



Integration of biophysical and economic models into a decision support framework for sustainable food production and natural resource management in Benin



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Food security and natural resources in Africa: Present situation



Low input agriculture due to:

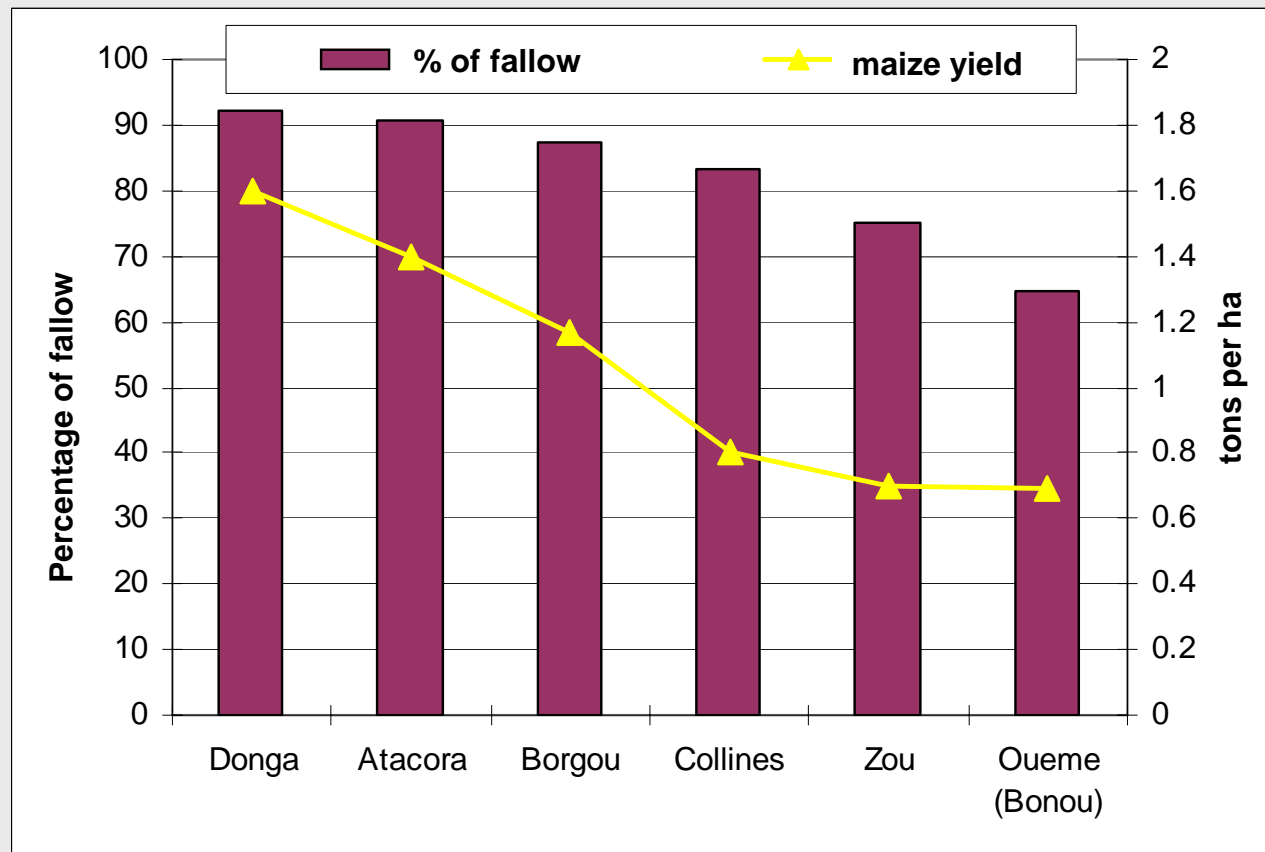
- Scarcity of capital
- Soil degradation
- Human capacities



Food security and natural resources in Africa: The future?



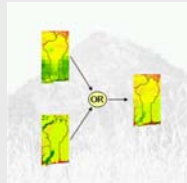
➤ Reduction of fallow periods





IMPETUS Decision support tools

SDSS at the national scale:



AGROLAND

(Expert Model for Assessment of Agricultural Marginality)



BenIMPACT (**B**enin **I**ntegrated **M**odel for **P**olicy **A**nalysis, **C**limate and **T**echnology **C**hange)



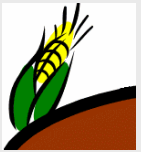
ClimModInfo

(Informations sur les résultats des modèles climatiques)



IMPETUS Decision support tools

SDSS at the regional scale:



PEDRO

(**P**rotection du sol **E**t **D**urabilité des **R**essources agricoles dans le bassin versant de l'**O**uémé)



BenIVIS

(Benin Inland Valley Information System)



SYMBA

(Planning of Small-scale Reservoirs)



Steps in SDSS development:

- Data collection and analysis
- Model calibration (point/regional scale)
- Model validation (regional scale)
- Scenario simulations
- Integration into the IMPETUS client
- Training of administrators/end-users



IMPETUS Decision support tools

SDSS at the regional scale (Upper Ouémé basin):



PEDRO

(**P**rotection du sol **E**t **D**urabilité des **R**essources agricoles dans le bassin versant de l'**O**uémé)



BenIVIS

(**B**enin **I**nland **V**alley Information **S**ystem)



SYMBA

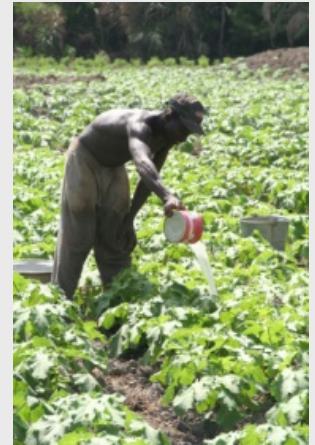
(**P**lanning of **S**mall-scale **R**eservoirs)



BenIVIS - Agro-potential of inland valleys in the Upper Ouémé catchment



- High agro-potential of inland valleys due to their higher water availability, lower fragility and higher fertility compared to the upland soils
- Often inland valleys are not exploited in Benin
- The Ministry of Agriculture wants to promote the exploitation of inland valleys
- BUT: Scarce data of inland valley locations and characteristics, which are required for an efficient planning and management

