

Trade-offs between livelihoods and wetland ecosystem services:

An integrated dynamic model of Ga-Mampa wetland, South Africa

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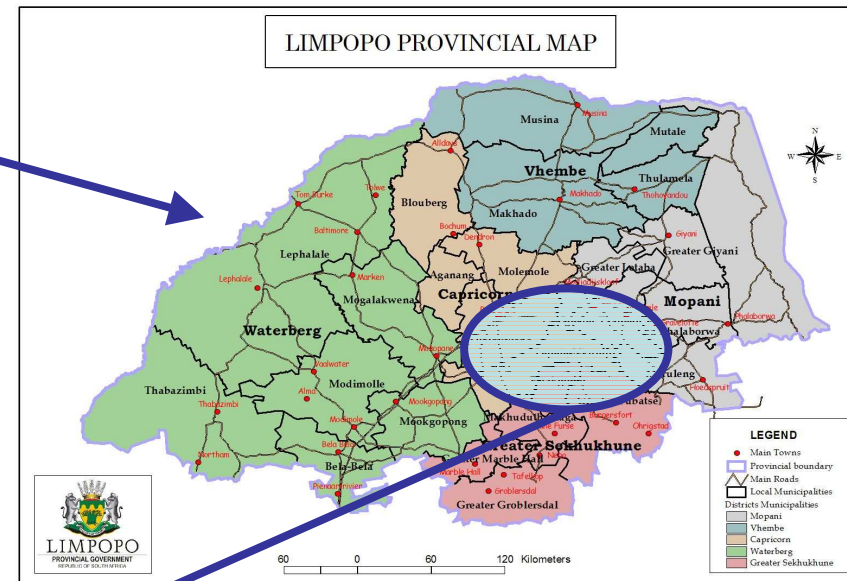
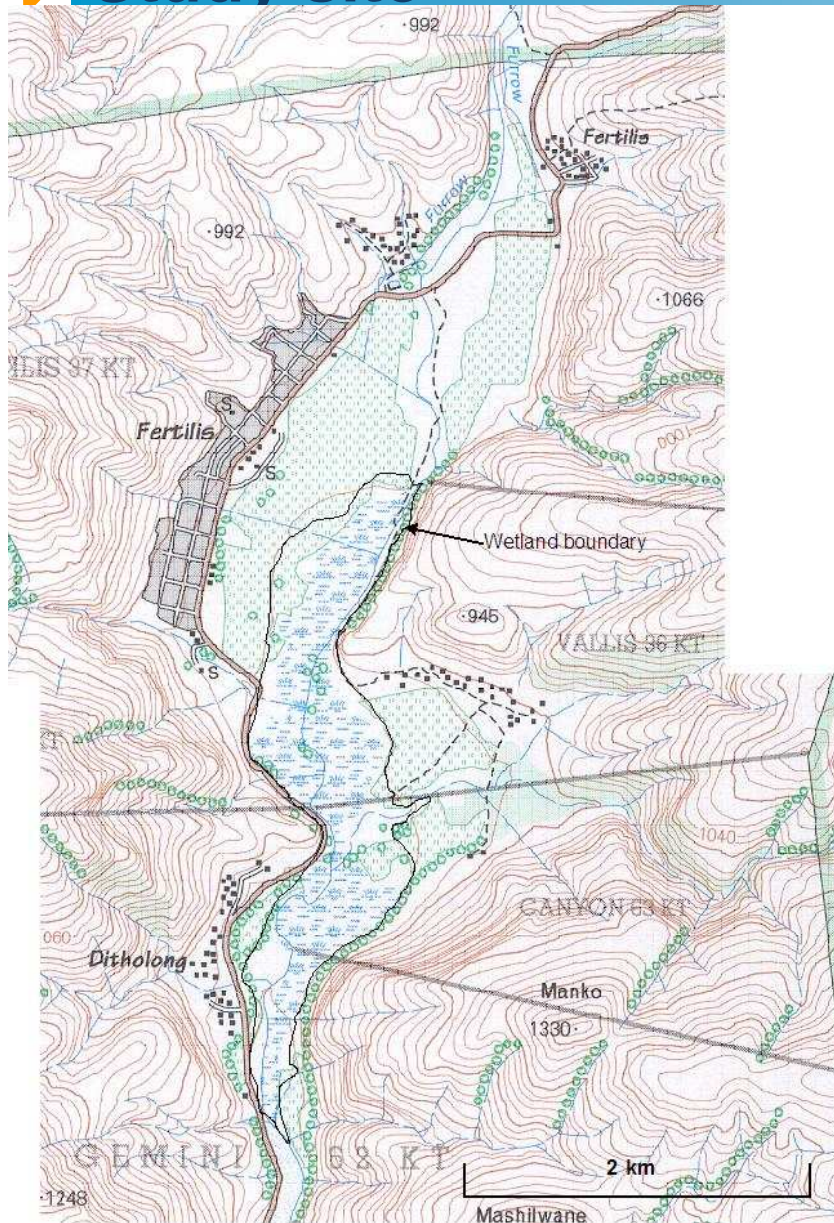
▶ Outlines

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 - Focus on community well being and land use sectors
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Introduction

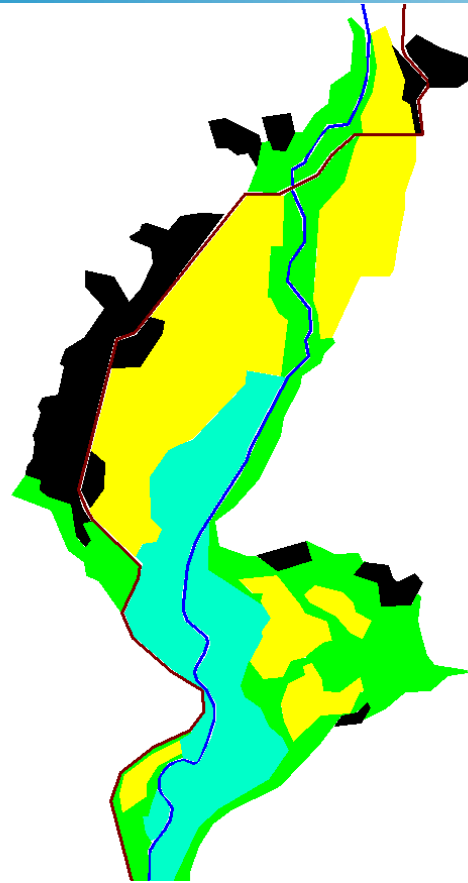
- Multiples services supplied by wetlands to rural communities in Southern Africa (arid to semi-arid climate)
- Human interventions threaten ecosystem health and its ability to provide services in the future
- A research project aiming at analysing trade-off among ES provided by wetlands in Southern Africa and between these services and ecosystem integrity
- Develop a system dynamic model to
 - Integrate existing scientific knowledge on small-scale wetlands
 - Support the development of a wetland management plan

