



BAPPENAS

INTEGRATION OF SYSTEM DYNAMIC AND SPATIAL DYNAMIC MODELS TO SUPPORT REGIONAL DEVELOPMENT PLANNING (CASE STUDY IN JAWA-BALI ISLAND)

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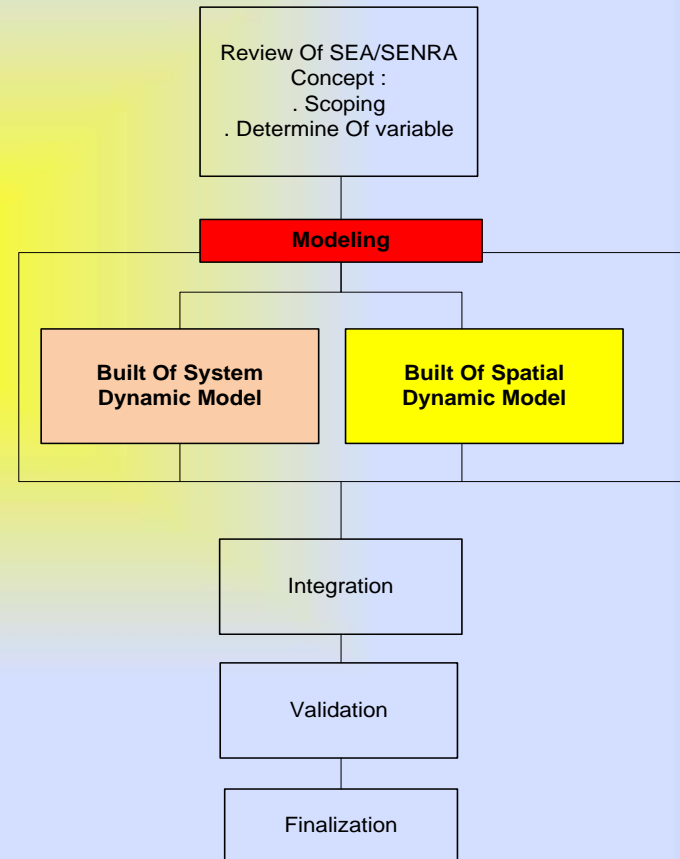
OBJECTIVE OF PROJECT

□ General :

- Providing a software of spatial dynamic to utilize spatial data as a tool for regional development planning in Indonesia.

□ Special :

- Providing the information spatial for analysis spatial_dynamic that are :
 - ❖ Carrying capacity natural resources for economic activity and regional development.
 - ❖ Land availability based on spatial planning policy.
- Providing the facility to do simulation of land use distribution based on the some implemented sectoral and spatial scenarios



PLANNING ISSUES

- IMPROVEMENT PLANNING PROCESS
 - PARTIAL, SECTORAL -> integrated and interdependent
 - QUALITATIVE -> more quantitative analysis
 - UN-TRACEABLE -> traceable, documented, continuous improvement process
- LACK OF ENVIRONMENTAL CONSIDERATION
 - “SEA CONCEPT” implementation
 - Equilibrium : Economic, Social, Environmental aspect
- LACK OF SPATIAL DIMENSION
 - Integration systems dynamic and spatial dynamic
 - Integration mental, numerical and spatial database unit