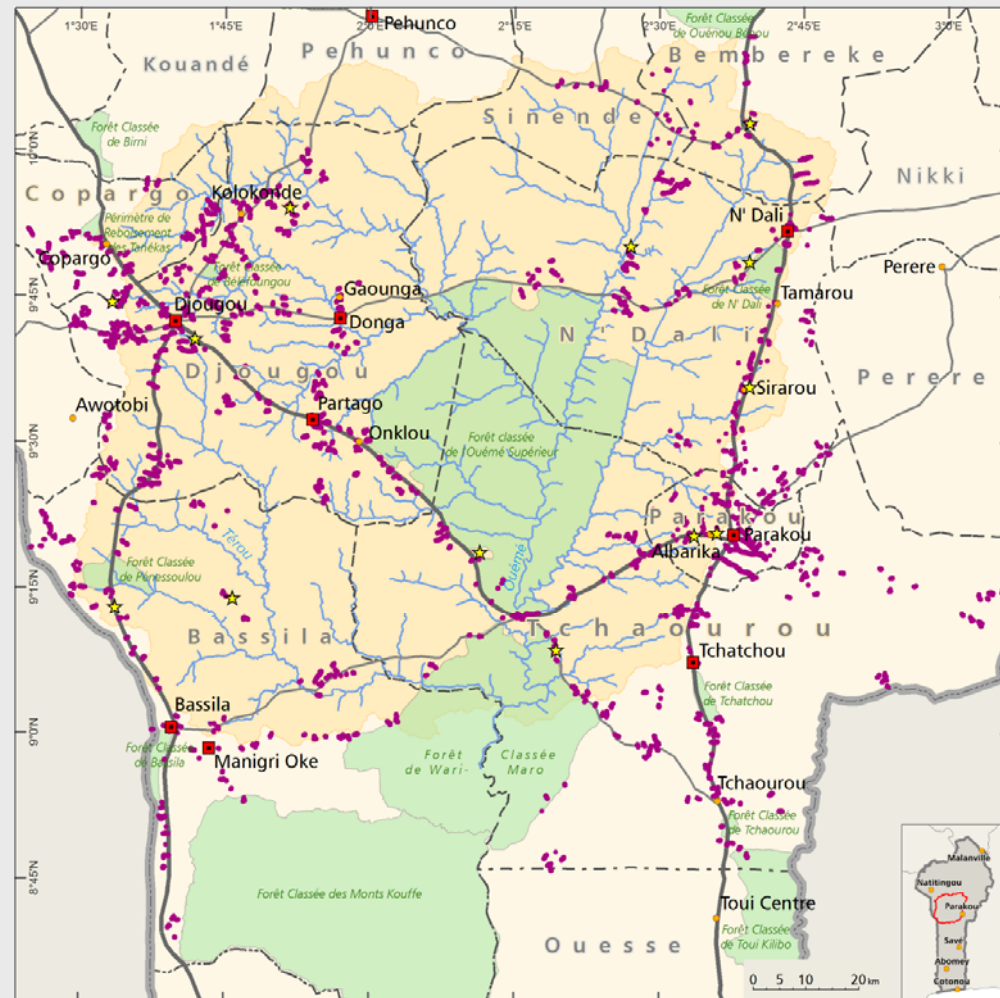




BenIVIS – Location of inland valleys



BenIVIS contains information about 817 inland valleys with a total area of 5563 ha



Legend

- | | | | |
|--|---------------------------|--------------|----------------------|
| Inland valley | Settlements (Inhabitants) | Road network | Administrative units |
| Inland valleys with pedological investigations | 5000 - 10000 | Paved Road | Country border |
| River | > 10000 | Dirt Road | Commune |

Data source: Street map Benin, IGN 1998
Population data, INSAE 2003

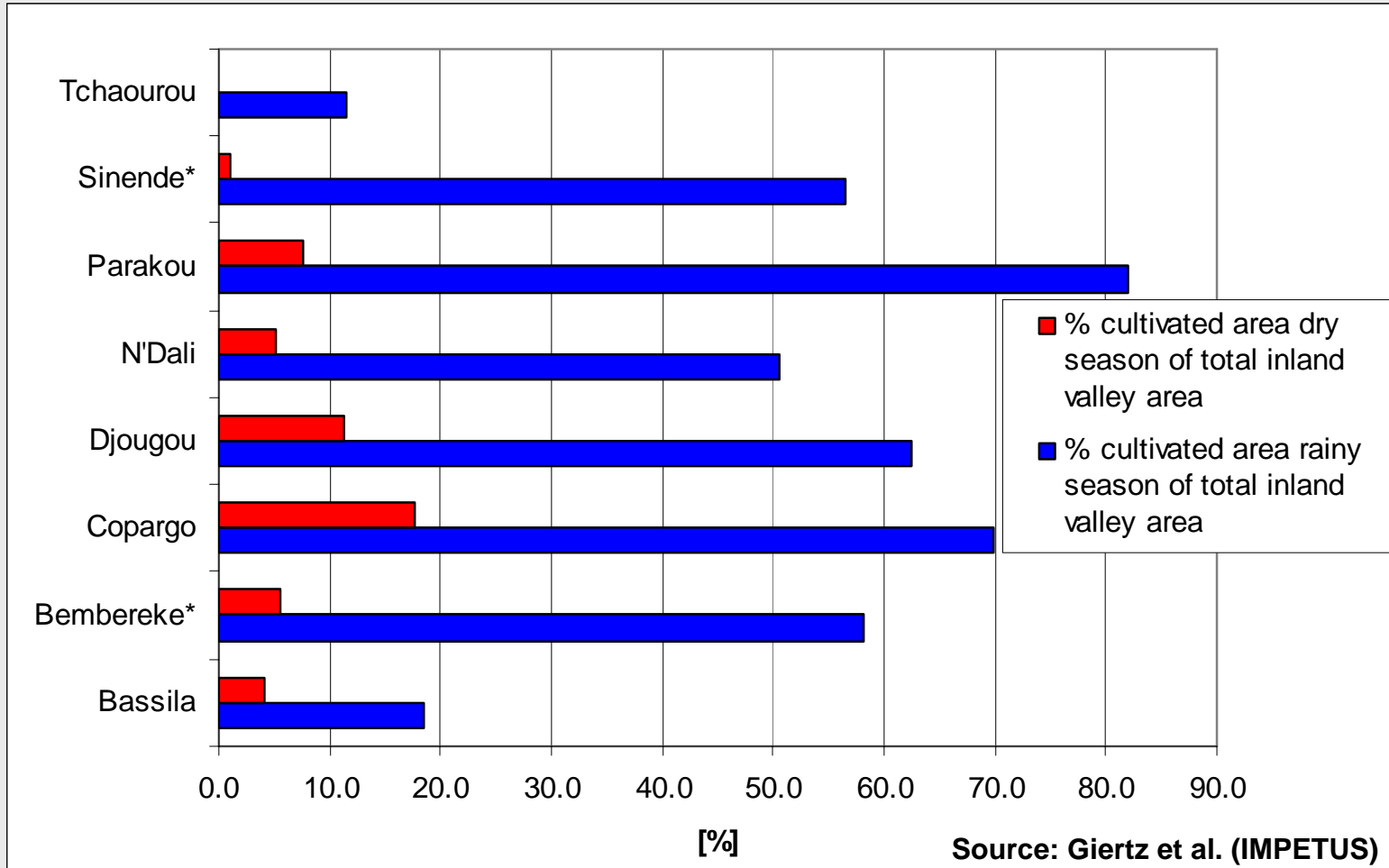
Processing and cartography: S.Giertz, G.Steup, H.Voigt

Source: Giertz et al. (IMPETUS)