Study site

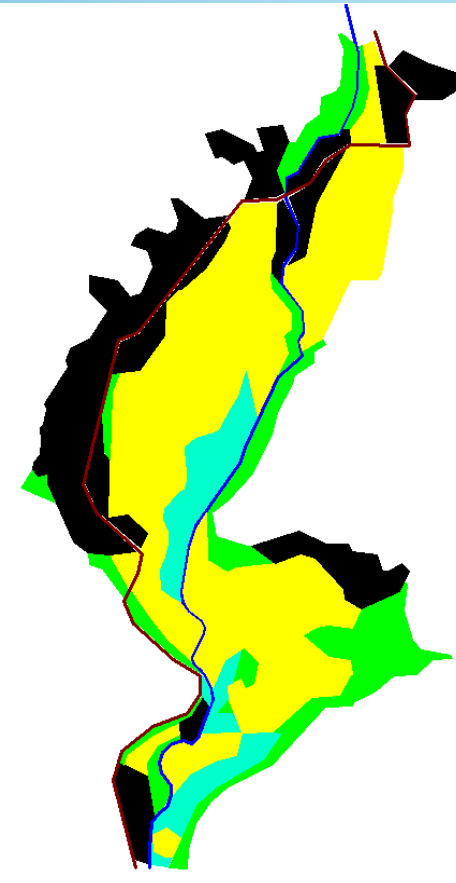


- 4 villages, 2700 people
- Surrounded by nature reserves
- 3 irrigation schemes
- Livelihoods depend on natural resources and social transfers

