



Glowa Jordan River Project

GLOWA Jordan River Phase 2

Project 1 Integration Regional Scenario Analysis & Land Cover Modeling

GLOWA JR Status Conference
Herrenberg, Germany, 25-26 June 2007

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Why a Scenario Exercise?

- To provide new knowledge about **consequences of global and regional change on water resources** in the region;
- To explore new ideas on how society can **adapt to expected changes** and increase the well-being of people living in the region through sustainable water management;
- To **integrate information** from the **scientific sub-projects** of the GLOWA-Jordan River Project in a form useful to stakeholders in the region.

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What is the SAS (*Storyline and Simulation*) Approach?

A type of scenario exercise that ...

- ... includes both **qualitative** information (storylines) and **quantitative** information (model calculations) and combines their advantages;
- ... is an **iterative process** engaging both stakeholders and environmental modelers;
- ... is a useful tool for **synthesizing information/findings** from the Glowa-Jordan River sub-projects in a form relevant to policymakers.



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SAS Approach is under development

The SAS approach is under development

Major methodological challenges –

e.g. How to convert from qualitative (stakeholder-relevant) information to quantitative information (model inputs) and back again?



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Who is involved?

SAS integrates activities

Scenario Panel: Stakeholders. Representatives from water & agriculture ministries of Israel, Jordan, and Palestinian Authority; NGOs; scientific advisors.

→ *Develop qualitative scenarios (“storylines”).*

Scenario Team: GLOWA-Jordan scientists (Univ. Kassel & Tübingen).

→ *Coordinate scenario exercise.*

Project Scientists: Partners from scientific sub-projects of the GLOWA-Jordan project. Support storyline development with modeling analyses.

→ *“Quantify” scenarios (with modeling and other analysis)*

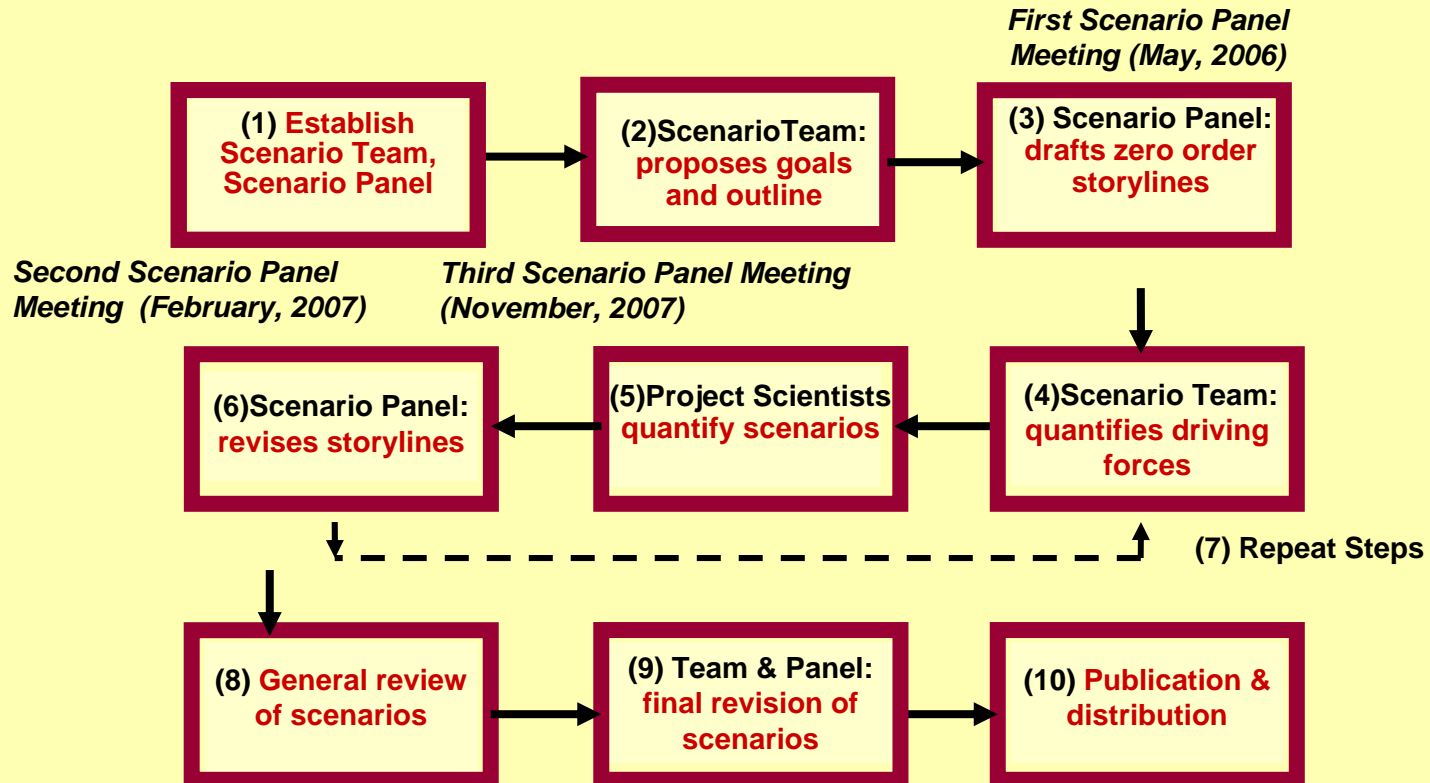
Moderator Team (“Prospex”).

