Towards a Logical Multidimensional Model for Spatial Data Warehousing and OLAP

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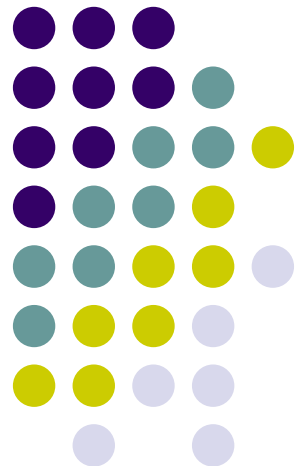
Brazil



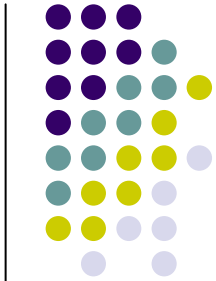
Outline

- Introduction
- The Multi-Dimensional Model
- Mapwarehouse prototype
- Case study
- Optimization techniques
- Conclusion

Introduction

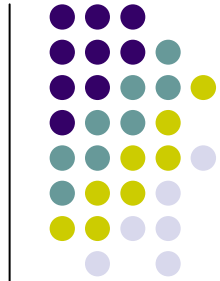
- Spatial data exist in more than 80% of enterprise data:
  - Client address, supplier address, sales by region, etc
- Traditional Decision-support systems use location as a text information.
- Spatial databases enable searching space through spatial operators
- Thus:
  - GIS + DW = advanced information system, with enhancements in:
    - Quantity
    - Quality

Introduction



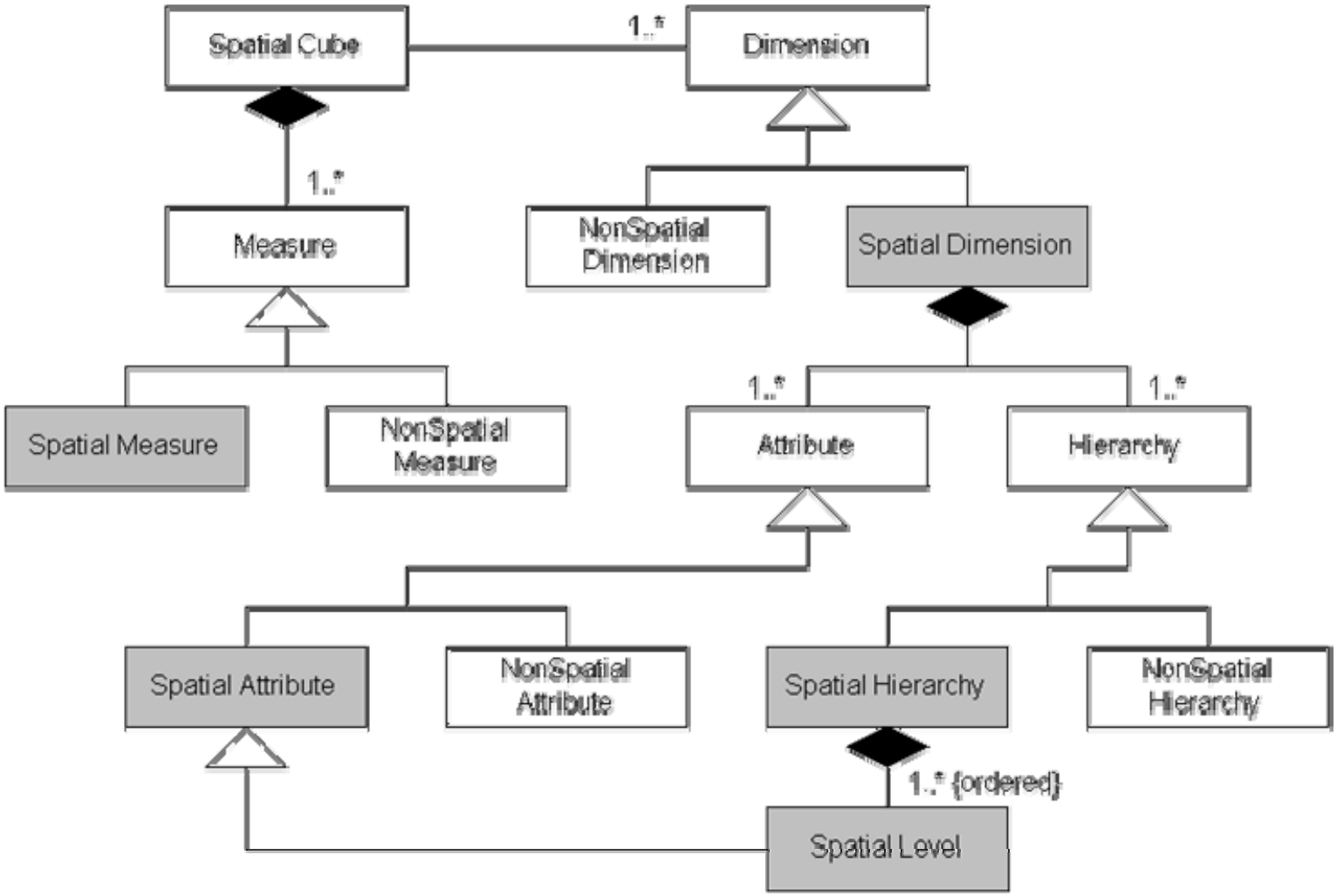
- Two types of architetures:
  - Federated
    - GIS + DW
  - Integrated
    - Spatial DW