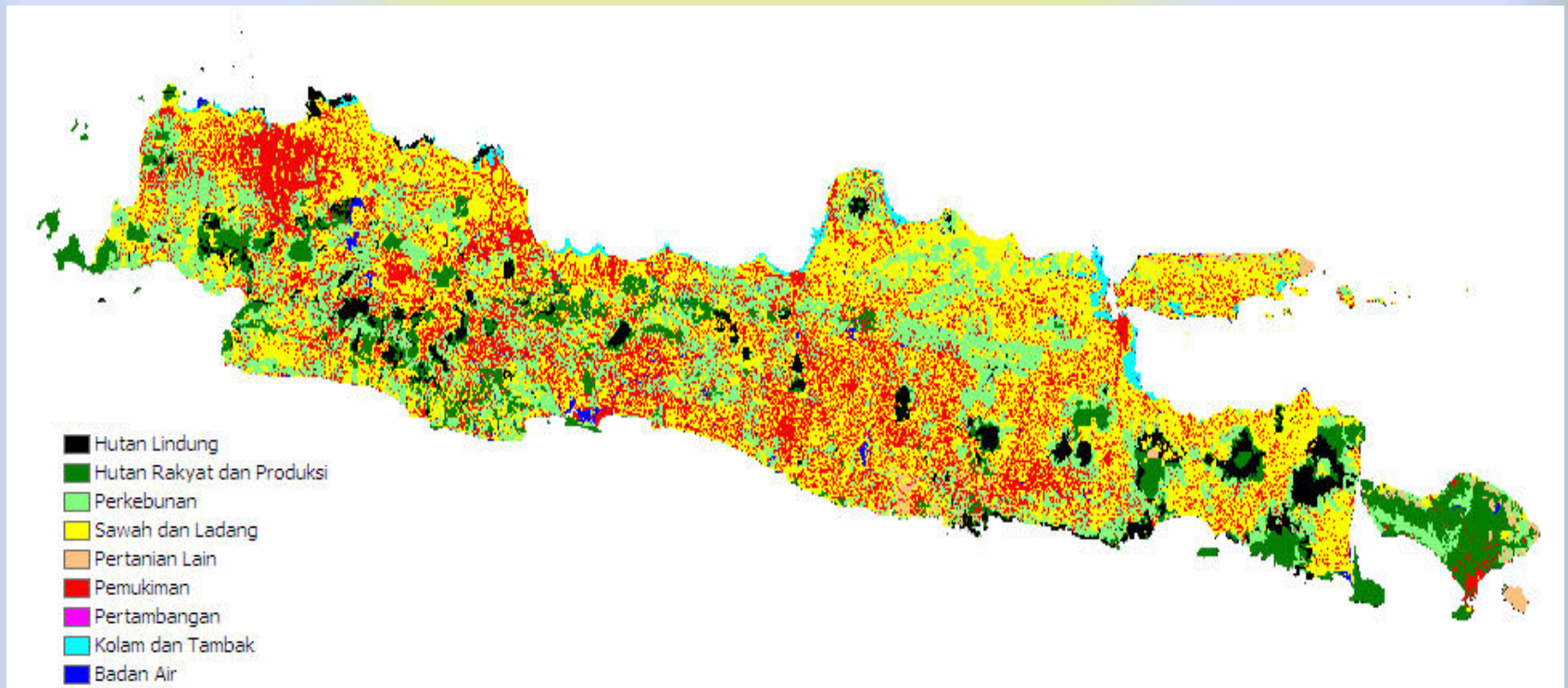
DEVELOPMENT OF MODEL

SCOPING OF MODEL

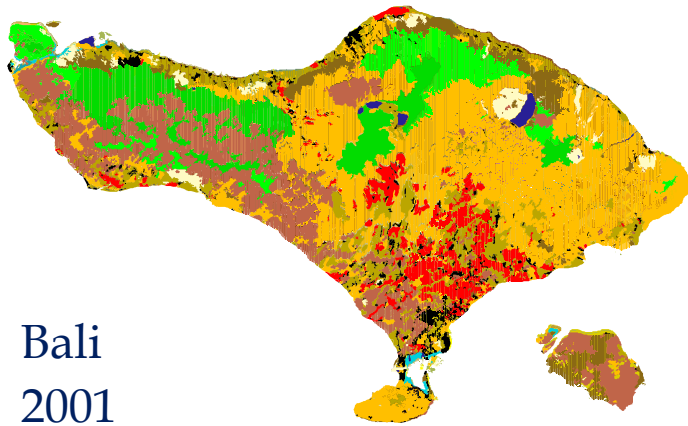
- The phenomena of land use development is modelled behaviour.
- The area of study is Jawa and Bali islands.
- The type of modelling land use are protection and production forest, dry and wet agriculture land, field, settlement, industry, services and trade area.
- The model of spatial analysis are analysis based on raster.
- The smallest unit is grid cell with size 1 x 1 km for island.
- The model of quantitative analysis is probability model with logit regression statistical technical
- The transition rule of land use changing used iteration system with defined variable and factor.

Understanding of Spatial-Dynamic Behaviour at Jawa-Bali.