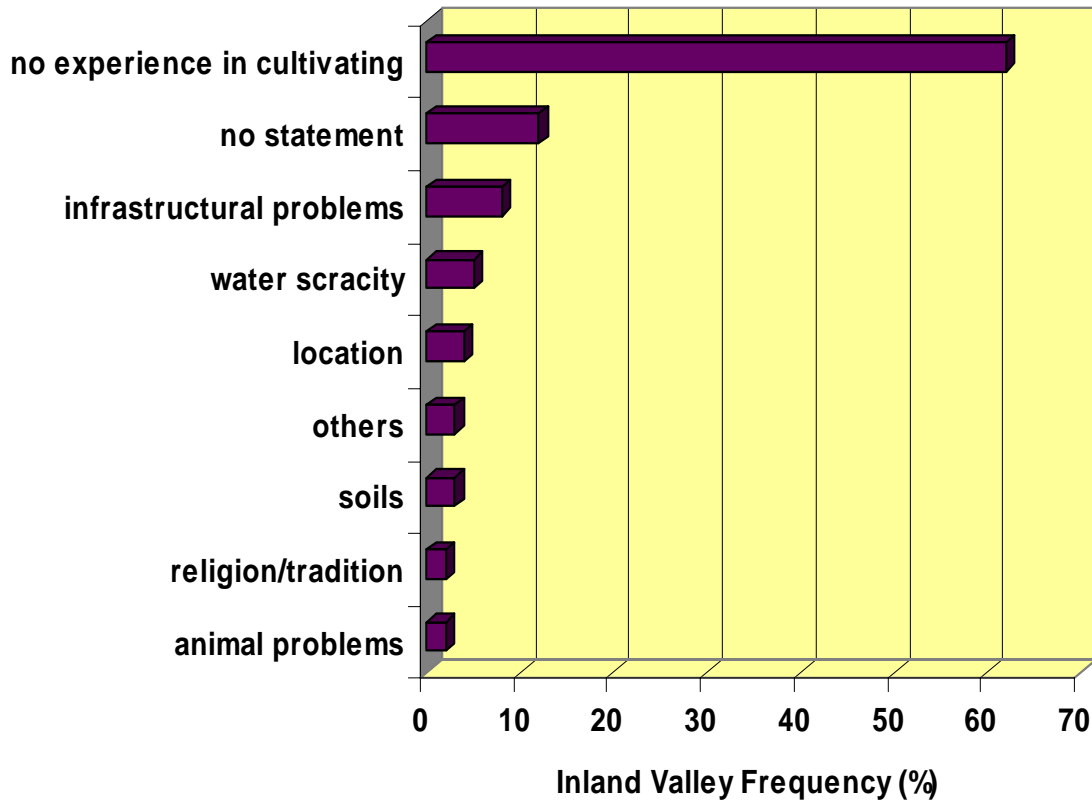
BenIVIS – Exploitation potential



*Only the part of the commune lying in the Upper Ouémé catchment was surveyed



BenIVIS – Reasons for not using inland valleys



Source: Giertz et al. (IMPETUS)

Visit BenIVIS at the booth
“Food Security in Benin”





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SYMBA

(Planning of Small-scale Reservoirs)



User specified driving forces:



- Climate
- Extension of cultivated area
- Irrigation system, volume and interval
- Selection of improved varieties
- Planting date
- Crop specific application of fertiliser



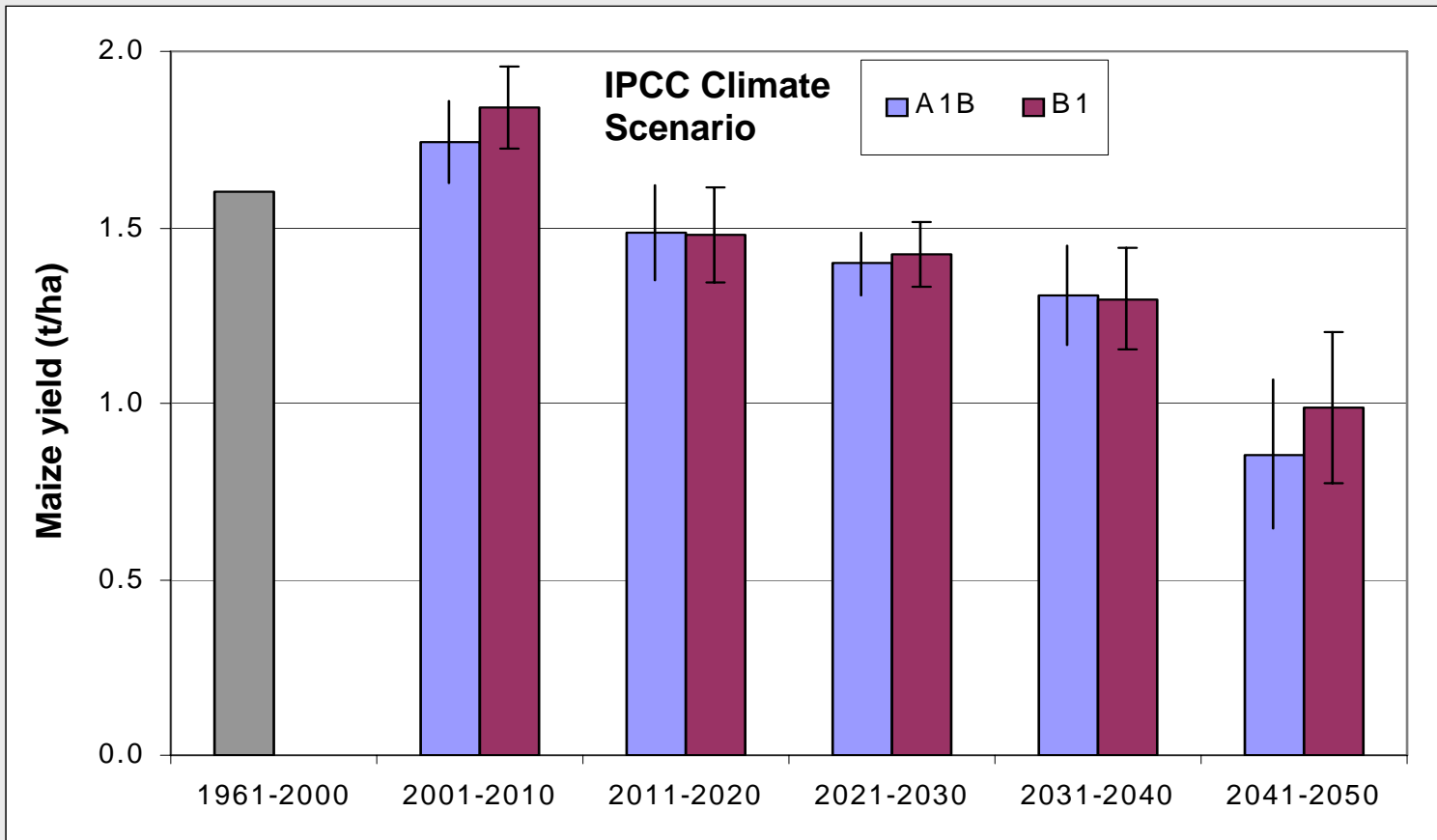


Driving force: Climate (Decreasing rainfall/Increasing temperature)

Impact: Crop productivity



Rainfall



Source: Gaiser et al. (IMPETUS)