Land use change



1996



2004

Main services provided by Ga-Mampa wetland



Cropping



Livestock grazing



Sedge and reed collection



Edible plant collection

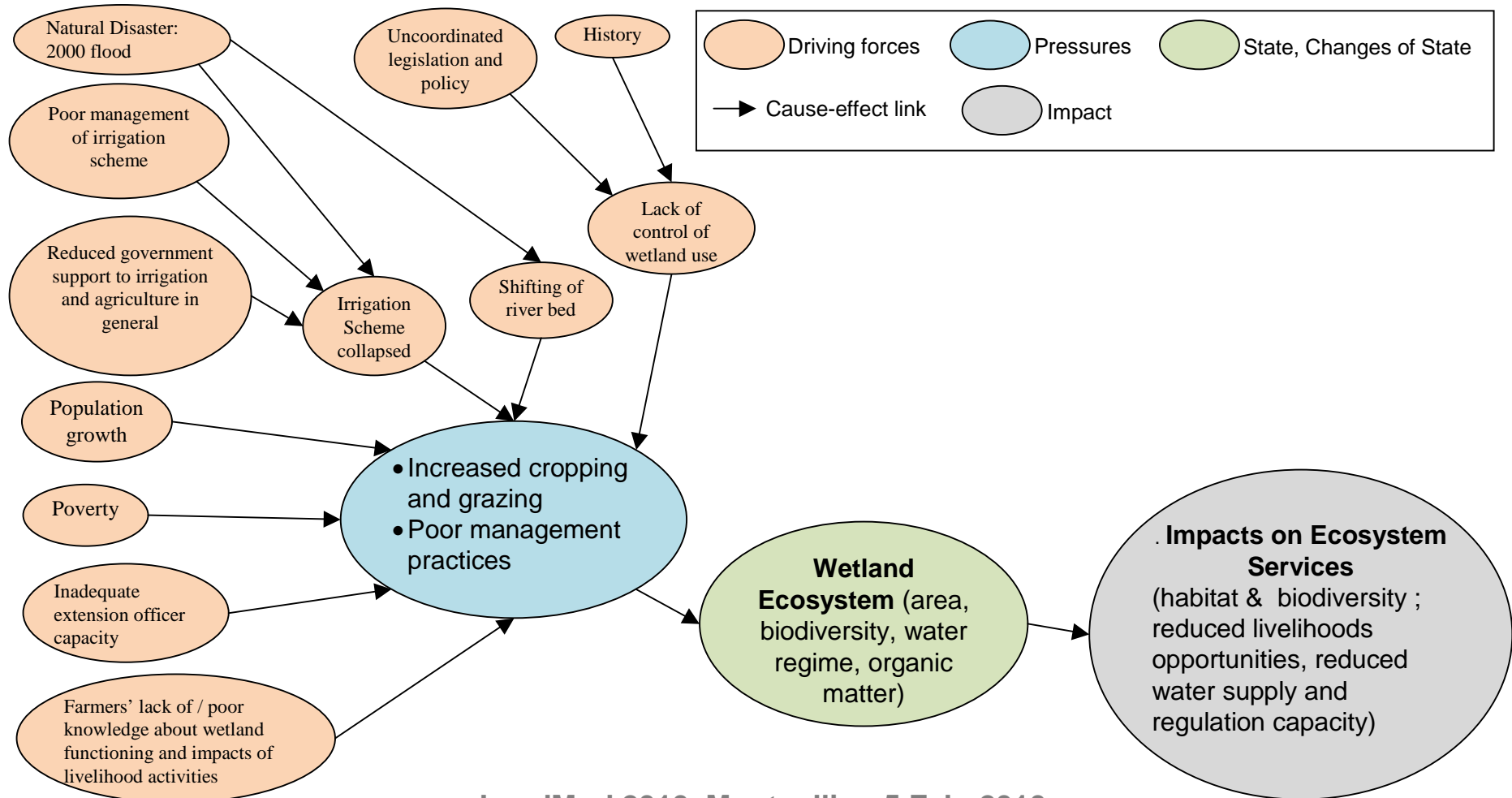
Water collection

Hunting

Fishing

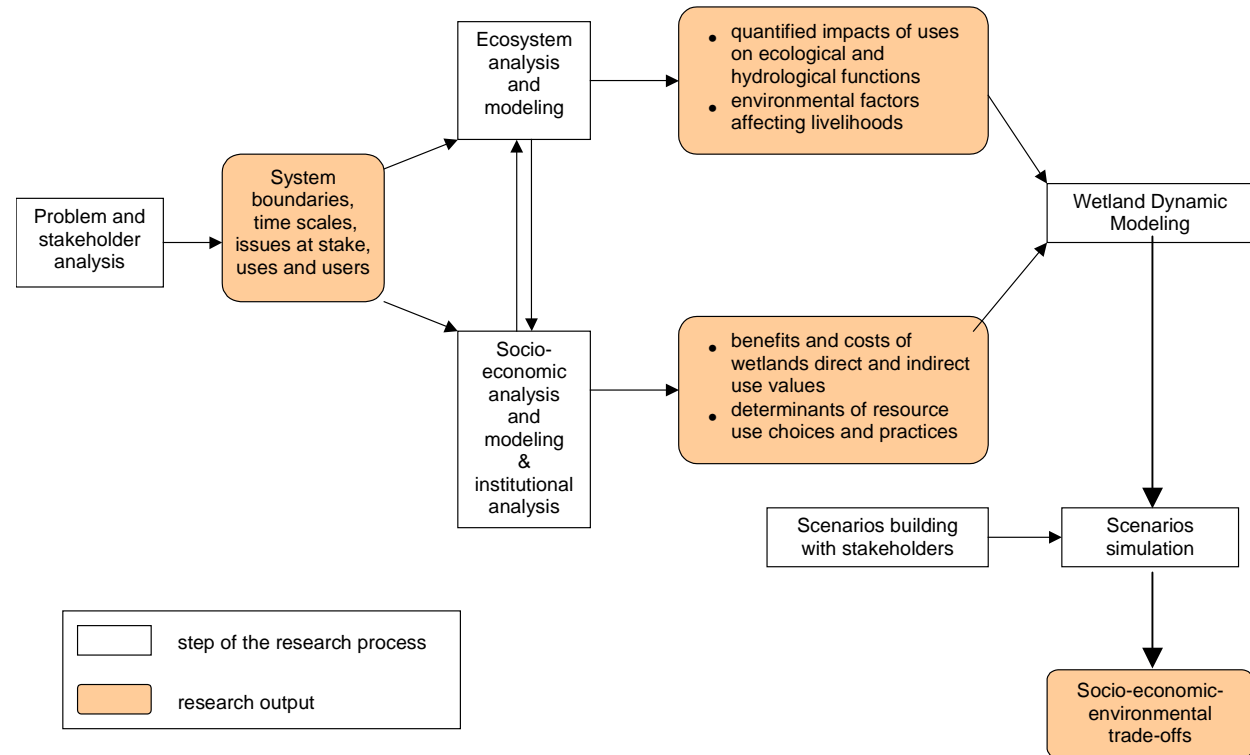
Medicinal plant collection

Hydrological regulation?



Material & methods

- Conceptual framework inspired by MEA framework
- Modeling = one step of the research process
- System dynamics approach
- Interdisciplinarity : hydrology, agronomy, economics
- Various sources of data