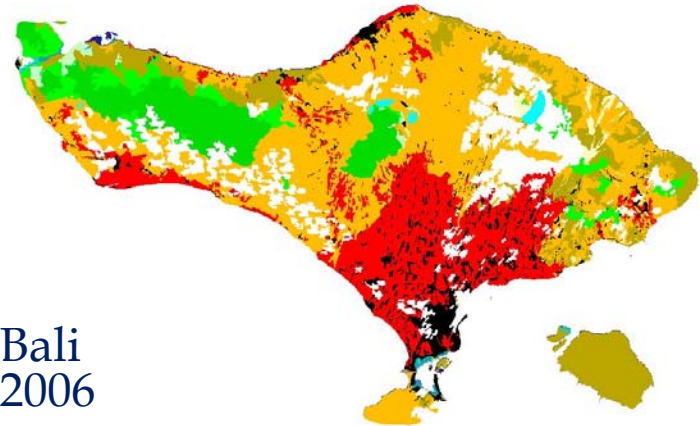
URBAN SPRAWL



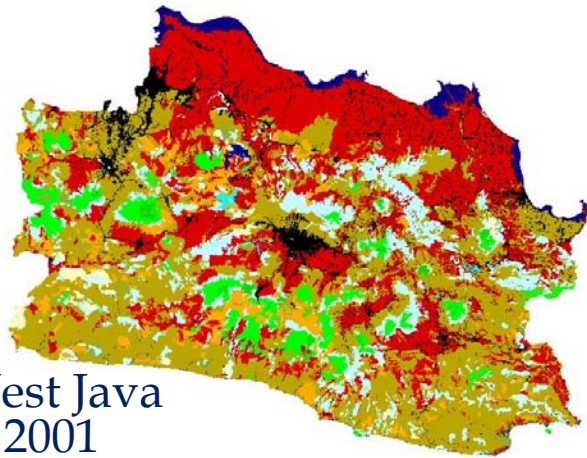
LAND USE CHANGE IN BALI ISLAND



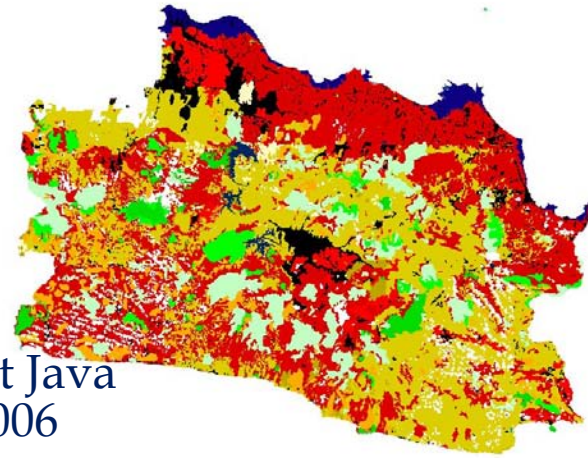
Bali
2001



Bali
2006



West Java
2001



West Java
2006

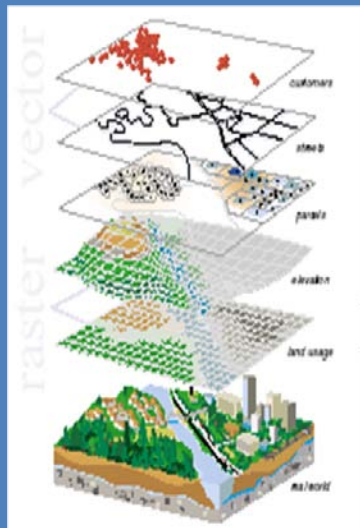
LAND USE CONVERSION

- Average of national conversion agriculture land are 0,75% to 1,53% per year or 50,000 to 86,000 ha per year (statistic 2008)
- Average agriculture land conversion to settlement at Bali reach 0,85% per year
- Average agriculture land conversion at Jawa as 58,7% to settlement and 21,8% to industry, office building, trading area during 15 years