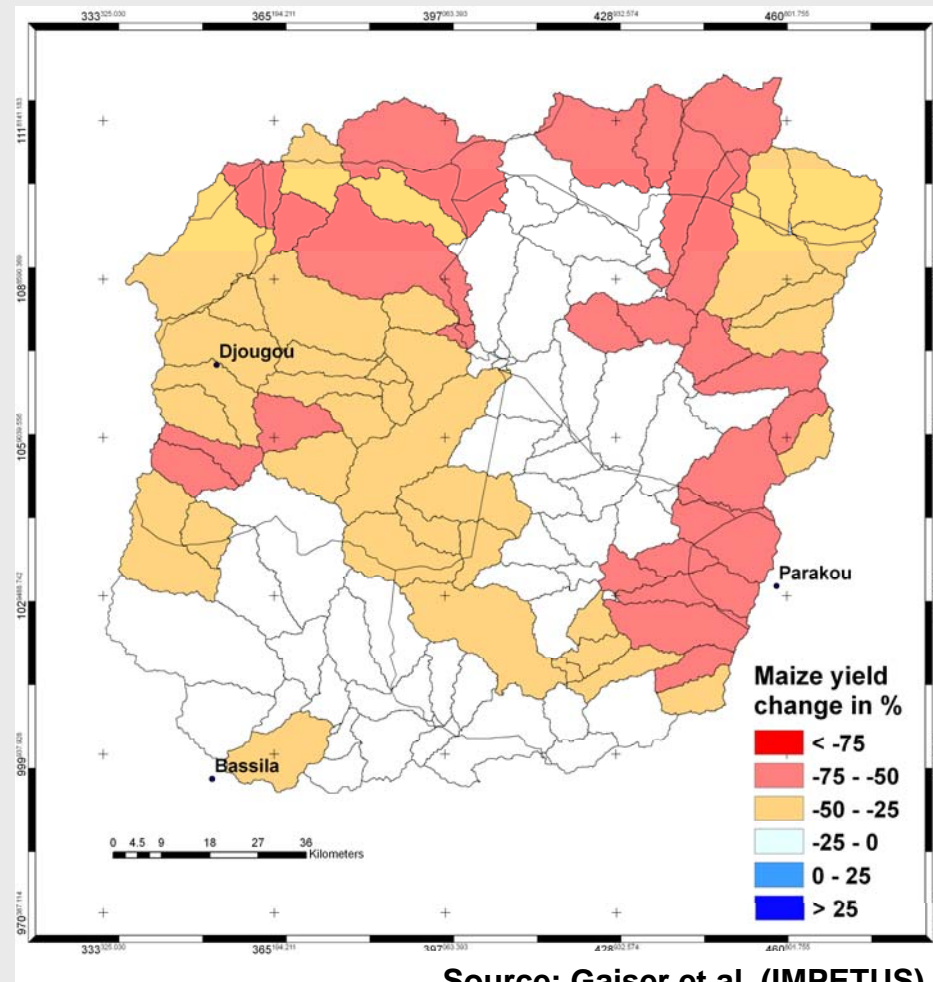
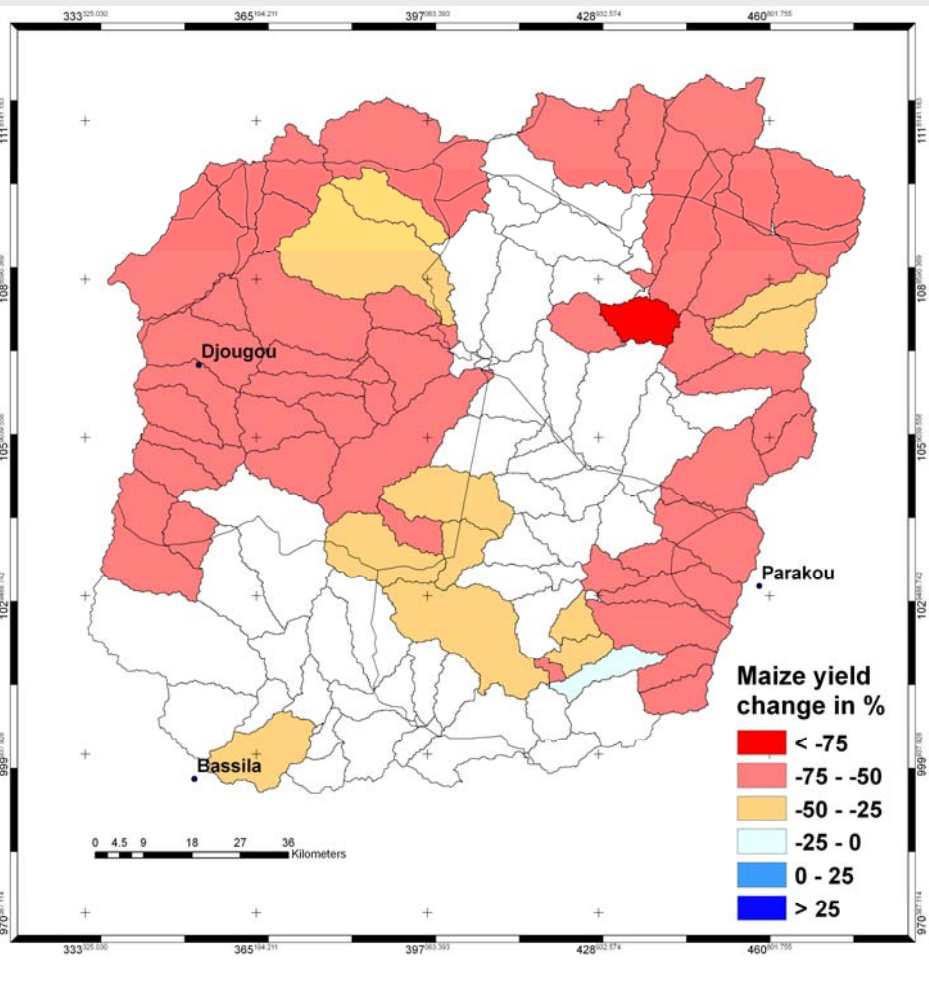


Driving force: Climate

Change in crop productivity in 2041-2050 compared to 2001-2010

Climate scenario A1B

Climate scenario B1



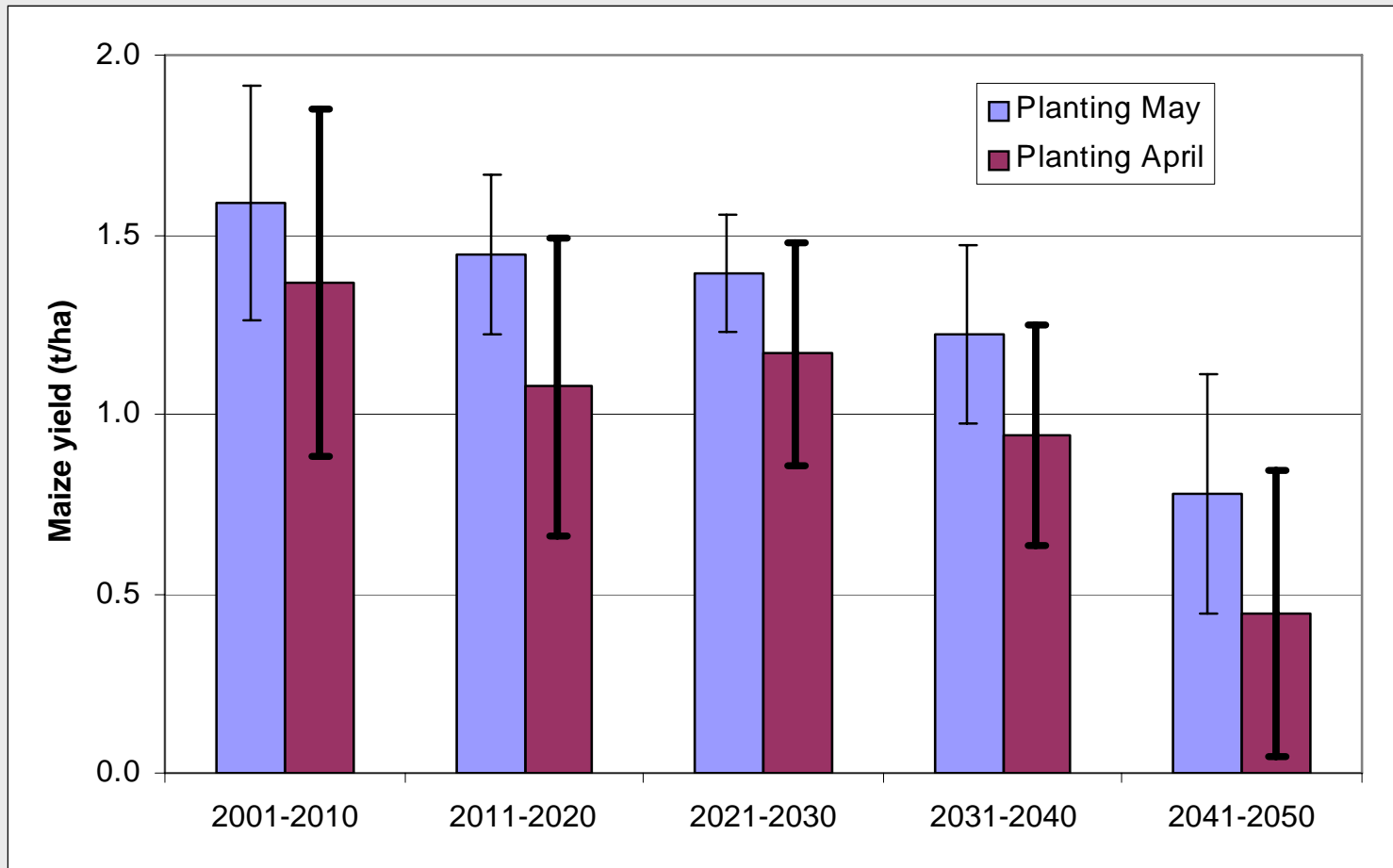
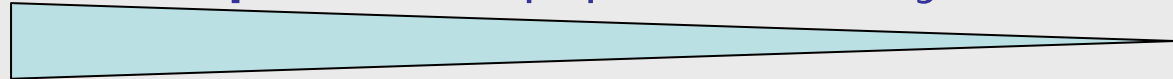
Source: Gaiser et al. (IMPETUS)