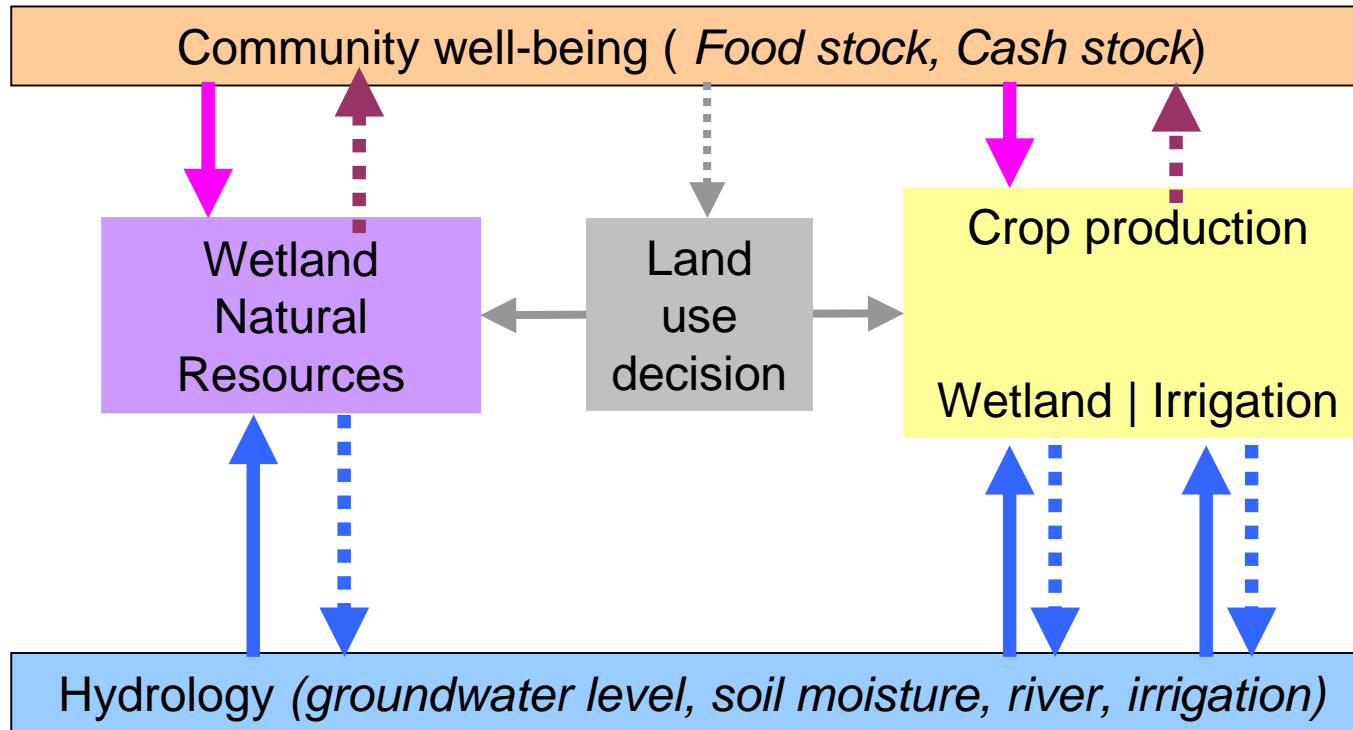


▶ Model overview

- Objective: analysing trade-offs among wetland ES by simulating scenarios
- Micro-scale: the valley (5km², 2700 inhabitants)
- 3 landscape entities: irrigation scheme, cultivated wetland and natural wetland
- Not spatially based :each spatial entity and community supposed to be homogeneous
- Production technology given
- Land use decision based on logical rules (if ...then..., else...)
- Monthly time steps with some evaluation at seasonal or annual time steps (crop production, food security, well being index)
- Developed with STELLA