Multidimensional Model

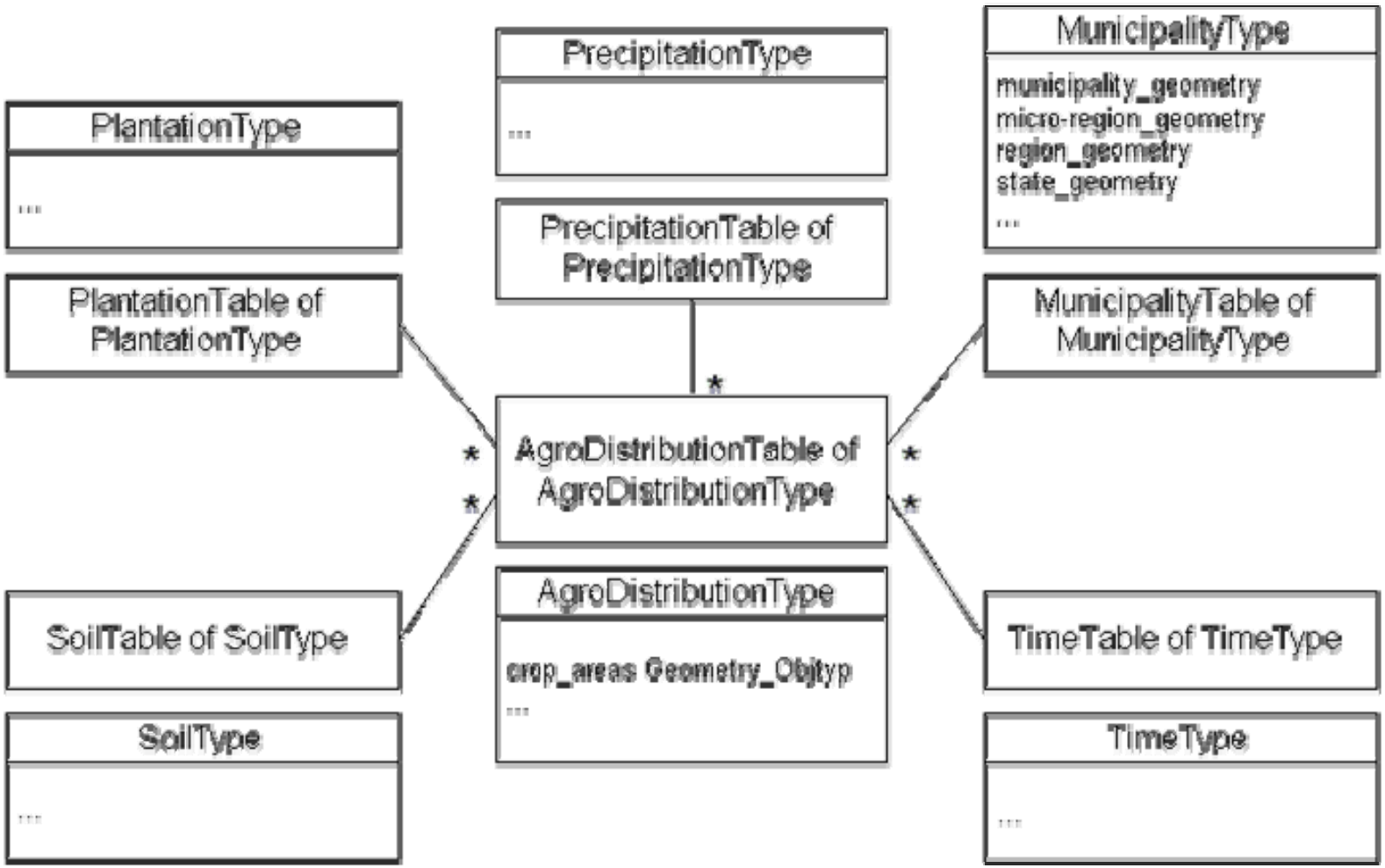


- We propose a logical multidimensional model
- Extension of the classical star-schema:
  - (1) object-relational concepts and structures; and
  - (2) spatial components.

Multidimensional Model



Agro-distribution Star-schema



Spatial OLAP operators

- Spatial roll-up
- Spatial drill-down

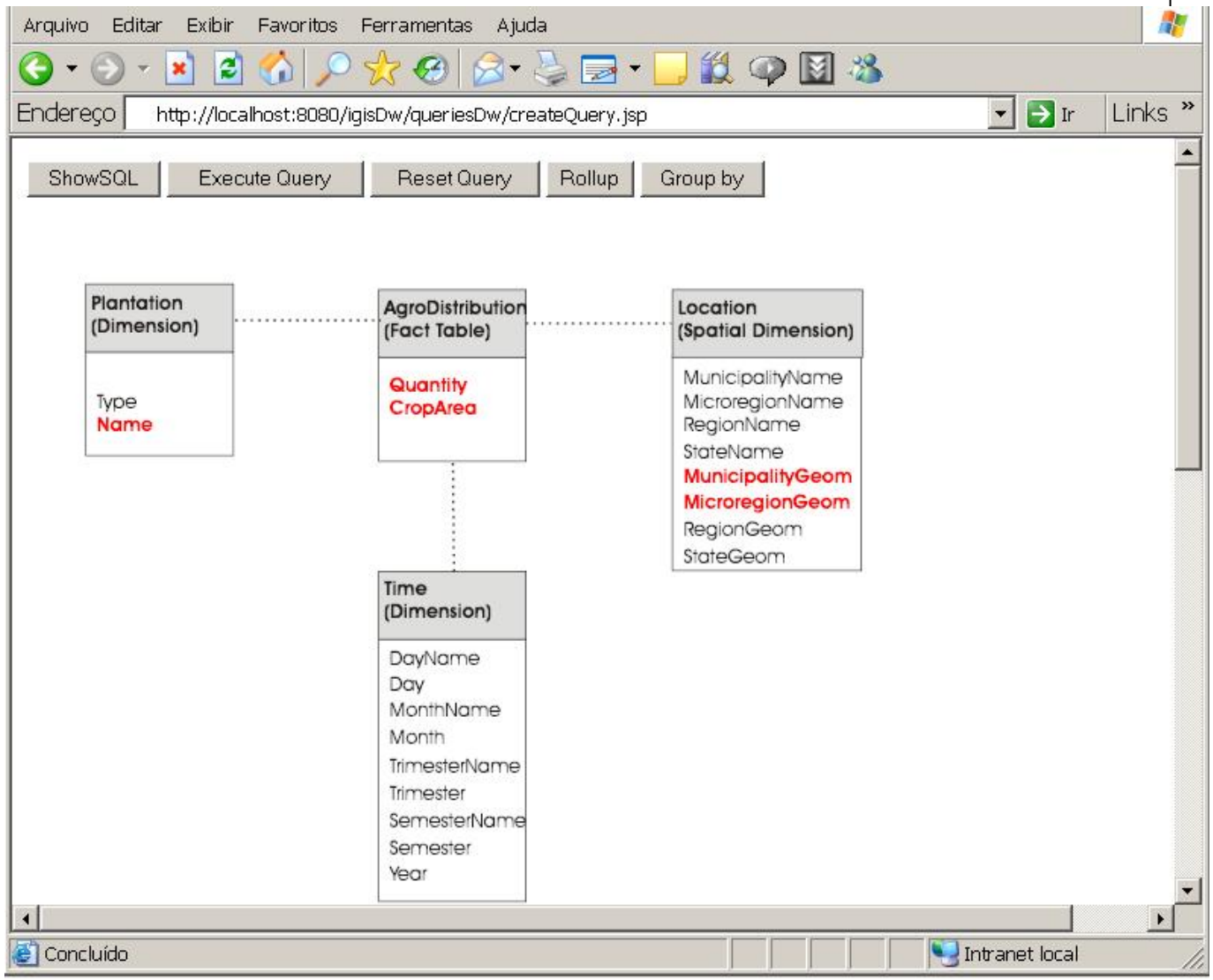
Case study – agricultural crops

- To achieve an efficient seed distribution policy to Brazilian farmers, several issues are relevant:
  - soil and plantation types,
  - precipitation and
  - location.
- Hence, a SDW may help authorities in finding the best policy for a particular situation, according to different aggregation criteria, based on:
  - dynamic maps,
  - tables,
  - graphics,
  - reports and so on.