Driving force: Climate (IPCC A1B) and planting time

Impact: Crop productivity

Rainfall

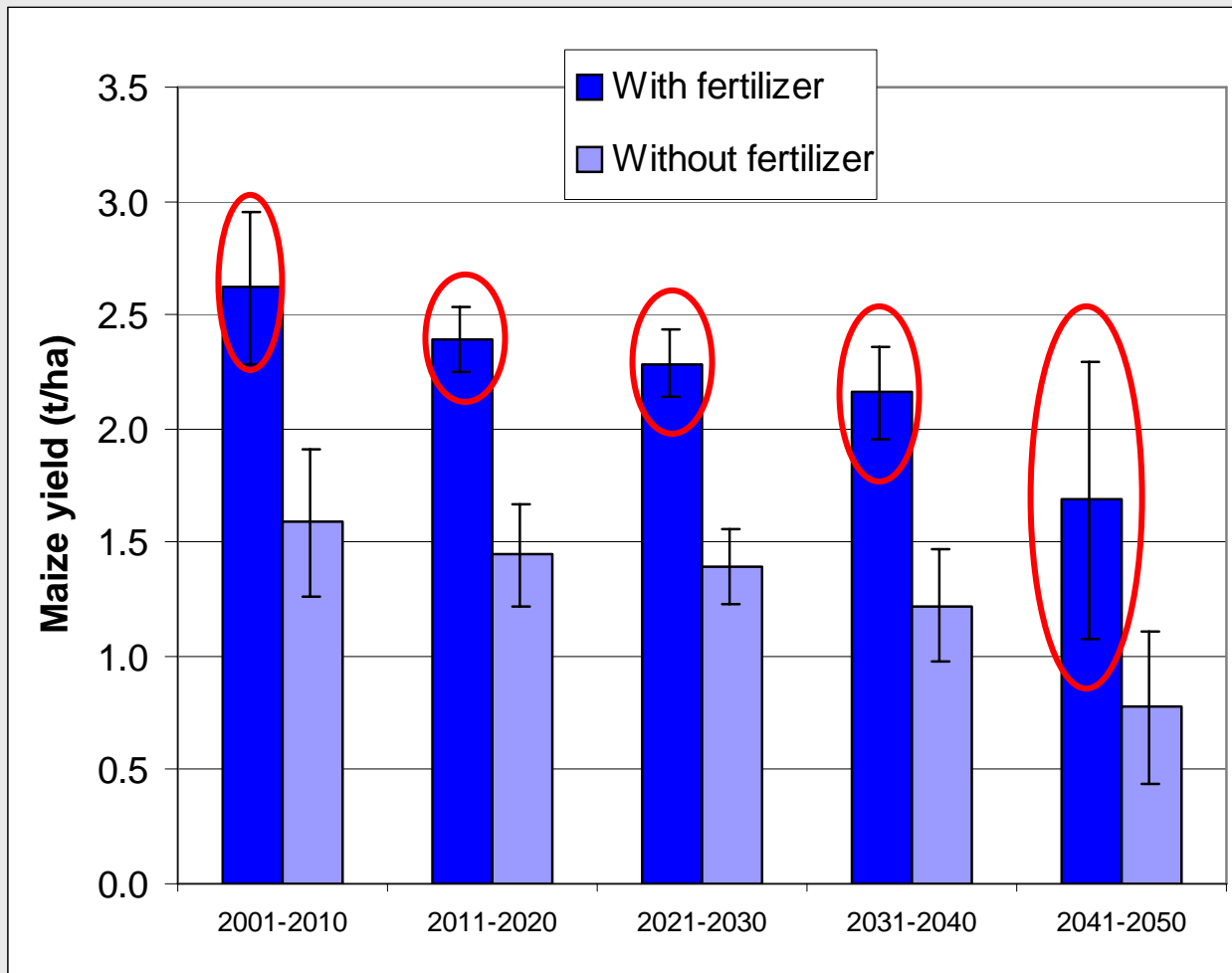


Source: Gaiser et al. (IMPETUS)