SCOPE OF SPATIAL DYNAMIC

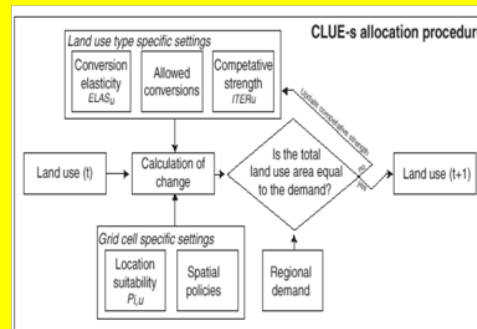
- Spatial Dynamic is method to draw the behaviour and phenomena of system in the reference of time and space.
- Spatial Dynamic to stimulate of transformation process of land use changing

DRIVING FACTORS

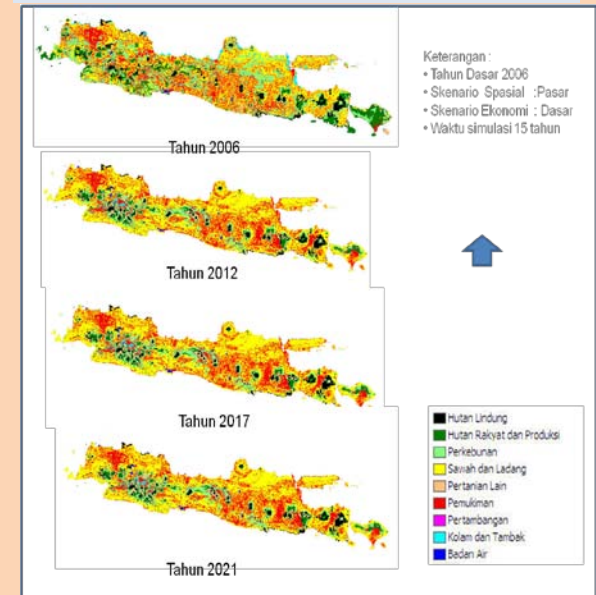


KRITERIA
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TRANSITION RULES



SIMULATION RESULTS



Thematic Digital Data

Probability Model

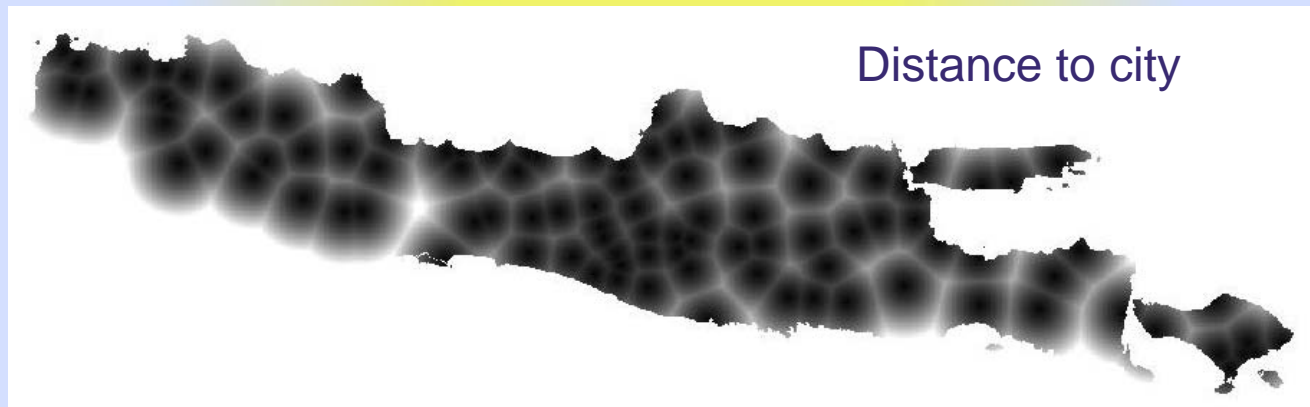
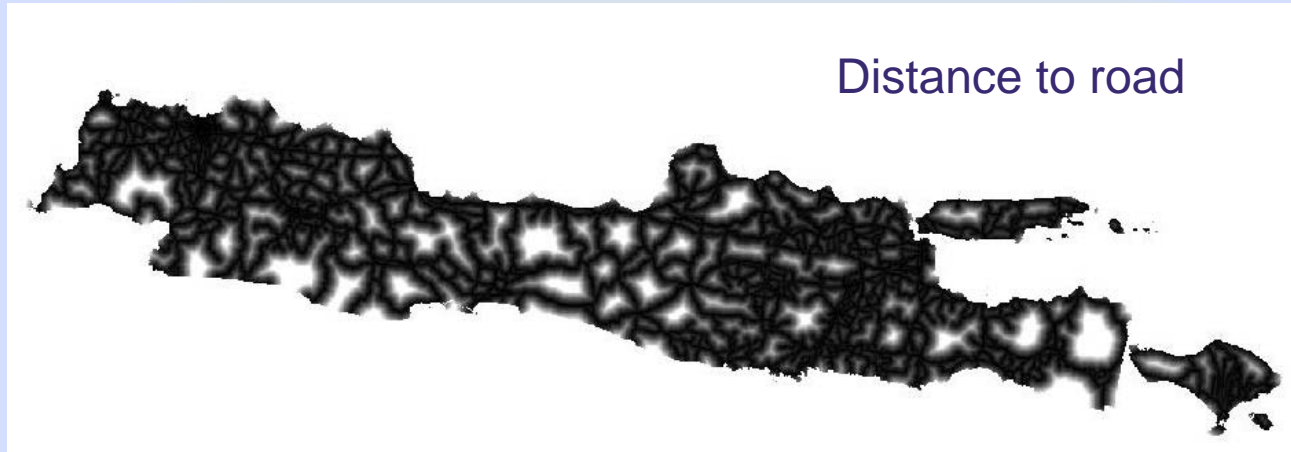
Prediction of Land use