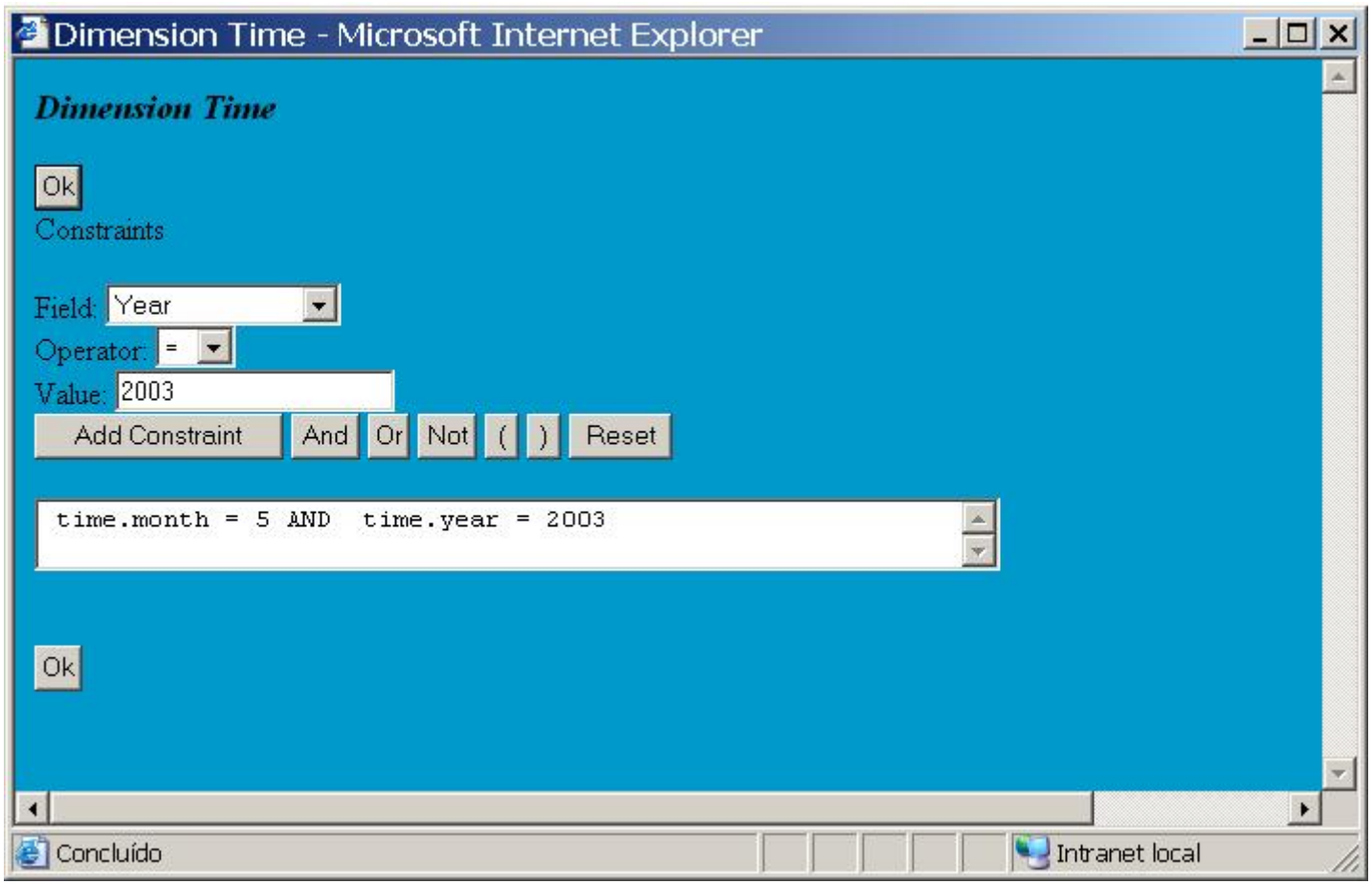
Question

- *Retrieve the corn crop areas inside a given rectangular window, for each micro-region (region) and for each region (micro-region) of the state of Paraíba, during May 2003.*