Driving force: Climate and fertilizer

Impact: Crop productivity



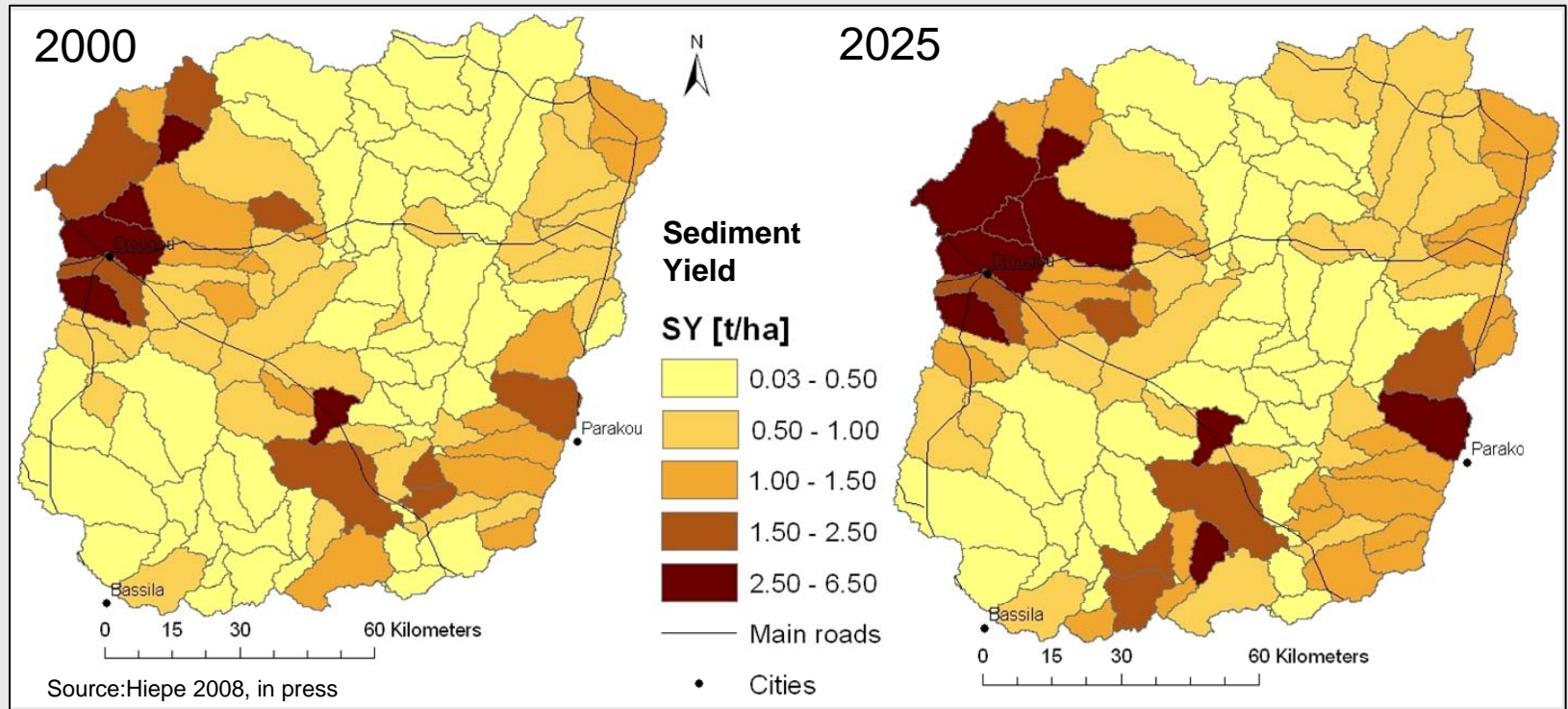
Source: Gaiser et al. (IMPETUS)



Driving force: Land use
Impact: Sediment yield (SY)

Actual situation

Scenario: Business as usual



% cropland

13%

Visit PEDRO at the booth
 "Food Security in Benin"

26%





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BenIMPACT (Benin Integrated Model for Policy Analysis, Climate and Technology Change)

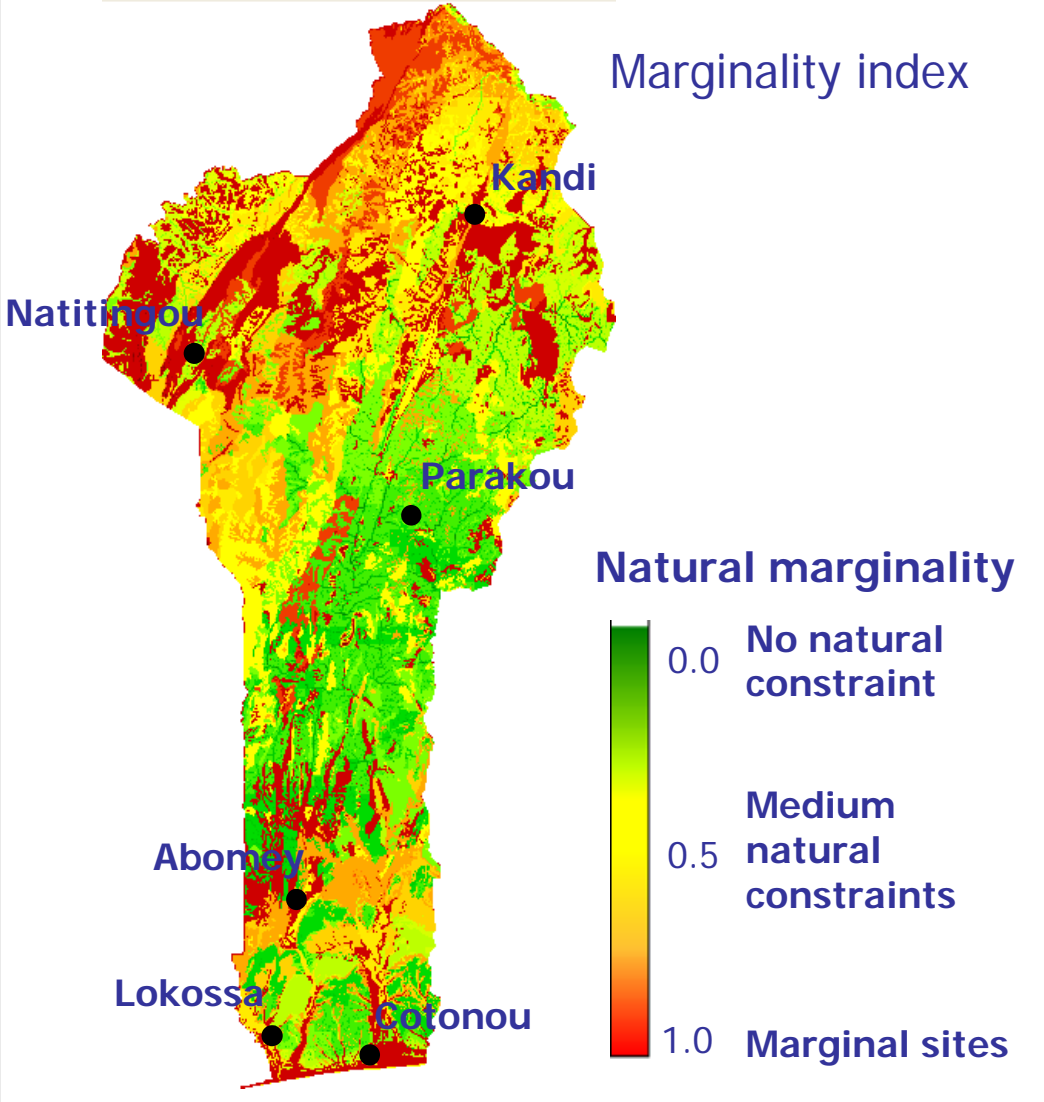


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(Informations sur les résultats des modèles climatiques)

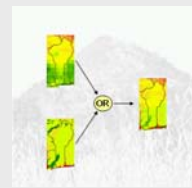


Evaluation of current biophysical land resources for agricultural land use



- The marginality index according to Cassel-Gintz (1997) was calculated
- Mean marginality index is 0.55
- Benin has sites with good biophysical conditions for agricultural land use in Southern and Central region
- Main constraints are rainfall variability, length of growing period and soil fertility
- **Visit AGROLAND at the booth "Food Security in Benin"**

Source: Röhrig (IMPETUS)