The spatial data needed in modelling

- ▣ Land use data
- ▣ Spatial Planning data
- ▣ Erosion susceptibility level
- ▣ Elevation
- ▣ Slope
- ▣ Geology
- ▣ Distance to road network
- ▣ Distance to river network
- ▣ Distance to center of city
- ▣ Distance to shoreline
- ▣ Distance to national and international harbor /airport

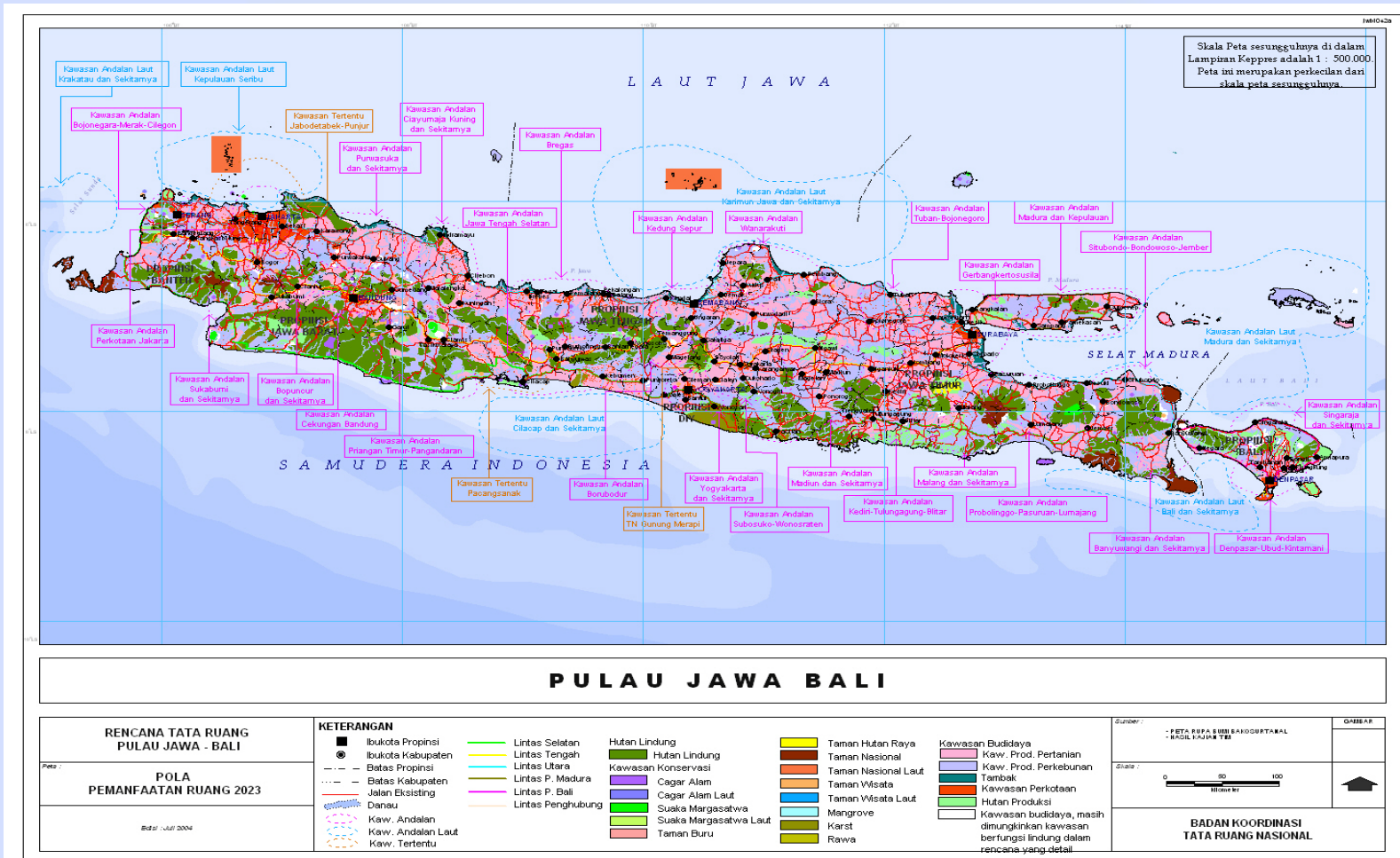
STEP OF MODEL DEVELOPMENT

Variable Analysis : Accessibility



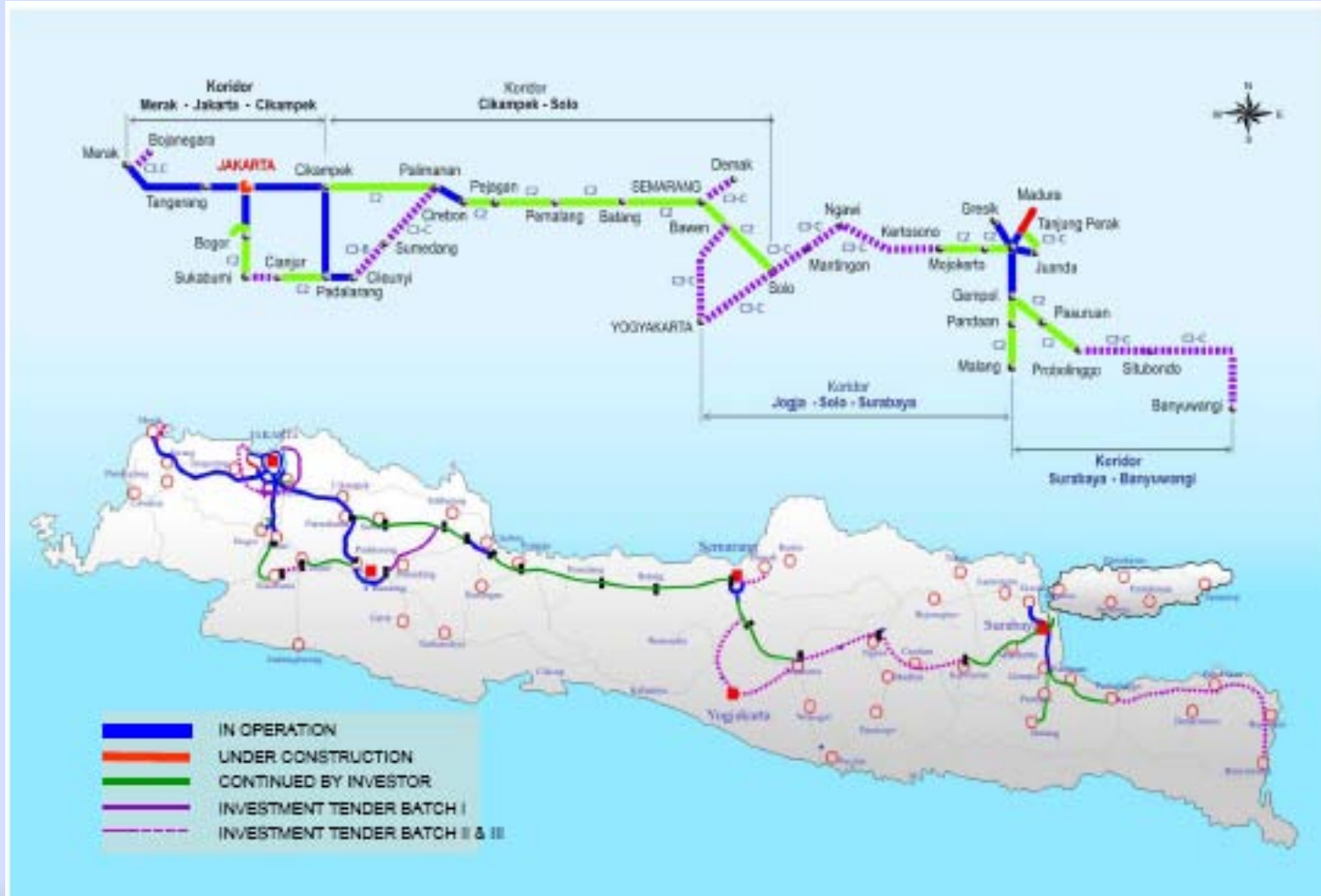
STEP OF MODEL DEVELOPMENT

Variable Analysis: Policy of Spatial Planning



STEP OF MODEL DEVELOPMENT

Variable analysis : transportation policy

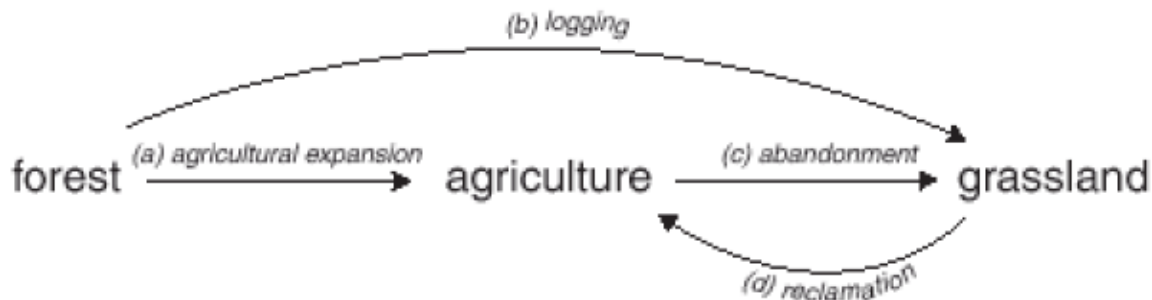


STEP OF MODEL DEVELOPMENT

Analysis Variable and factor : Land Conversion Pattern

The pattern of land conversion based on empirical observation in the defined time. It shows what kind of land is possible to converse each other

