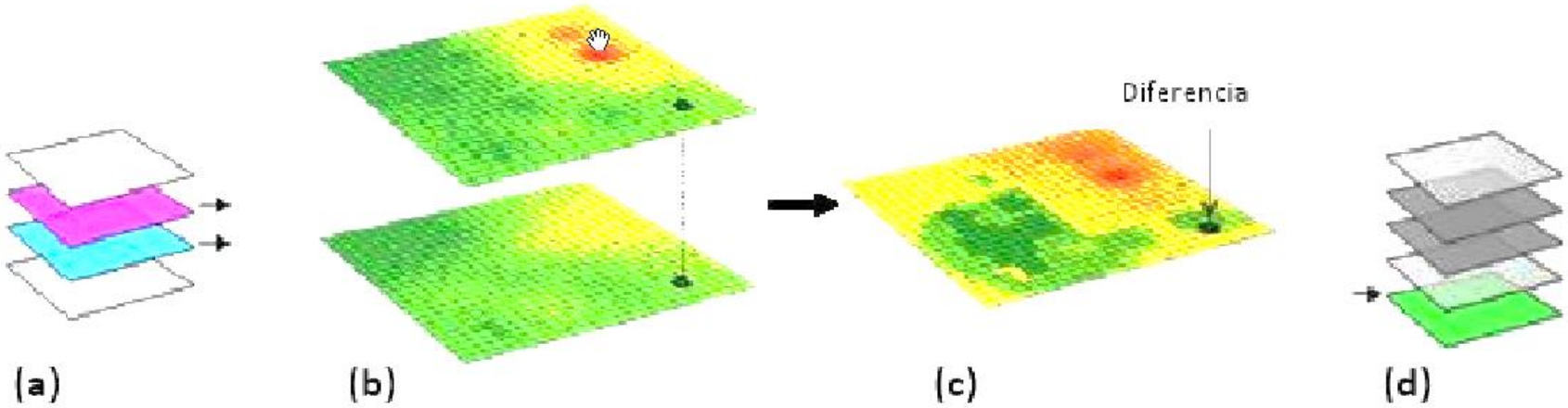
*Talhão*


(302.2ha.)Field Boundary
Pontos
200 0 200 400 Meters


V
21.0 - 33.0
33.0 - 37.9
37.9 - 42.8
42.8 - 49.7
49.7 - 58.1
800
0
Meters

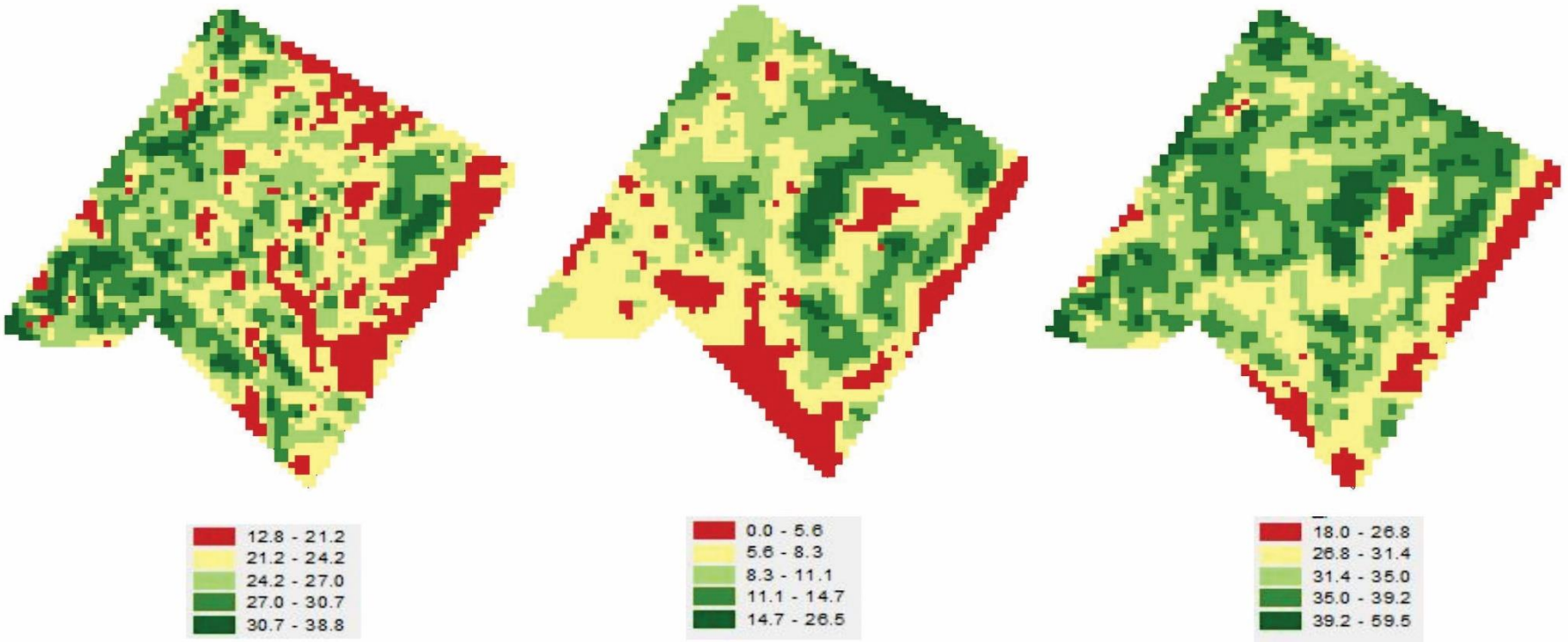

ılhao 302.2 ha
Calcario recomendado
200 - 667 kg/ha
668 - 1267 kg/ha
1267 - 1787 kg/ha
1787 - 2274 kg/ha
2274 - 3465 kg/ha
300 0 300 600 900 Meters