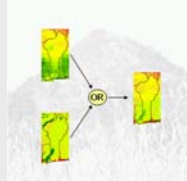


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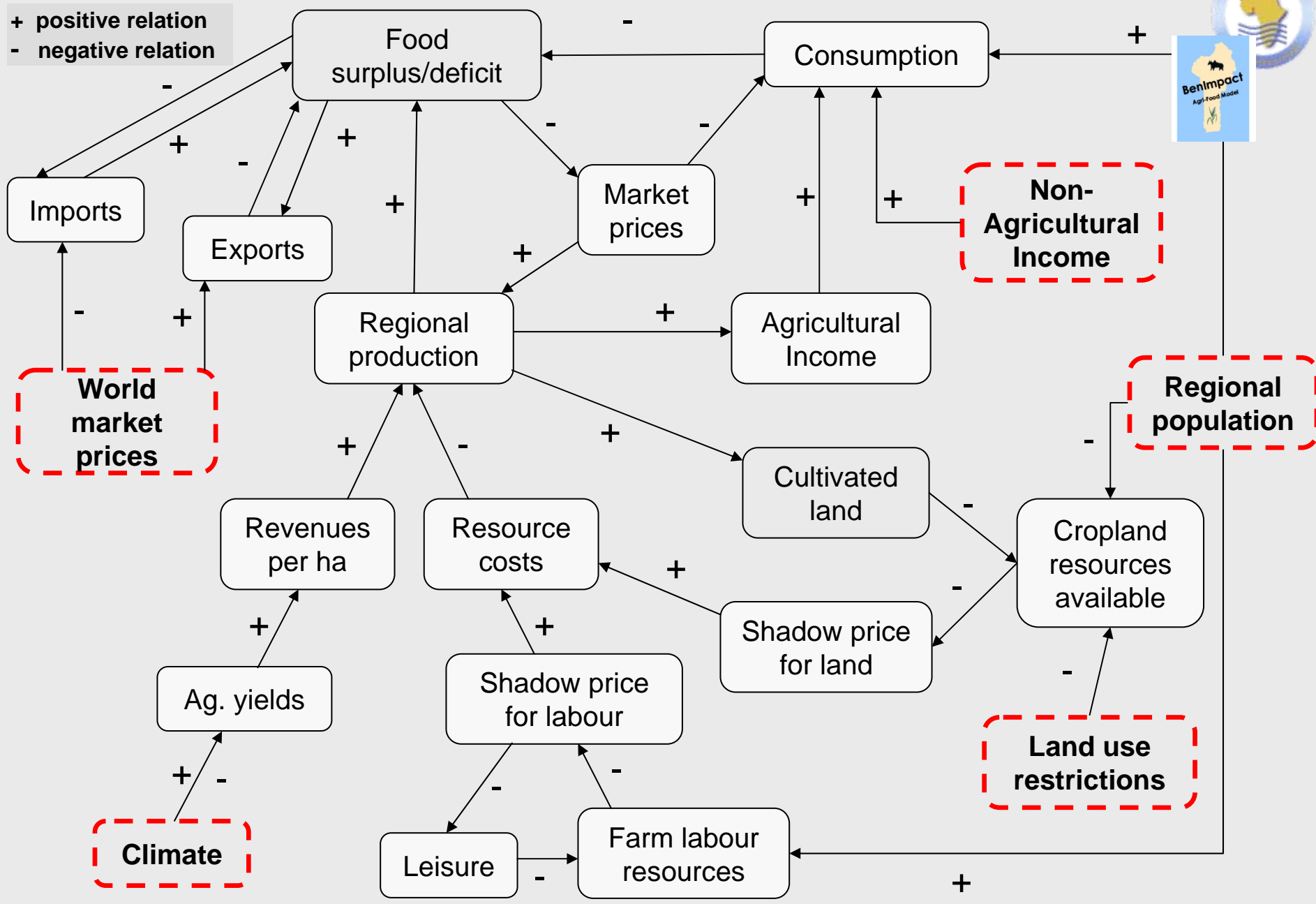
BenIMPACT Agricultural Sector Model

(Benin Integrated Model for Policy Analysis, Climate and Technology Change)

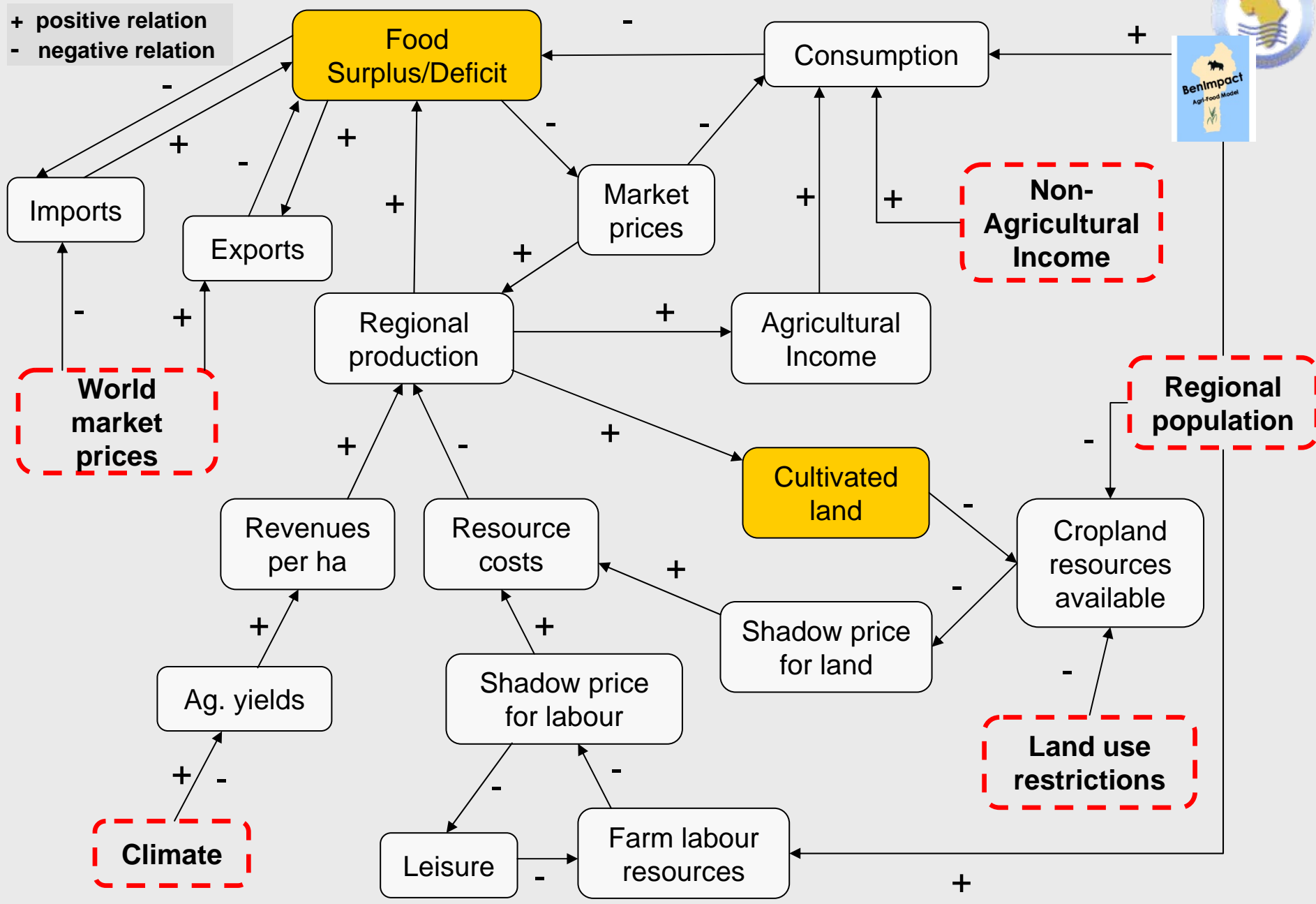
- Eight crops (~ 85% of agricultural area)
- livestock varieties (5 species)
- Model regions: 8 departments, 18 communes (Borgou, Donga, Collines)
- Produces scenario simulations 2000 to 2025 in five-year steps
- Partial equilibrium, recursive-dynamic