Land use change sequence



Land use conversion matrix

| future land use → | Forest | Agriculture | Grassland |
|-----------------------|--------|-------------|-----------|
| present land use ↓ | | | |
| Forest | + | +(a) | +(b) |
| Agriculture | - | + | +(d) |
| Grassland | - | +(e) | + |

+ conversion possible

- conversion not possible

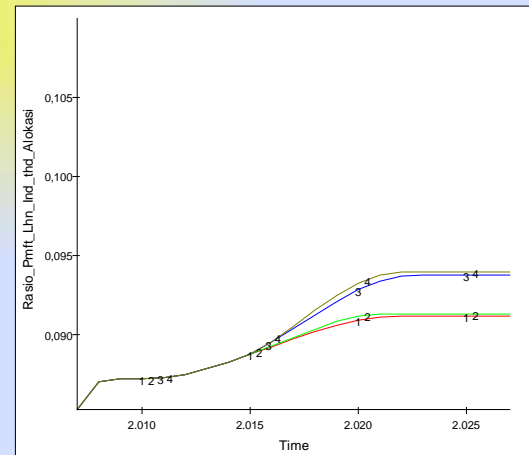
Figure 3. Illustration of the translation of a hypothetical land use change sequence into a land use conversion matrix

STEP OF MODEL DEVELOPMENT

Analisis Variable and factor : Land Demand

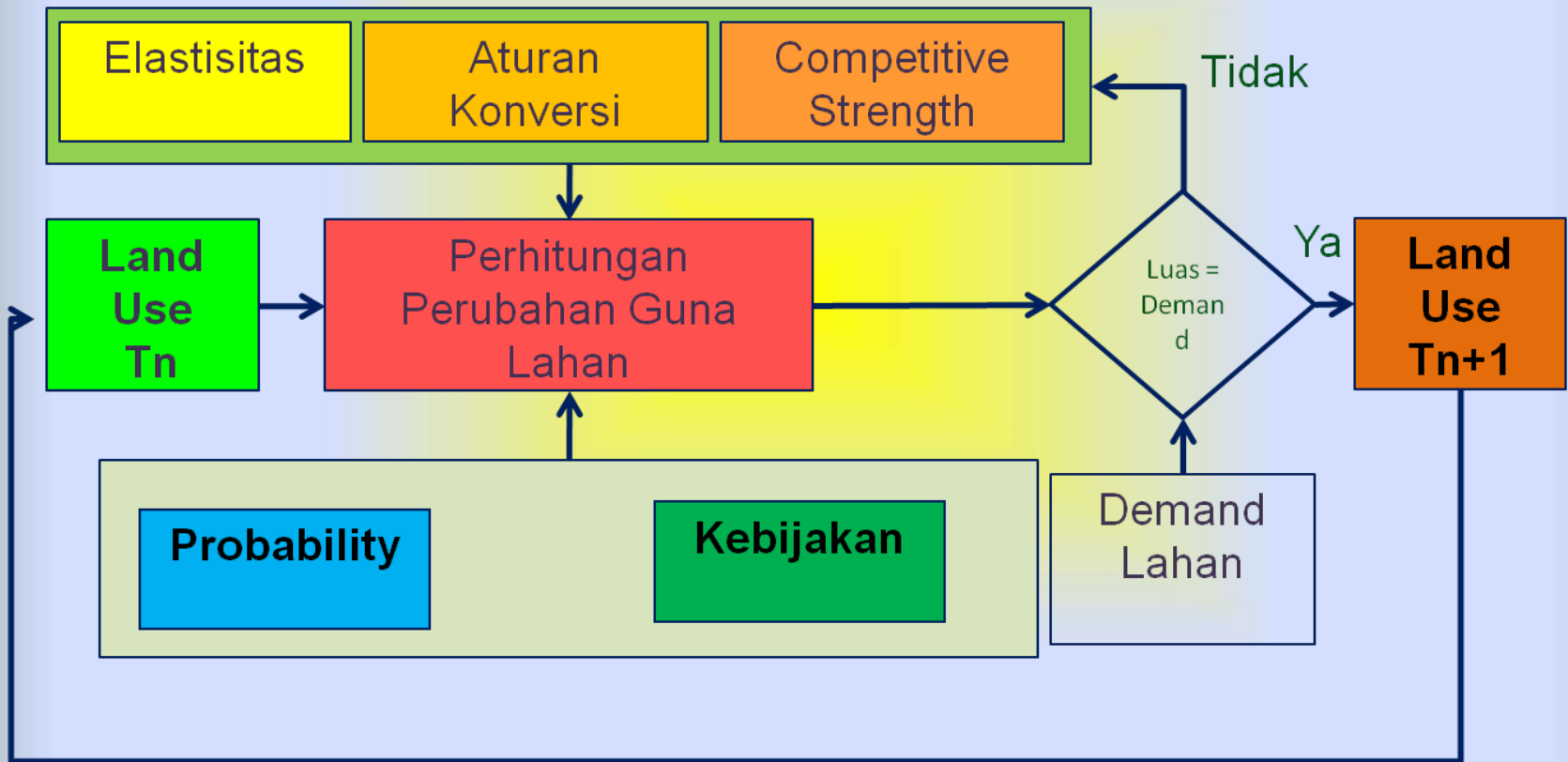
Land demand is the result of non spatial analysis that are quantity of land use type in the future (prediction)
The process of computing land demand was done by dynamic modeling