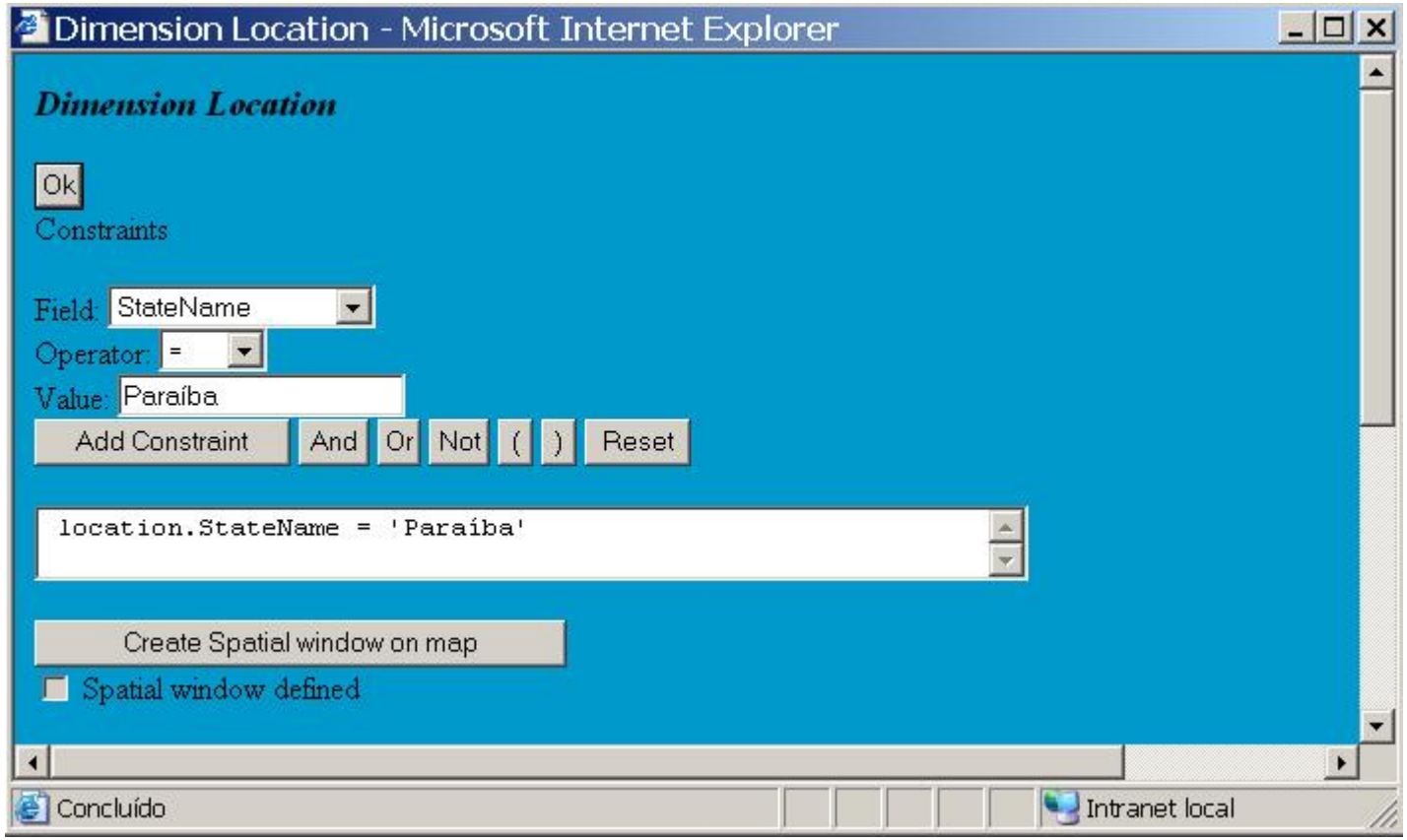
Creating the Query



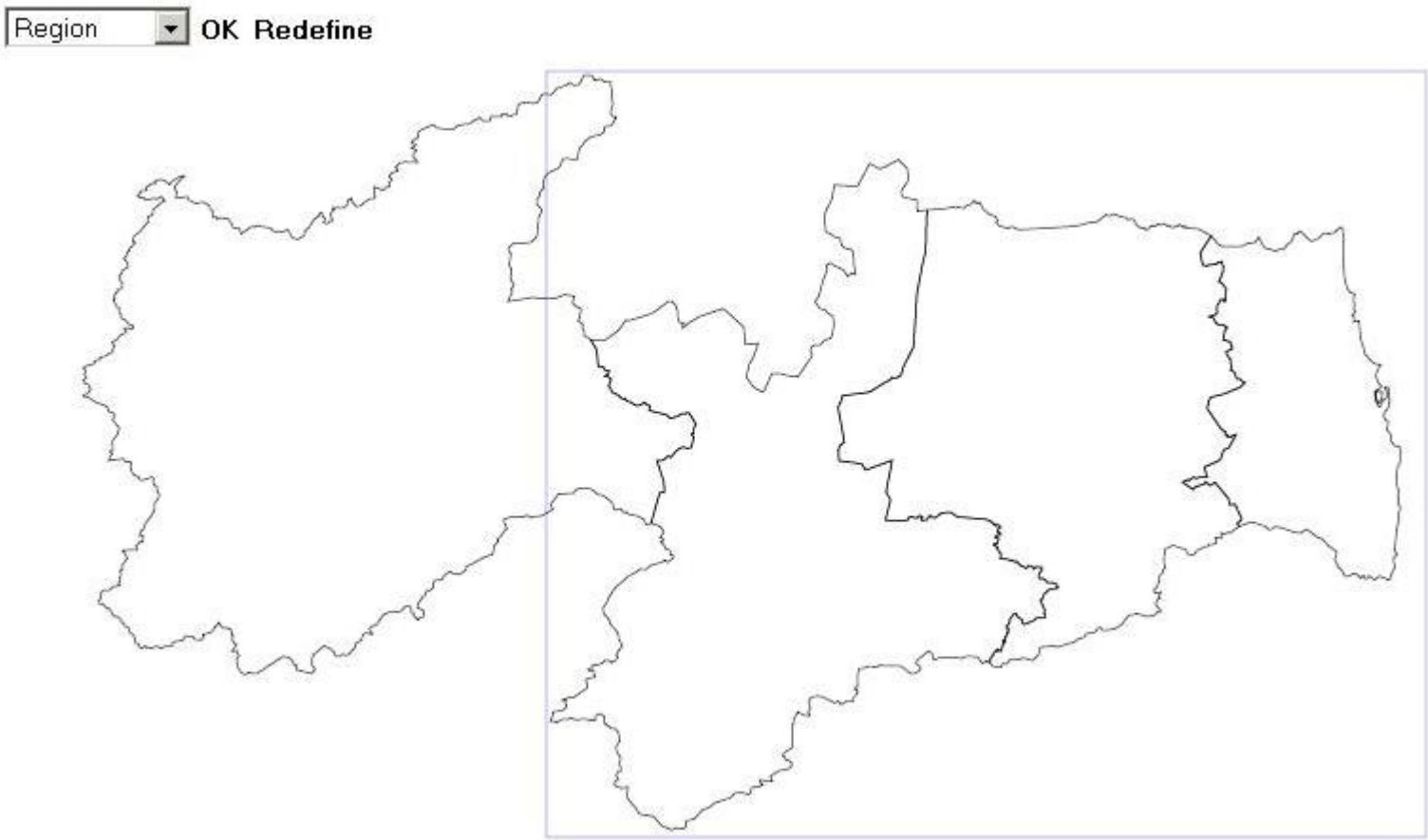
Time constraints



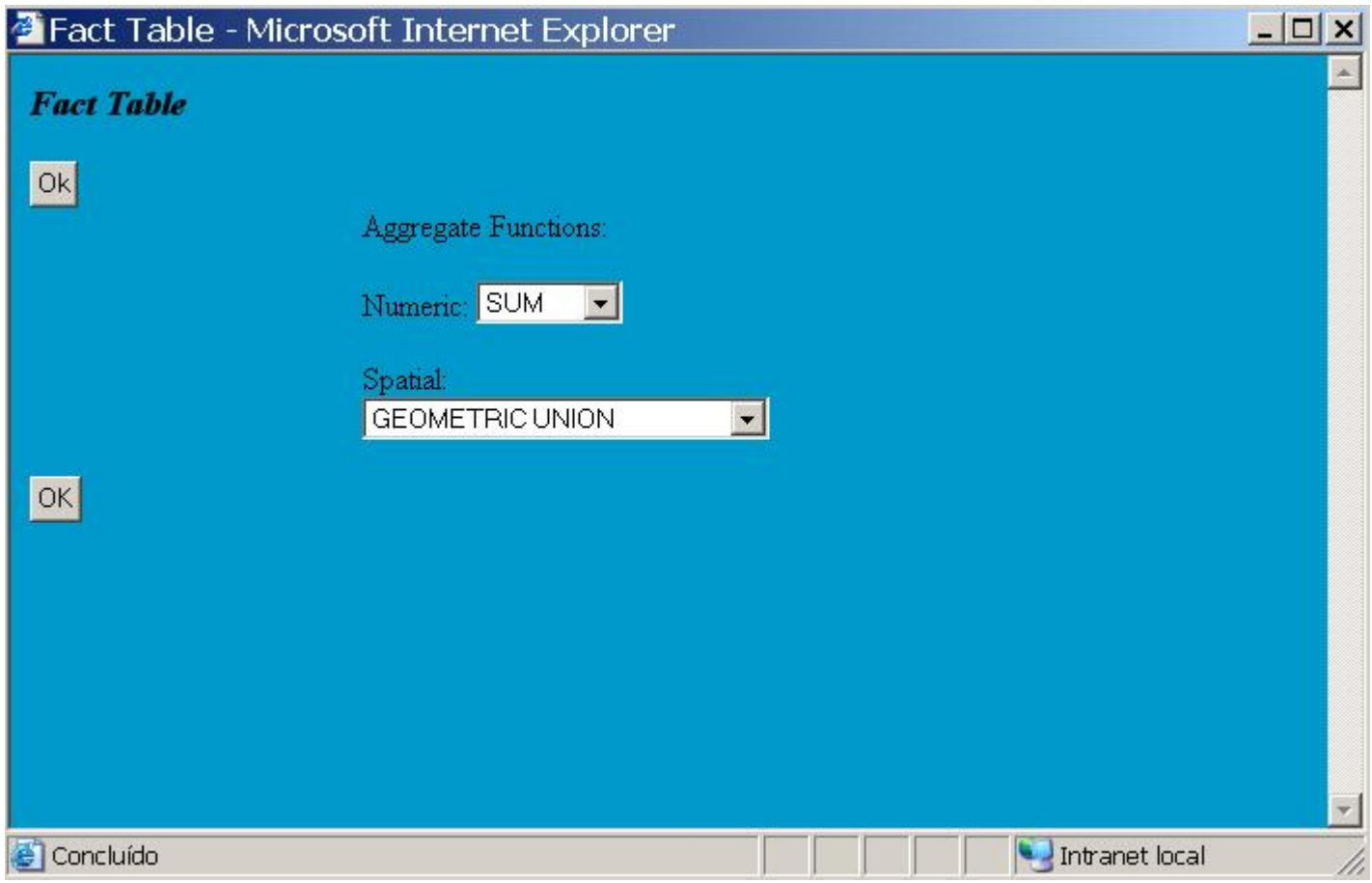
Spatial Constraints



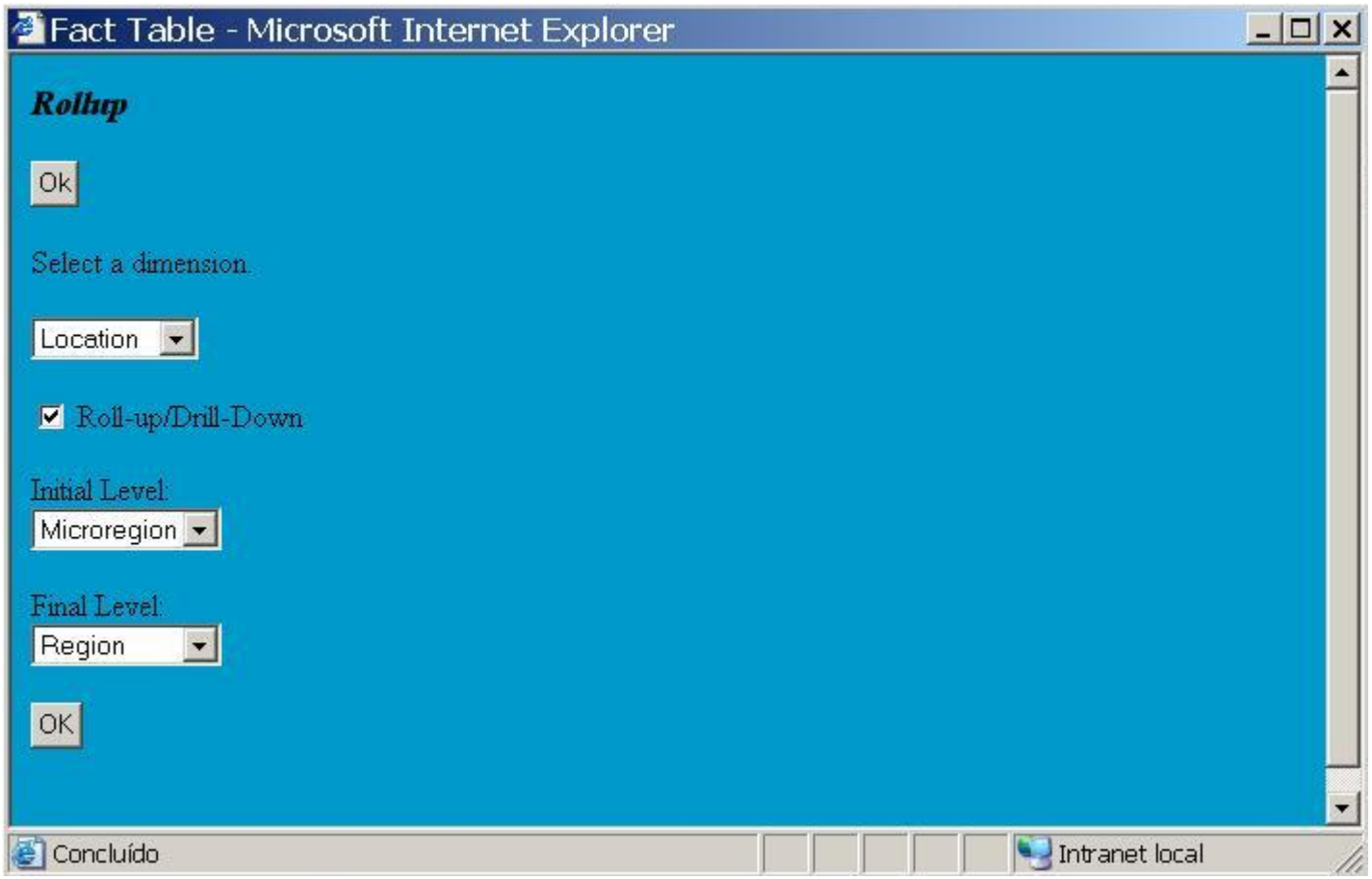
Spatial Constraints : spatial window



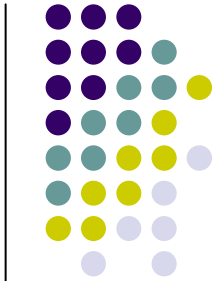
Aggregate Functions



Rollup


Fact Table - Microsoft Internet Explorer
Rollup
Ok
Select a dimension:
Location
Roll-up/Drill-Down
Initial Level:
Microregion
Final Level:
Region
OK
Concluído
Intranet local

MapWarehouse Query



```
(SELECT a.municipality_ref.microregion_geometry,
 SDO_AGGR_UNION(MDSYS.SDOAGGRTYPE   (a.crop_areas,
    0.005))
 FROM AgroDistribution_Objtab a
 WHERE a.plantation_ref.name = ‘corn’ And a.time_ref.month = 5
    And a.time_ref.year = 2003 And a.municipality_ref.state_name =
    ‘Paraíba’ And SDO_INSIDE (a.crop_areas, SDO_GEOMETRY
        (2003, 8307, NULL, SDO_ELEM_INFO_ARRAY
        (1,1003,3), SDO_ORDINATE_ARRAY (-37.1,
            -6.0, -34.0, -9.0))) = 'TRUE'
GROUP BY a.municipality_ref.micro-region_geometry)
UNION …
```