# Álgebra de mapas



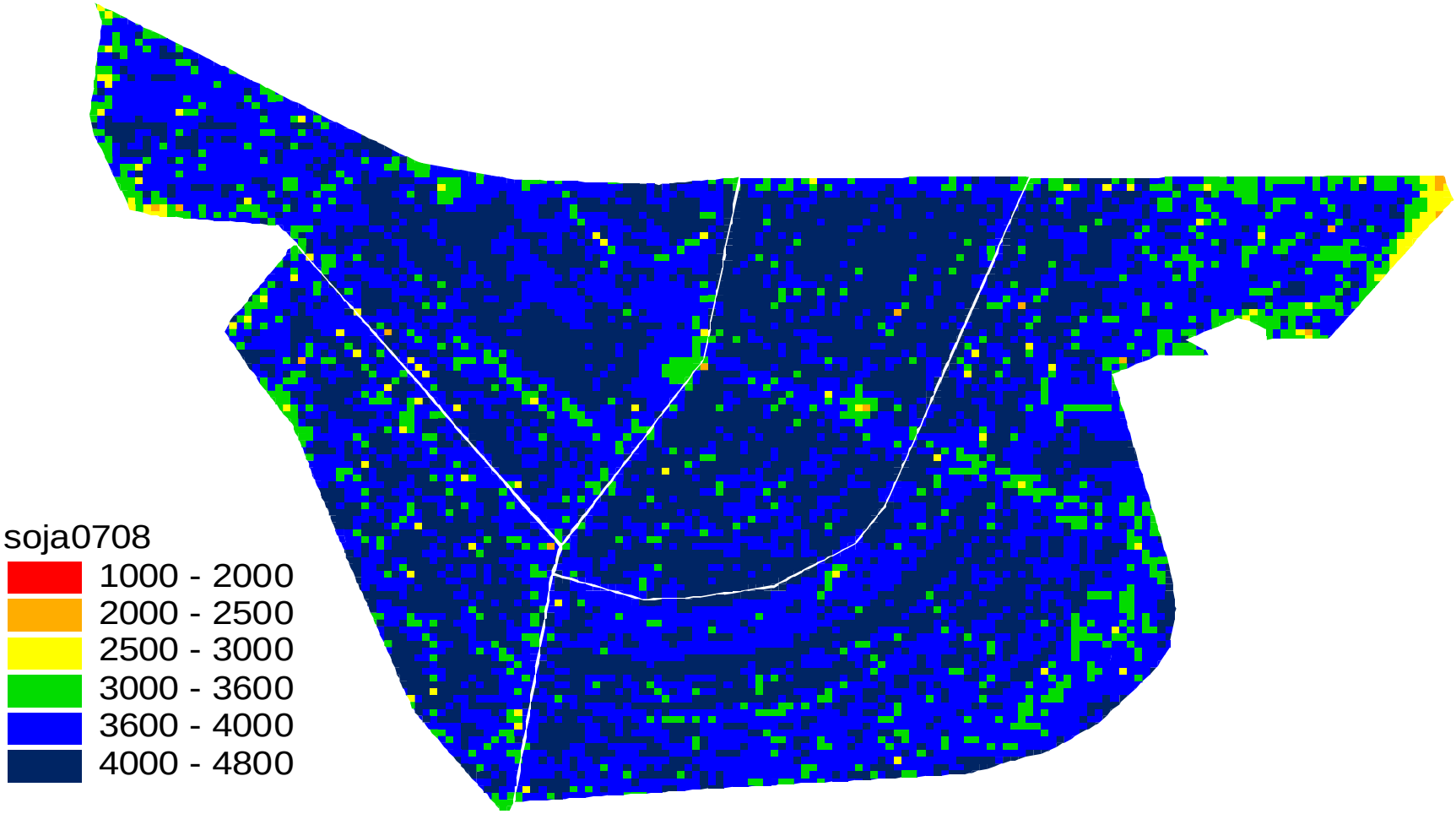

Os dados (mapas) são adquiridos da base de dados (a); dois temas no formato raster são usados (b) para gerar um terceiro tema (mapa) por álgebra (c) e o novo tema (mapa) é armazenado na base de dados (d)

**Mapas de colheita de laranja com suas respectivas legendas: primeira colheita (a), segunda colheita (b) e da soma das colheitas (c)**