Model sectors

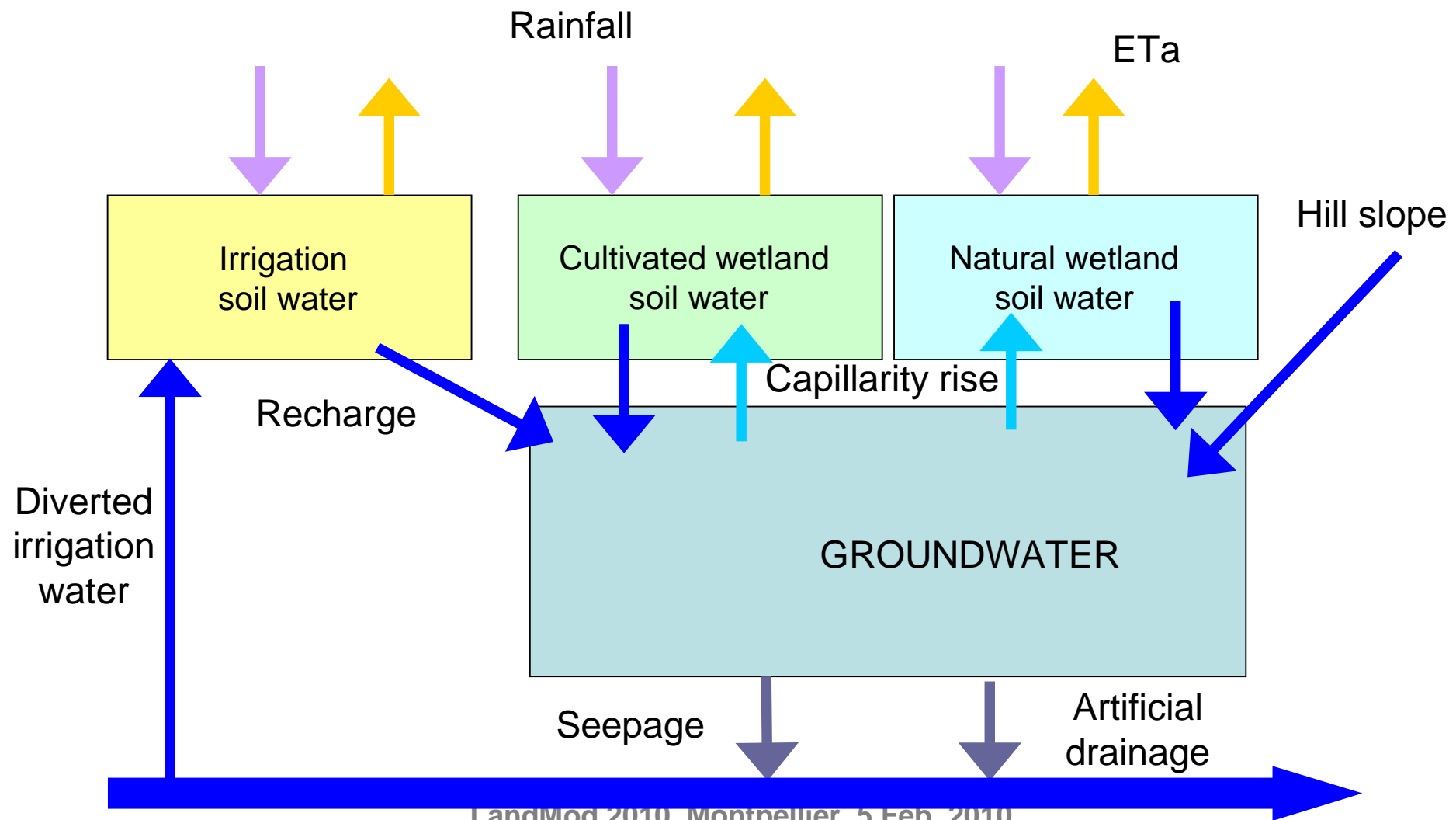


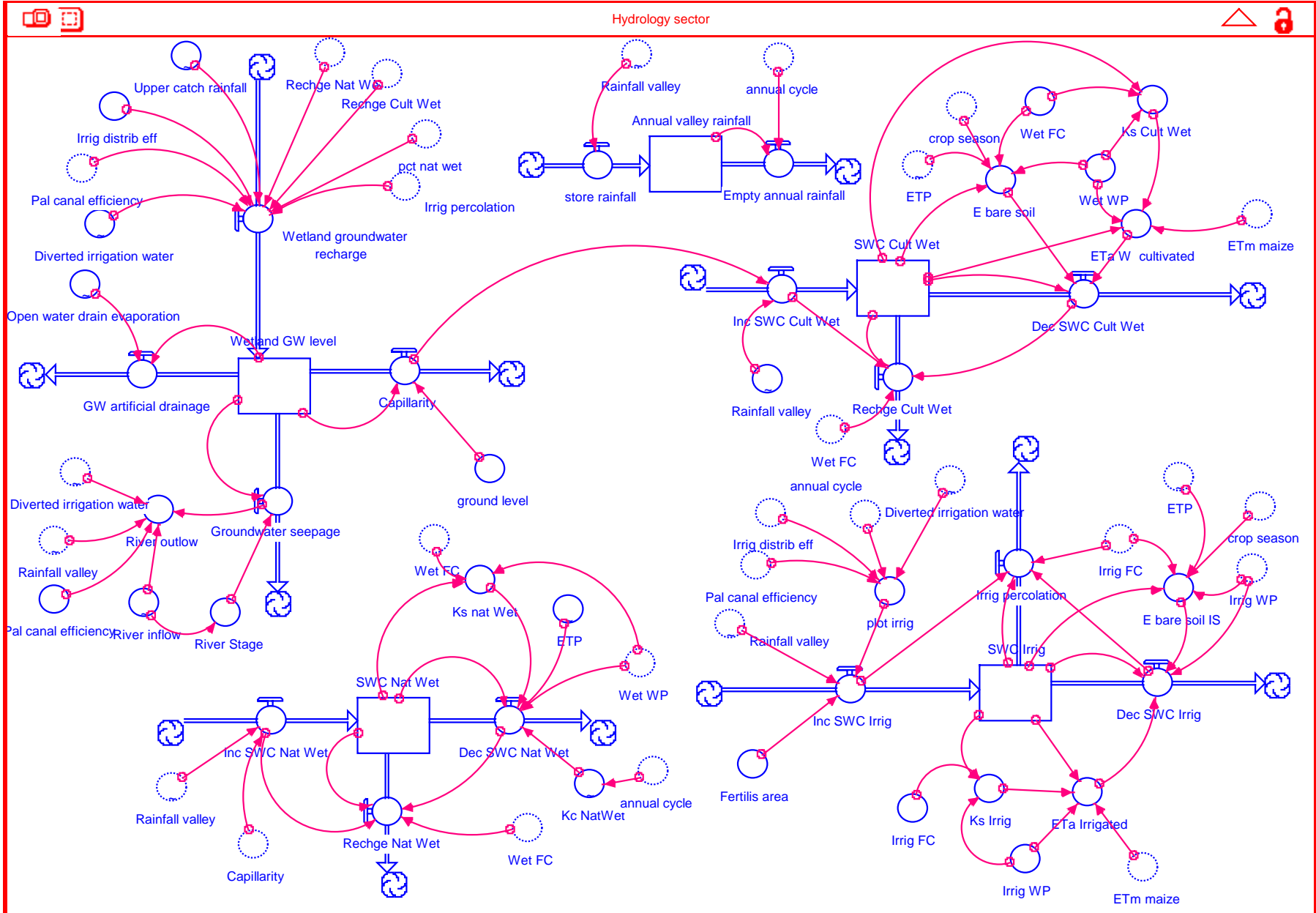
- Income, food
- Labour, inputs
- Water supply
- Water use
- Well-being indicator
- Land use areas

▶ Inputs & outputs

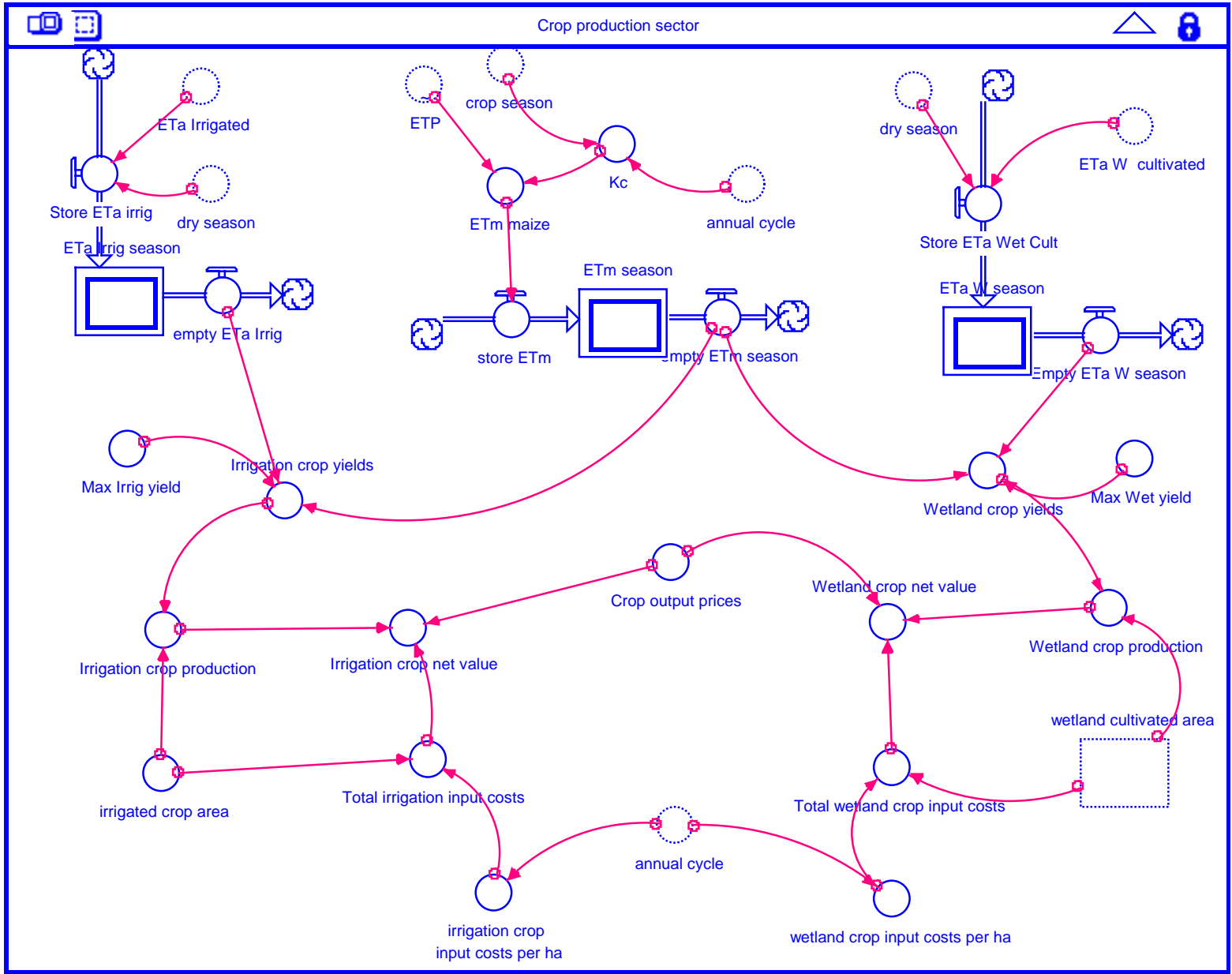
- Inputs:
 - Climatic & hydrologic data (P, ETP, river inflow),
 - Demography (population growth, emigration),
 - Economic (food need, basic expenditure, social transfers, external income, prices, average plot area)
 - Soils and crops characteristics
 - Agricultural production technology
- Outputs (indicators)
 - Socio-economic: income index, food security, well-being
 - Environmental: percentage wetland area, groundwater level, river outflow