→ *Facilitate Scenario Panel meetings.*



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SAS Procedure in GLOWA-JR Project





First Scenario Panel Meeting and Follow-up

Before, during and after the First Scenario Panel Meeting (Waldeck, May, 2006)

- Clarified scope of storylines
- Agreed to basic outlines and messages of storylines.
- Modeling and other groups informed stakeholders about information available from Glowa-J subprojects.

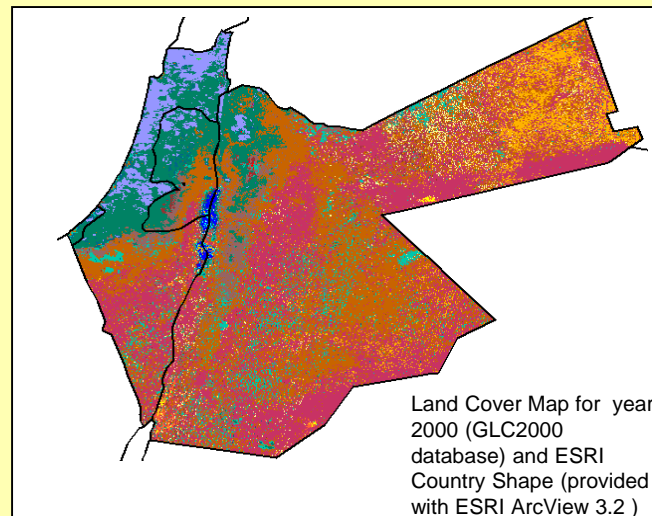


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First Scenario Panel Meeting and Follow-up

Study region

Territory of Israel, Jordan and the Palestinian Authority related to water resources of Jordan River.



Time scale of scenarios

Up to 2050 to evaluate impacts of climate change, long-term changes in vegetation cover.

Beginning (2008-2010) and middle (2025-2030) to evaluate steps towards sustainable development



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First Scenario Panel Meeting and Follow-up

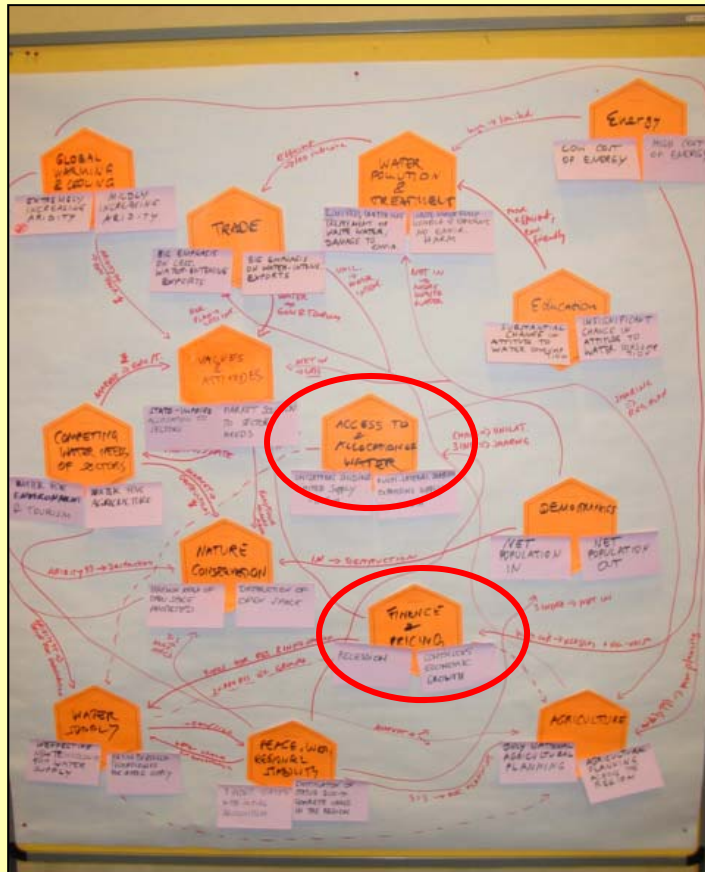
Key Factors / Driving Forces in the Storylines