MapWarehouse Query

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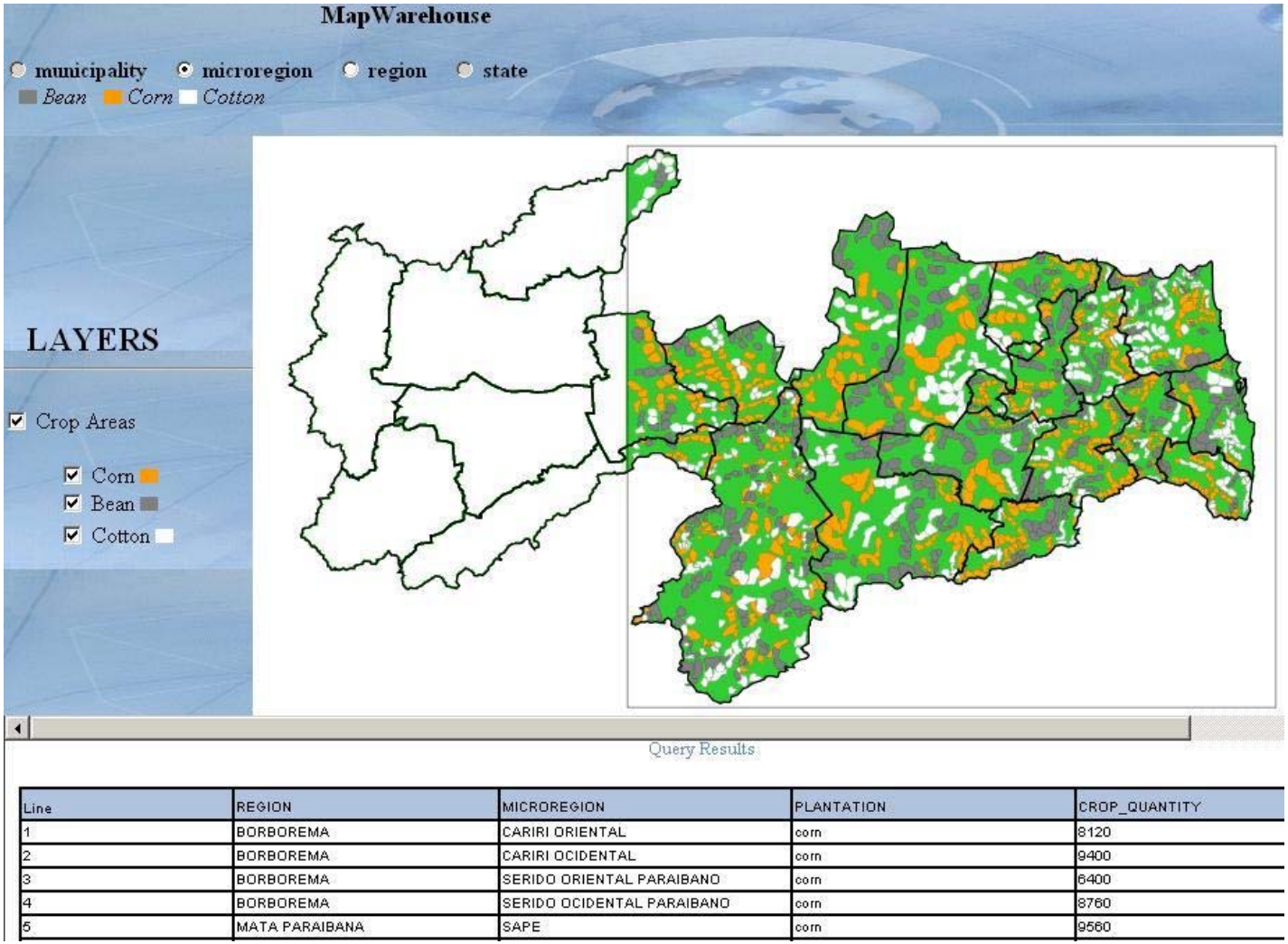
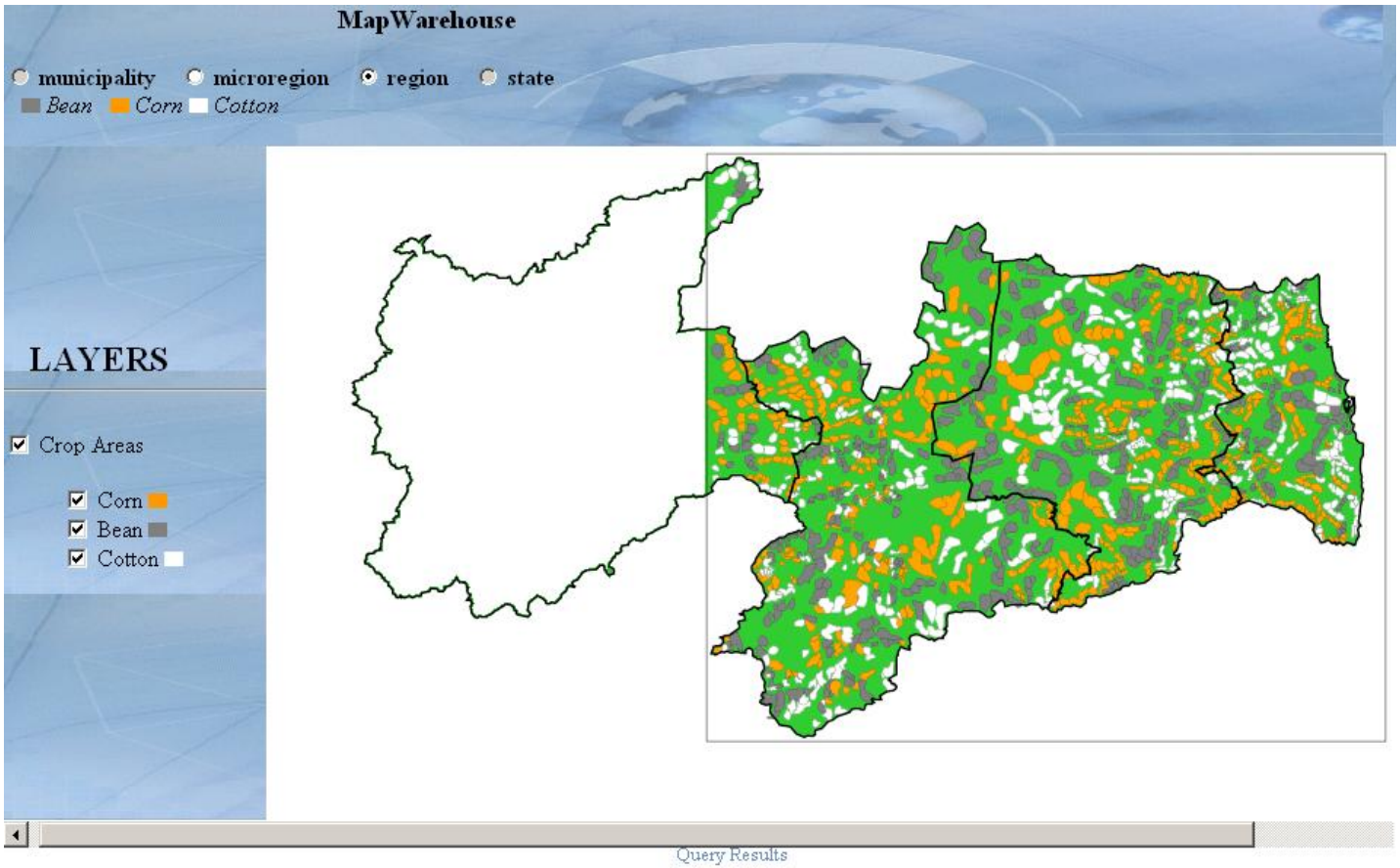
```

Rollup Operation: Micro-region



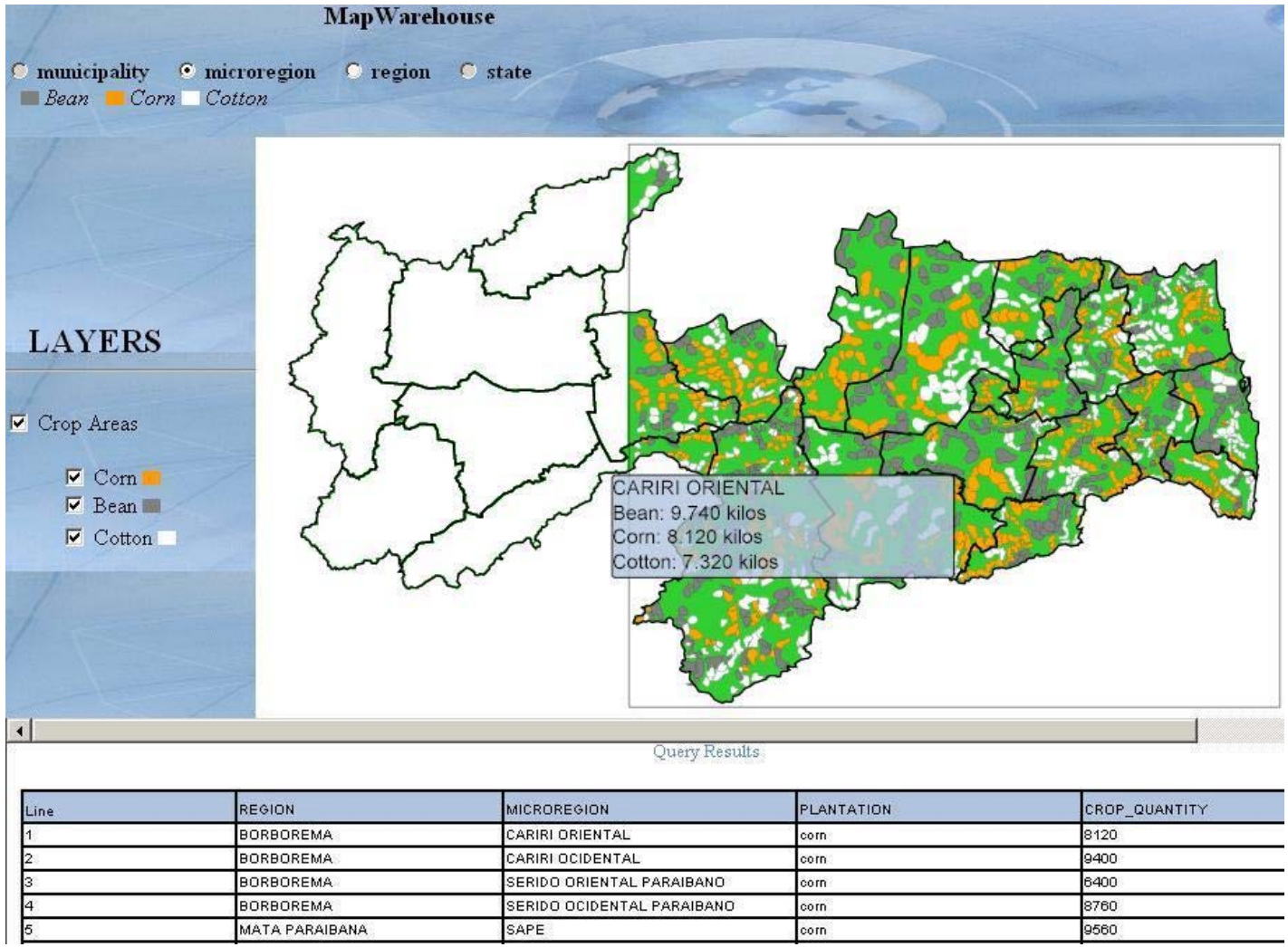
Line	REGION	MICROREGION	PLANTATION	CROP_QUANTITY
1	BORBOREMA	CARIRI ORIENTAL	corn	8120
2	BORBOREMA	CARIRI OCIDENTAL	corn	9400
3	BORBOREMA	SERIDO ORIENTAL PARAIBANO	corn	6400
4	BORBOREMA	SERIDO OCIDENTAL PARAIBANO	corn	8760