+ positive relation
- negative relation



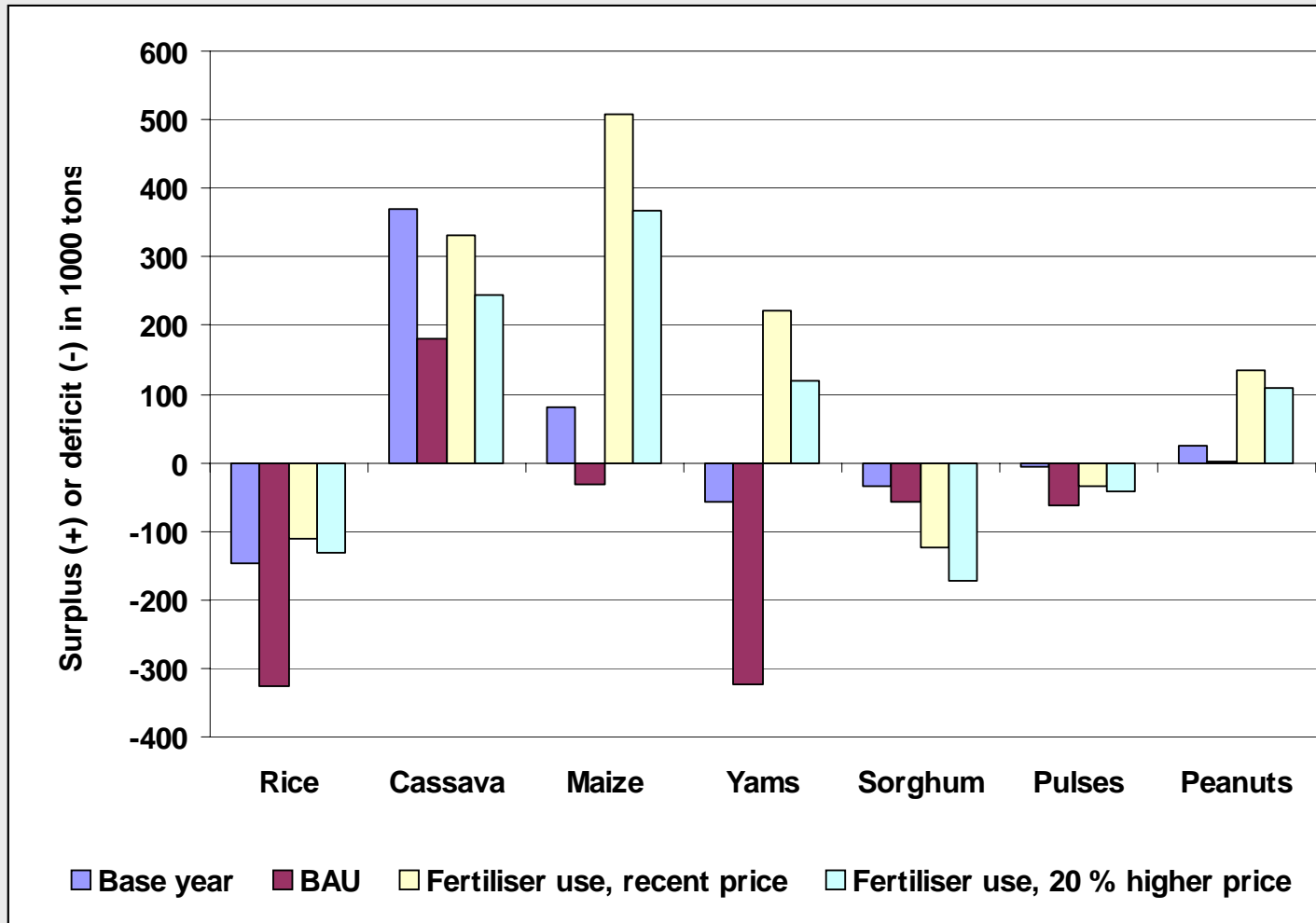
+ positive relation
- negative relation





BenIMPACT fertiliser scenario:

Surplus or deficit on food markets for major crops



Source: Kuhn et al. (IMPETUS)



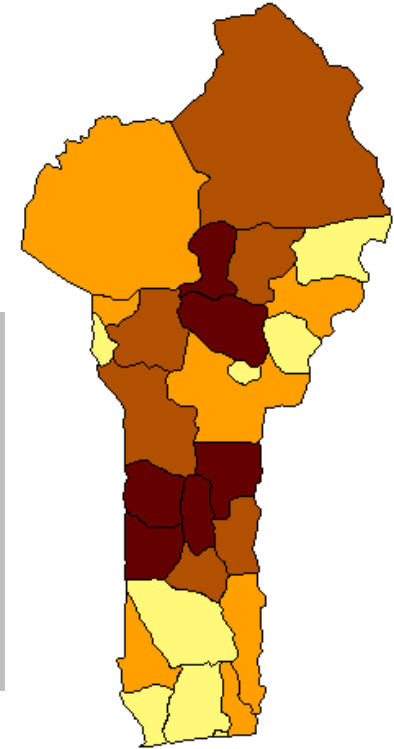
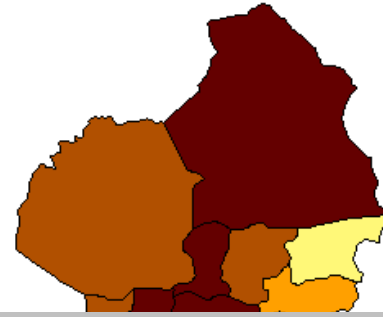
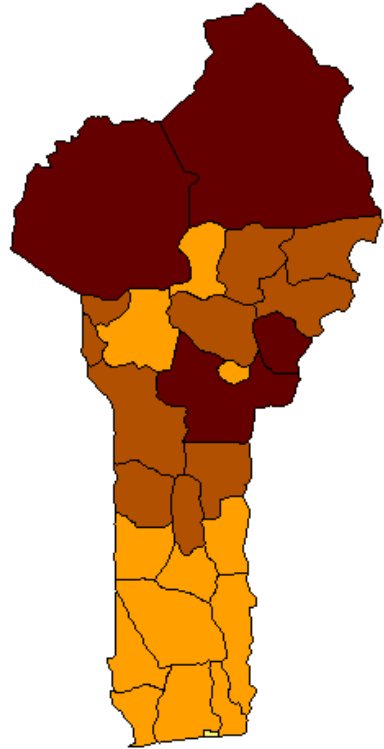
BenIMPACT fertiliser scenario:

Impact on resources use (Increase in cropland compared to 2000)

Baseline for 2025

Effect of fertiliser use at recent price

Effect of fertiliser use at 20% higher price



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Source: Kuhn et al. (IMPETUS)

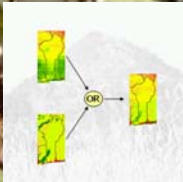
Conclusions

- Benin has areas with a high agricultural potential in the Southern and Central Region
- Doubling of cropland until 2025 may increase soil erosion by almost 30%
- Food deficit tends to increase until 2025 with the present cropping systems and the expected future climate change
- The use of mineral fertilisers is reducing food deficits, is economically profitable, but cannot prevent the pressure on land
- In order to push mineral fertilizer application, some accompanying measures have to be implemented
- Inland valleys have high production potential if the obstacle of lacking knowledge is removed





Thank you for your attention



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