| Tahun | Lhn_Ind_Yg_Terpakai | Lhn JsPrdgn_Terpakai | Lhn_Pmkn_Terpakai |
|-------|---------------------|----------------------|-------------------|
| 2007 | 3.961.180 | 633.365 | 6.425.640 |
| 2009 | 4.054.965 | 736.728,80 | 6.917.019 |
| 2011 | 4.069.585 | 802.122,20 | 7.422.228 |
| 2013 | 4.104.514 | 859.438 | 7.941.705 |
| 2015 | 4.151.157 | 1.027.195 | 8.473.965 |
| 2017 | 4.245.251 | 1.112.231 | 9.021.868 |
| 2019 | 4.340.472 | 1.177.843 | 9.589.642 |
| 2021 | 4.388.534 | 1.241.186 | 10.181.013 |
| 2023 | 4.388.534 | 1.306.088 | 10.796.238 |
| 2025 | 4.388.534 | 1.371.098 | 11.431.050 |
| 2027 | 4.388.534 | 1.438.927 | 12.082.664 |



STEP OF MODEL DEVELOPMENT

Schema of land demand computation



SCENARIO OF RDP

Development Scenario

- ▣ Market Scenario

The Pattern of land use was defined by market. It follows market needed (free)

- ▣ Spatial Planning Policy

The Pattern of land use was following the policy has defined by government

- ▣ Limited of Conversion Land use Scenario

The pattern of land use was flexible with the rule of land conversion

RESULT OF RDP APPLICATION SOFTWARE DEVELOPMENT

User Interfaces for dynamic system application (for economy)

Masukkan Skenario

Ekonomi | Lahan | Penduduk

Industri

| | |
|-------------------------------------|-----------------------------------|
| Expected Investment Growth Rate (I) | <input type="text" value="2"/> |
| Waktu Skenario Investasi | <input type="text" value="2006"/> |
| Expected Export Growth Rate (X) | <input type="text" value="2"/> |
| Waktu Skenario Ekspor | <input type="text" value="2006"/> |
| Gov. Spending Fraction (G) | <input type="text" value="2"/> |
| Waktu Skenario | <input type="text" value="2006"/> |
| KOR sektor industri | <input type="text" value="3"/> |
| Waktu Skenario Impor | <input type="text" value="2006"/> |

Jasa

| | |
|-------------------------------------|-----------------------------------|
| Expected Investment Growth Rate (I) | <input type="text" value="3"/> |
| Waktu Skenario Investasi | <input type="text" value="2006"/> |
| Expected Export Growth Rate (X) | <input type="text" value="3"/> |
| Waktu Skenario Ekspor | <input type="text" value="2005"/> |
| Gov. Spending Fraction (G) | <input type="text" value="4"/> |
| Waktu Skenario | <input type="text" value="2001"/> |
| KOR sektor jasa | <input type="text" value="2"/> |
| Waktu Skenario Impor | <input type="text" value="2006"/> |

Buka Skenario Simpan Skenario Petunjuk OK

HASIL PENGEMBANGAN PERANGKAT LUNAK

User Interfaces for dynamic system application Scenario Menu for Population

The screenshot shows a software window titled "Masukkan Skenario" with a blue border and a close button in the top right corner. The window has three tabs: "Ekonomi", "Lahan", and "Penduduk". The "Penduduk" tab is selected. The main area contains four input fields with labels:

| | |
|--|-----------------------------------|
| Kebijakan Keluarga Berencana | <input type="text" value="1"/> |
| Waktu Pelaksanaan Kebijakan Keluarga Berencana | <input type="text" value="5000"/> |
| Kebijakan Pembatasan InMigrasi | <input type="text" value="1"/> |
| Waktu Pelaksanaan Kebijakan InMigrasi | <input type="text" value="5000"/> |

Below these fields is a label "Jumlah Penduduk" followed by an empty input field.

At the bottom of the window, there is a row of buttons: a small empty input field, "Buka Skenario", "Simpan Skenario", "Petunjuk", and "OK".

PART OF DEVELOPMENT SOFTWARE APPLICATION

USER INTERFACE SCENARIO DEVELOPMENT

Main Menu of Elasticity land conversion

Matrik Elastisitas

| Tipe Lahan | Elastisitas |
|-----------------|-------------|
| Hutan Lindung | 1 |
| Hutan Rakyat di | 0.2 |
| Perkebunan | 0.2 |
| Sawah dan Lada | 0.2 |
| Pertanian Lain | 0.2 |
| Pemukiman | 0.2 |
| Pertambangan | 0.2 |
| Kolam dan Tam | 0.2 |
| Badan Air | 1 |

Buttons: EDIT, OK, SIMPAN

```
0 1
1 0.2
2 0.2
3 0.2
4 0.2
5 0.2
6 0.2
7 0.2
8 1
```