5	MATA PARAIBANA	SAPE	corn	9560

Rollup Operation: Region



Line	REGION	MICROREGION	PLANTATION	CROP_QUANTITY
1	BORBOREMA	ALL	corn	32680
2	MATA PARAIBANA	ALL	corn	28710
3	SERTAO PARAIBANO	ALL	corn	5020
4	AGRESTE PARAIBANO	ALL	corn	49223
5	BORBOREMA	ALL	bean	26520

Infotip



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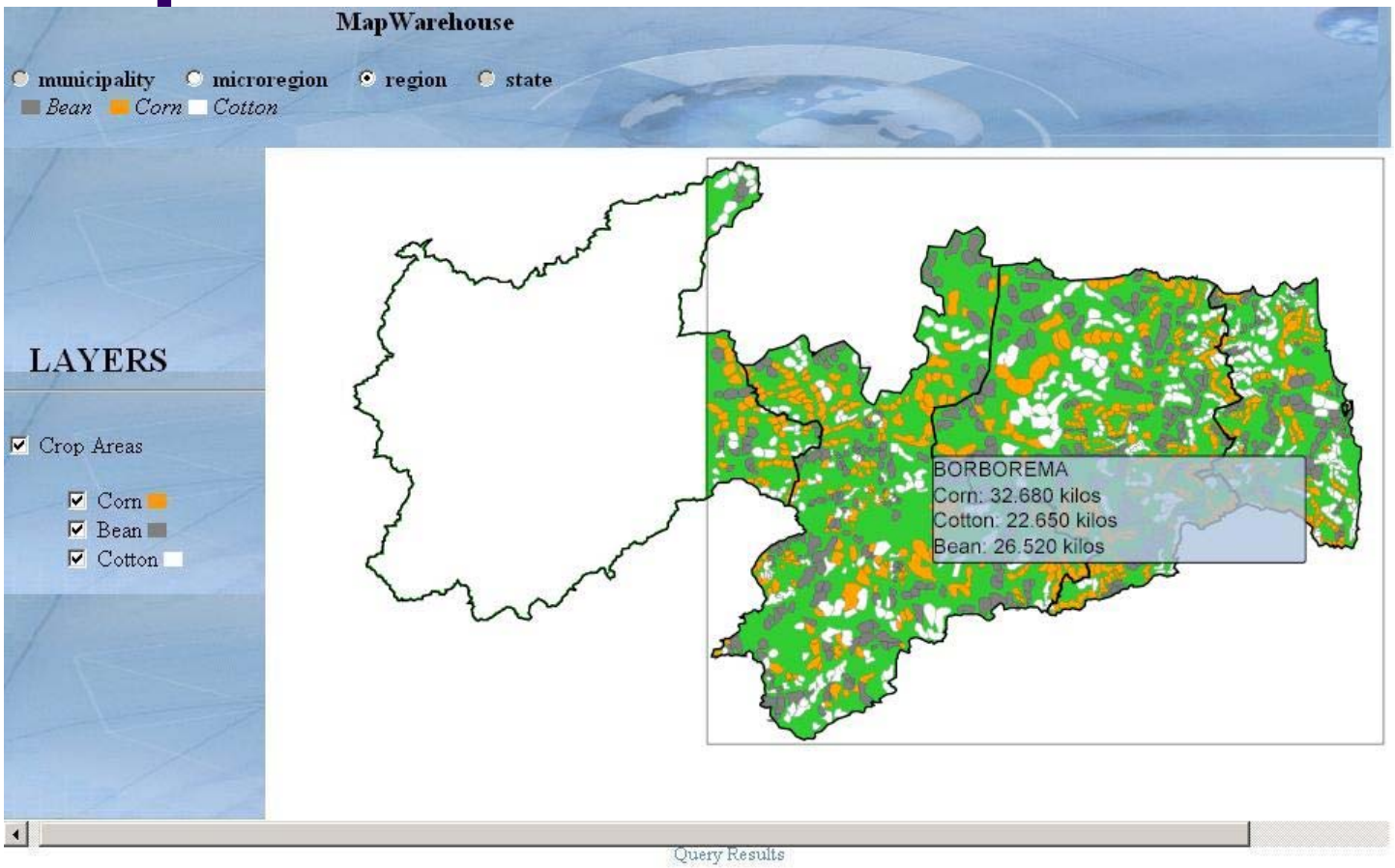

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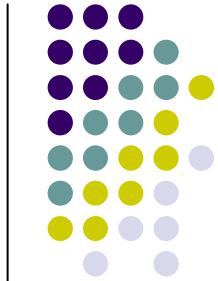
Conclusion

- The incorporation of spatial dimension and measure enables to locate more efficiently tendencies in a given application domain by using dynamic maps with zooming, panning, aggregation and other GIS functionalities.

Conclusion – Further Work



- Spatial Data Warehousing is still in its infancy and more research on this topic is due
- We need
  - to enhance usability and
  - to include other OLAP and spatial query capabilities.

Acknowledgements

- Many Thanks!
- Questions?