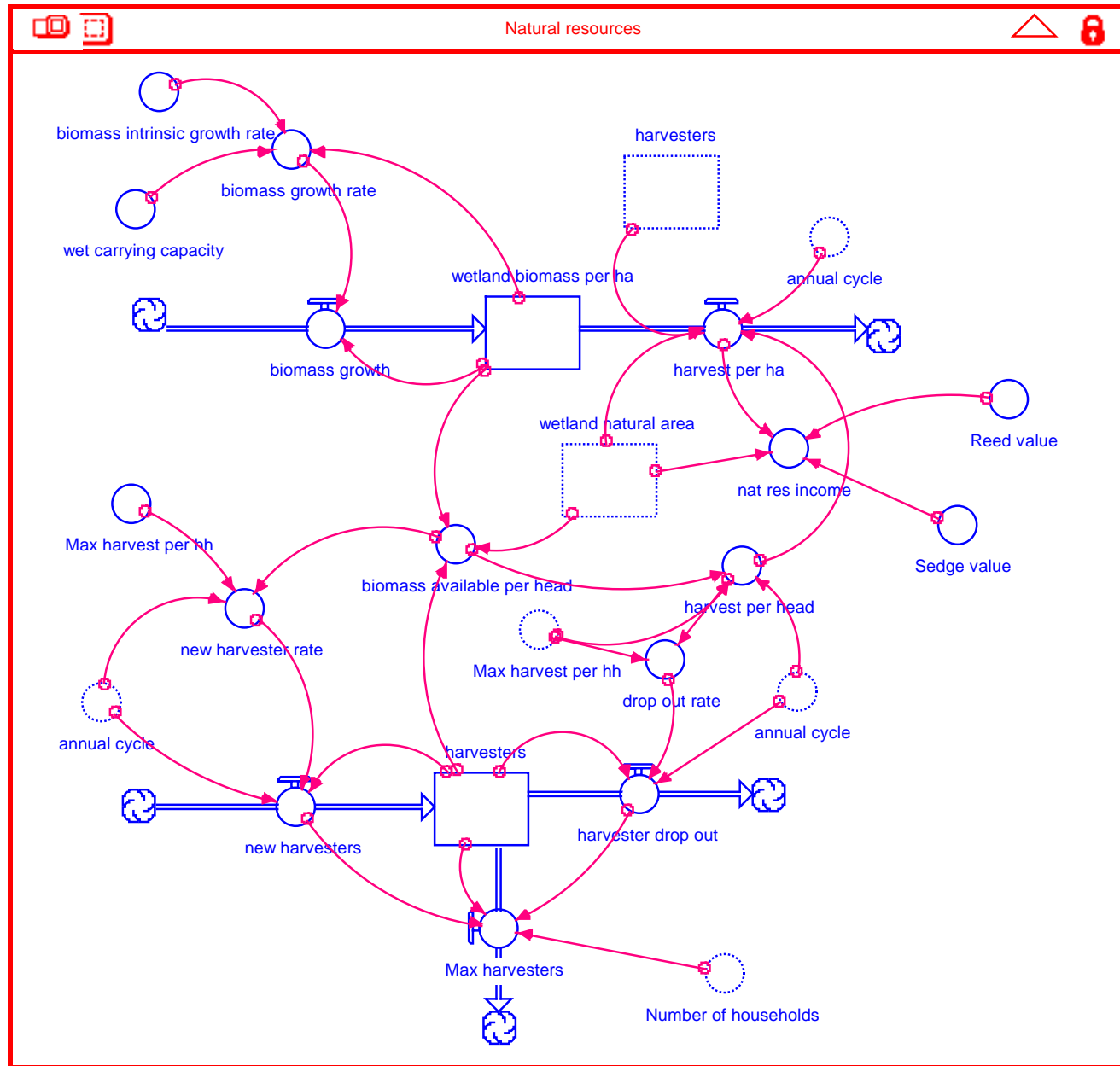
▶ Hydrology sector



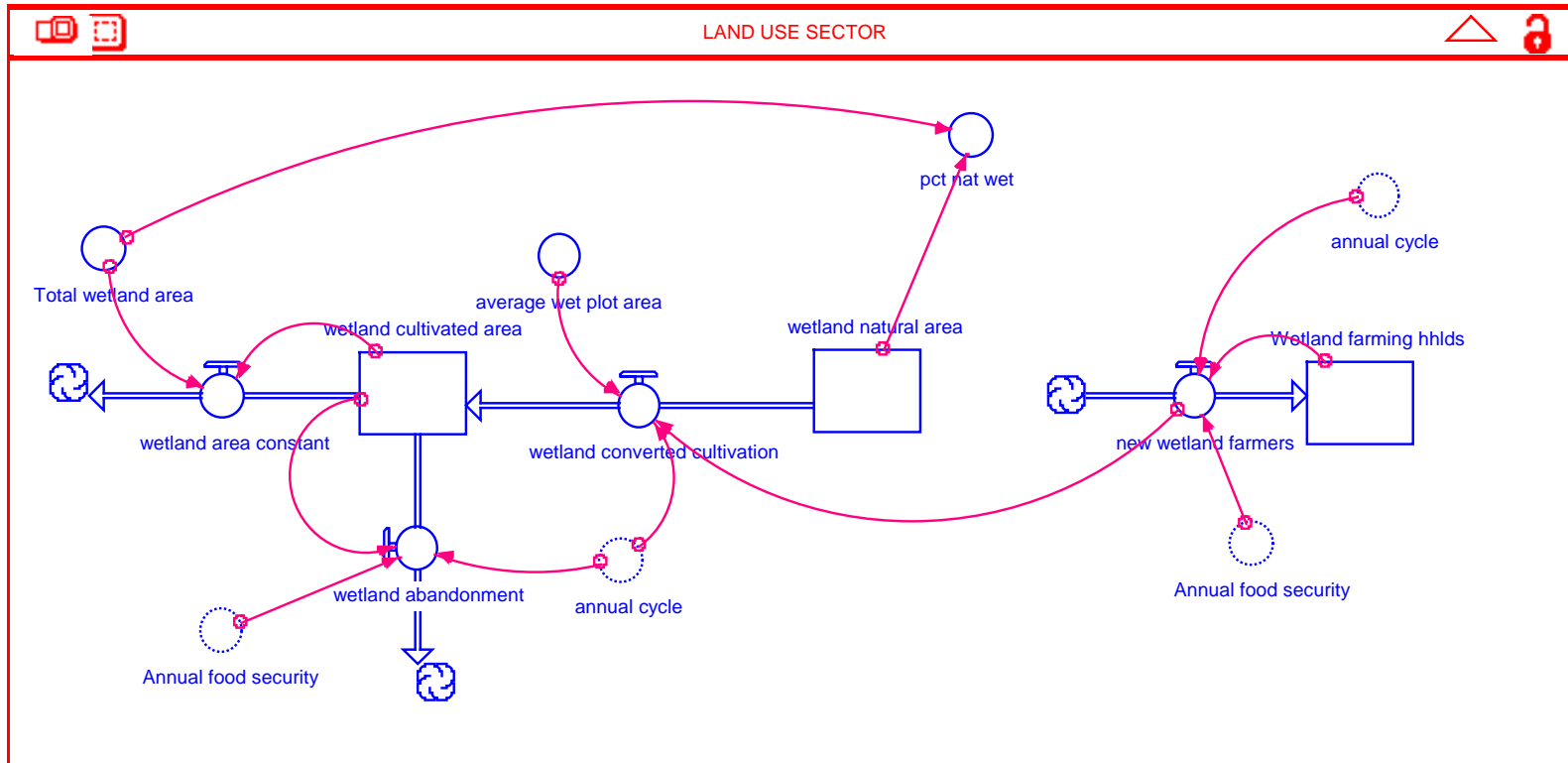


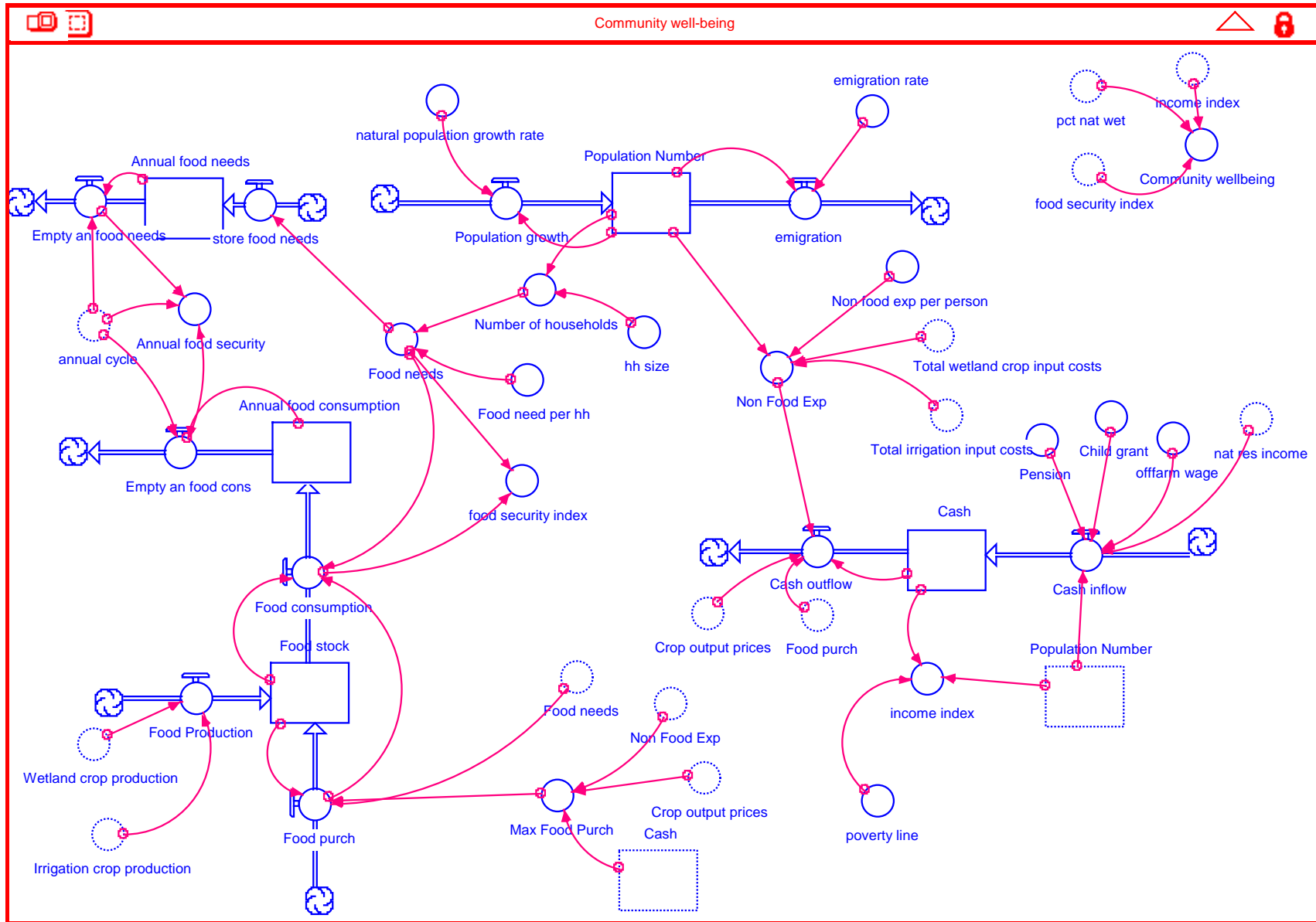
LandMod 2010, Montpellier, 5 Feb. 2010





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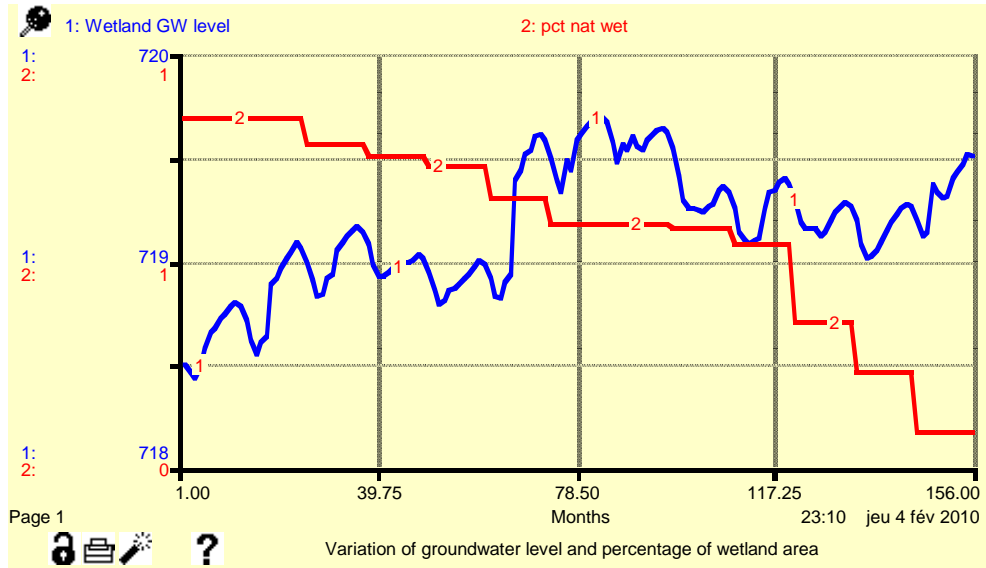


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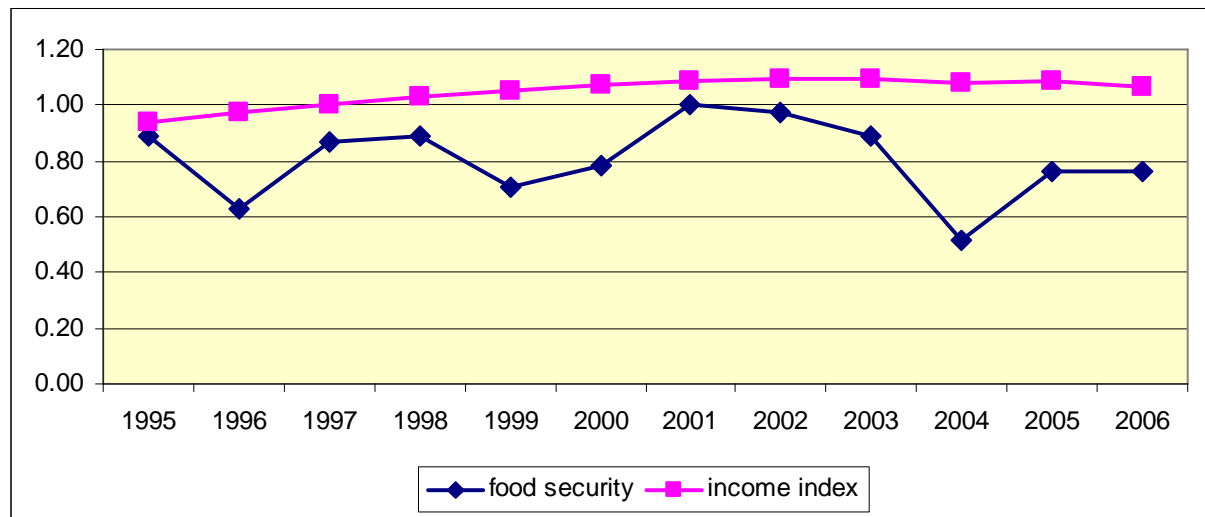
External drivers and management scenarios

- External drivers scenarios:
 - Climate changes (rainfall, ETP)
 - Population dynamics (natural growth and emigration rate)
 - Alternative sources of livelihoods (external income, ecotourism, social transfer)
- Management scenarios:
 - Rehabilitation of irrigation schemes (irrigation efficiency)
 - Alternative crops and reduced drainage in the wetland

Results



Simulation of past evolution
1994-2007

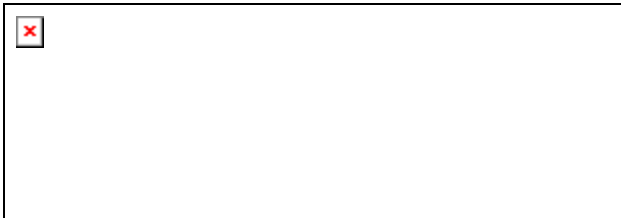


Conclusion

- Modeling was a good way for fostering inter-disciplinary dialogue and identify knowledge gaps
- Stakeholder involvement was minimal, but we intend to do better in the next phase
- Data availability to calibrate and validate = a challenge
- Difficulty to translate narratives about past land use changes into quantitative decision rules
- Possible developments of the model:
 - Improved land use decision rules
 - Feedback from well-being to population dynamics
 - Link biomass production to hydrology
 - Add organic matter dynamic
- Planned uses of the model
 - Trade-off analysis: supporting development of wetland management plan with stakeholders
 - Combined use of WETSYS and a role-playing game



Acknowledgements



LandMod 2010, Montpellier, 5 Feb. 2010