Menu of land conversion transition law

Matrik Konversi

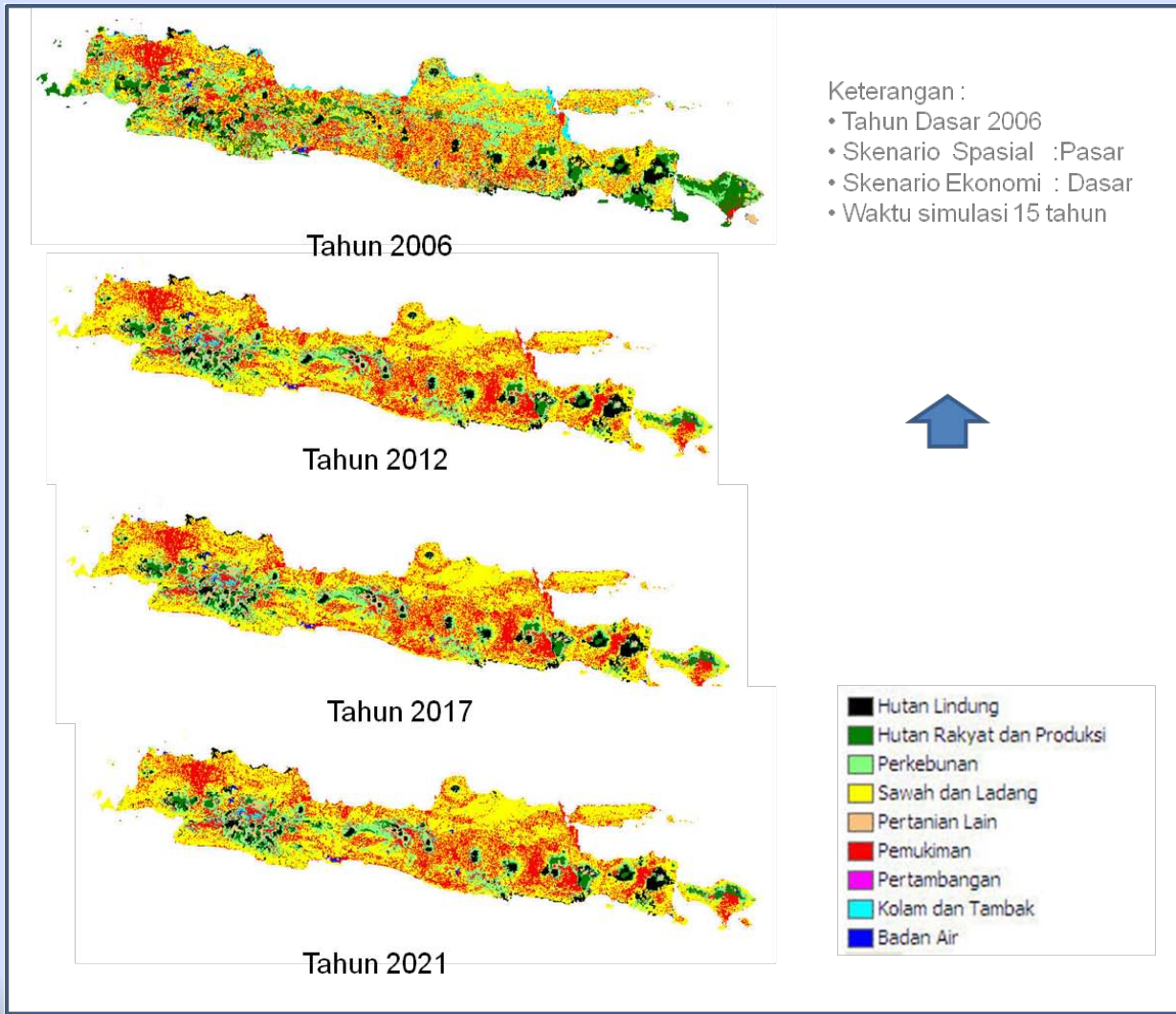
| Tipe Lahan | Hutan Lindung | Hutan Rakyat di | Perkebunan | Sawah dan lada | Perkebunan lain | Pemu |
|-----------------|---------------|-----------------|------------|----------------|-----------------|------|
| Hutan Lindung | 1 | 0 | 0 | 0 | 0 | 0 |
| Hutan Rakyat di | 0 | 1 | 1 | 0 | 0 | 0 |
| Perkebunan | 0 | 1 | 1 | 1 | 1 | 1 |
| Sawah dan lada | 0 | 0 | 1 | 1 | 1 | 1 |
| Perkebunan lain | 0 | 0 | 1 | 1 | 1 | 1 |
| Pemukiman | 0 | 0 | 0 | 1 | 1 | 1 |
| Pertambangan | 0 | 0 | 0 | 0 | 0 | 0 |
| Kolam dan Tam | 0 | 0 | 0 | 1 | 1 | 1 |
| Badan Air | 0 | 0 | 0 | 0 | 0 | 0 |

Buttons: EDIT, OK, SIMPAN

```
1,0,0,0,0,0,0,0
0,1,1,0,0,0,0,0
0,1,1,1,1,0,0,1,0
0,0,1,1,1,1,0,1,0
0,0,1,1,1,1,0,1,0
0,0,0,1,1,1,0,1,0
0,0,0,0,0,1,0,0,0
0,0,0,1,1,1,0,1,0
0,0,0,0,0,0,0,0,1
```

RESULT OF SPATIAL DYNAMIC MODELING

Skenario Pasar (Prediction Model)



CONCLUSION

Model of Spatial Dynamic was designed to fulfil the need of regional development planning based on integrated non spatial and spatial data.

The model was available to predict the demand and distribution of land in the future based on scenarios (market, policy, limited land conversion)

The model is still developing to get more validation the product

THANK YOU FOR YOUR ATTENTION