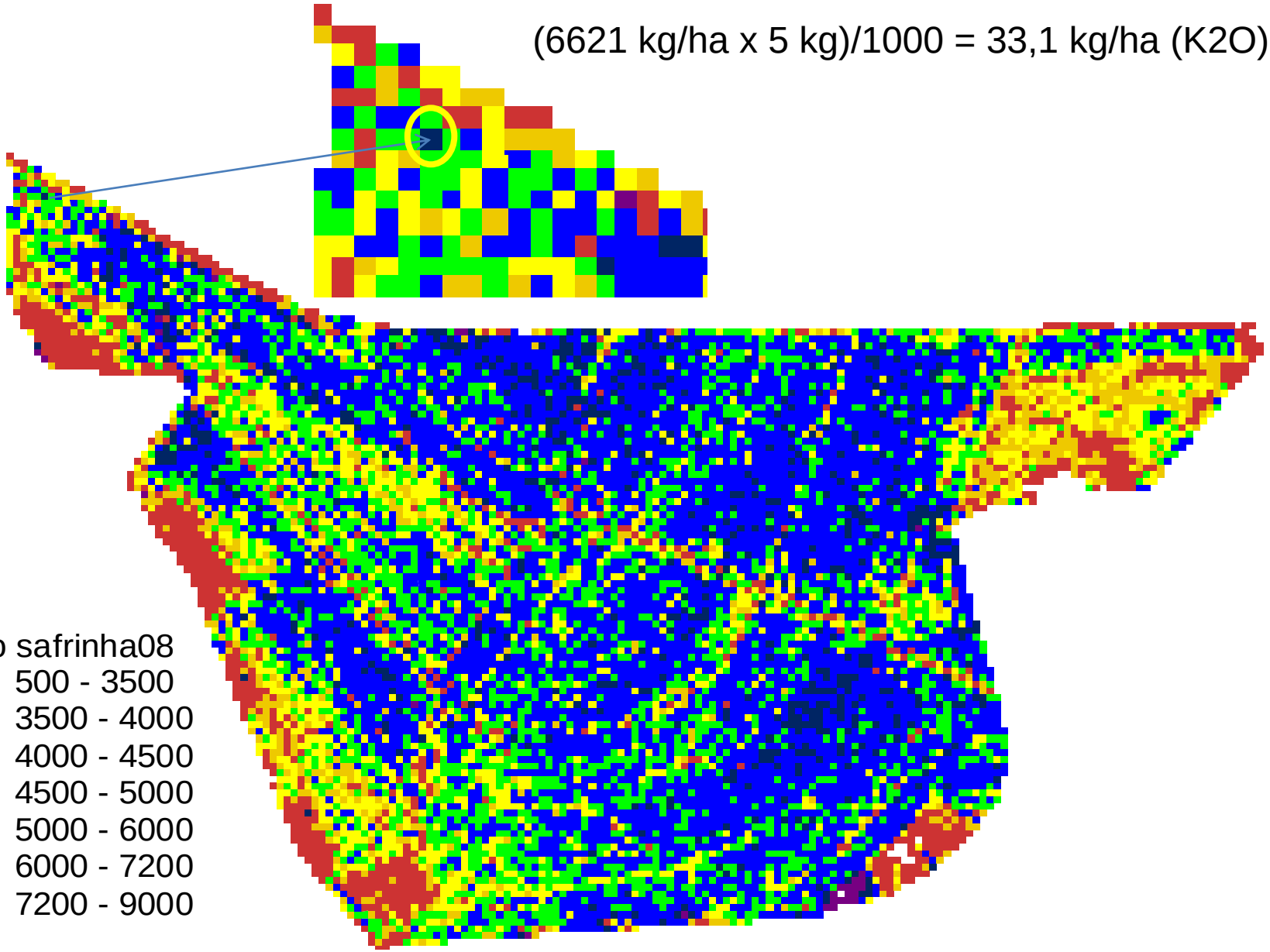


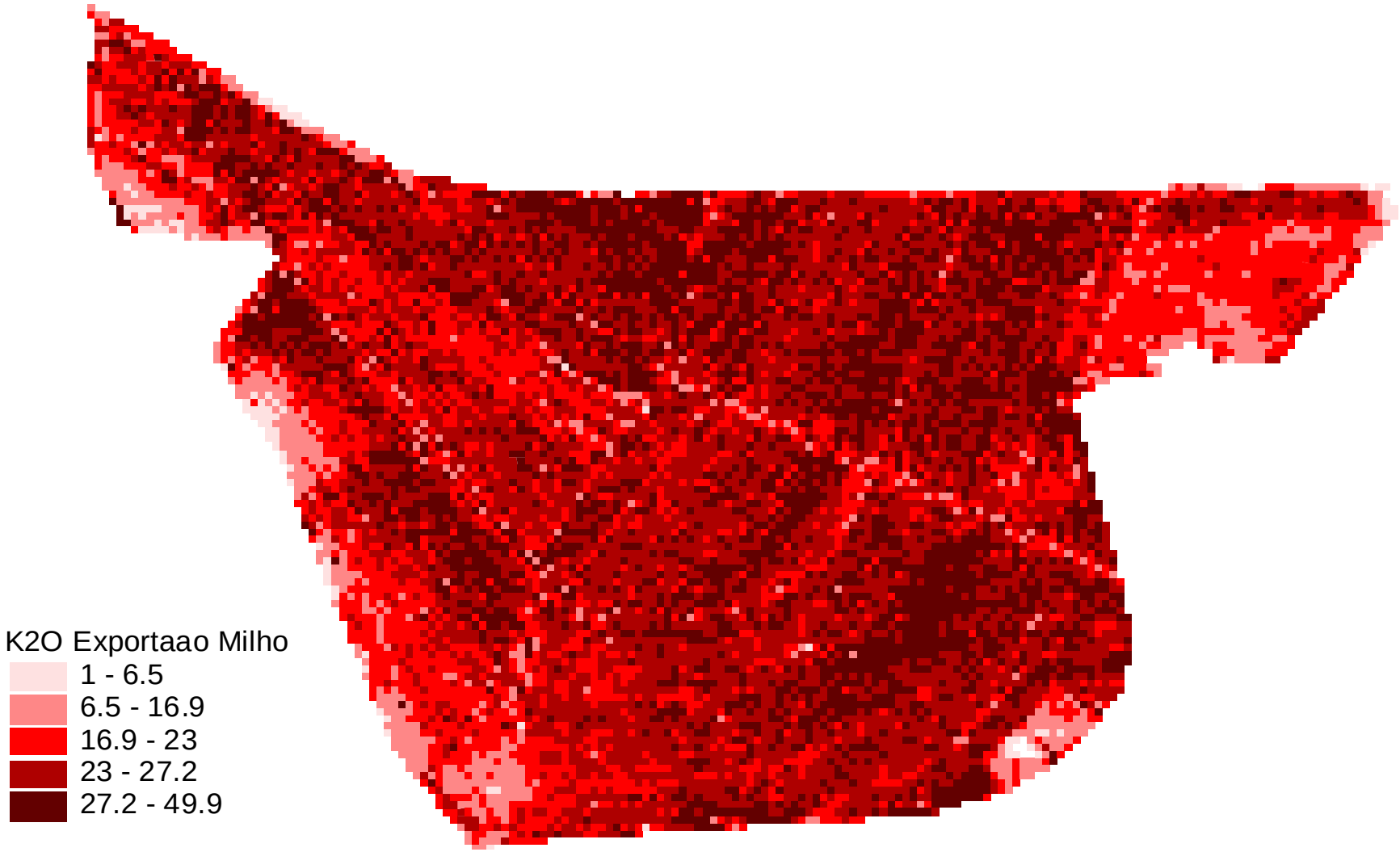

**(a)** **(b)** **(c)**

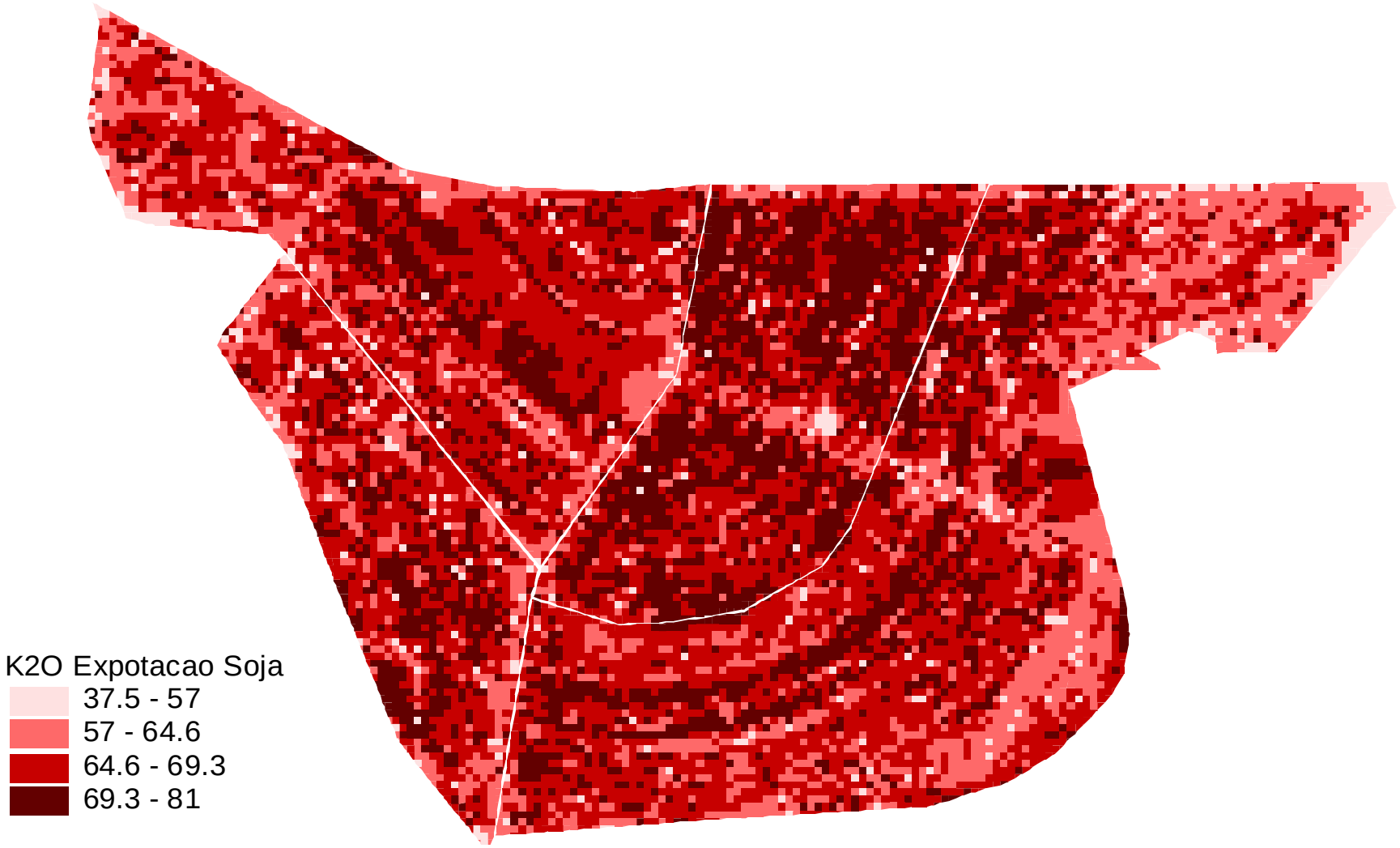
As planilhas permitem que o usuário efetue operações aritméticas no próprio SIG. Mantendo a coluna “Id”, que é a coluna de identificação dos pixels, pode-se adicionar novas colunas nessa tabela, como por exemplo as produtividades de outros mapas. Após adicionar a produtividade de outro mapa, pode-se fazer as somas das produtividades.


soja0708
1000 - 2000
2000 - 2500
2500 - 3000
3000 - 3600
3600 - 4000
4000 - 4800

(6621 kg/ha x 5 kg)/1000 = 33,1 kg/ha (K2O)




K2O Exportaao Milho
1 - 6.5
6.5 - 16.9
16.9 - 23
23 - 27.2
27.2 - 49.9


K2O Expotacao Soja
37.5 - 57
57 - 64.6
64.6 - 69.3
69.3 - 81

# Recomendação para aplicação de KCl com base na exportação do milho e da soja

Total : 39408.88 Kg.