<i>1. Global climate change</i>	<i>8. Access to and allocation of water</i>
<i>2. Trade</i>	<i>9. Nature conservation</i>
<i>3. Water pollution and treatment</i>	<i>10. Finance & Pricing</i>
<i>4. Energy</i>	<i>11. Demographics</i>
<i>5. Competing water needs between sectors</i>	<i>12. Water supply</i>
<i>6. Values and attitudes</i>	<i>13. Peace / war regional strategies</i>
<i>7. Education</i>	<i>14. Agriculture</i>



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First Scenario Panel Meeting and Follow-up

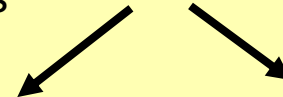


“Zero order” draft scenario storylines

Define influences between factors



Identify **key factors** that have **many interlinkages** with other factors



Access to water & allocation of water

Finance & pricing (Economic conditions)



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First Scenario Panel Meeting and Follow-up

Scenario Storylines

*Multilateral sharing
– expanding supply*

“Poverty & Peace”
Recession /
multi-lateral water
sharing

“Willingness & Ability”
Economic growth /
multi-lateral dividing of water

Recession

*Continued
economic growth*

**“Suffering of the Weak
& the Environment”**
Recession /
unilateral dividing of water

“Modest Hopes”
Economic growth /
unilateral water sharing

*Unilateral dividing
– limited supply*



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Second Scenario Panel Meeting and Follow-up

Before, during and after the Second Scenario Panel Meeting (Hofgeismar, February, 2007)

- Driving Forces in the storylines converted to driving forces for the models
- Models used to quantify scenarios
- Modeling results presented to stakeholders
- Storylines elaborated

Elaboration of First Draft Storylines e.g. “Poverty & Peace”

2008-2010

Politics

Regional peace process is revived → cease-fire in Gaza and West Bank → peace treaty and new water agreement between the Palestinian Authority and Israel

Water, Climate & Health

Lower than normal levels of precipitation persist for seven years → many wells run dry
→ conflicts break out between farmers and other water users

Breakdown in maintenance leads to an overloading of many wastewater treatment plants

Cholera breaks out

The Economy

Price of oil rises to over 150 \$/barrel → Irrigation pumping very costly



2025-2030

Politics

6-state Commission deals with the regional climate catastrophe

General peacefulness of the region → continuing immigration of Palestinian émigrés & increase of religion-tourism

Growing population → growing food demand

2025-2030 (continued)

Water, Climate & Health

Volume of water for irrigation is limited; Net volume of untreated wastewater grows and water pollution problems increase

Climate extremes have many economic impacts → Crop pest destroys regional vegetable crop

Land

With crop yield low, food demand growing, and local people too poor to import food, the only alternative is to expand cropland and pasture land in the region

Expanding crop land → shrinking “open land” → reduced biodiversity and eco-tourism

2050

Population

Immigration to the region slows

Water

Slowly increasing population + slow economic growth → increasing volume of municipal and industrial water withdrawals → decreasing water available for agriculture

New construction of wastewater treatment plants → water quality in the region slowly improves

New and relatively inexpensive desalination facilities are built in Jordan and Israel

Cooperative projects remain fairly small-scale and are dependent on financial support from outside the region

Integration of Modeling Results and Other Inputs

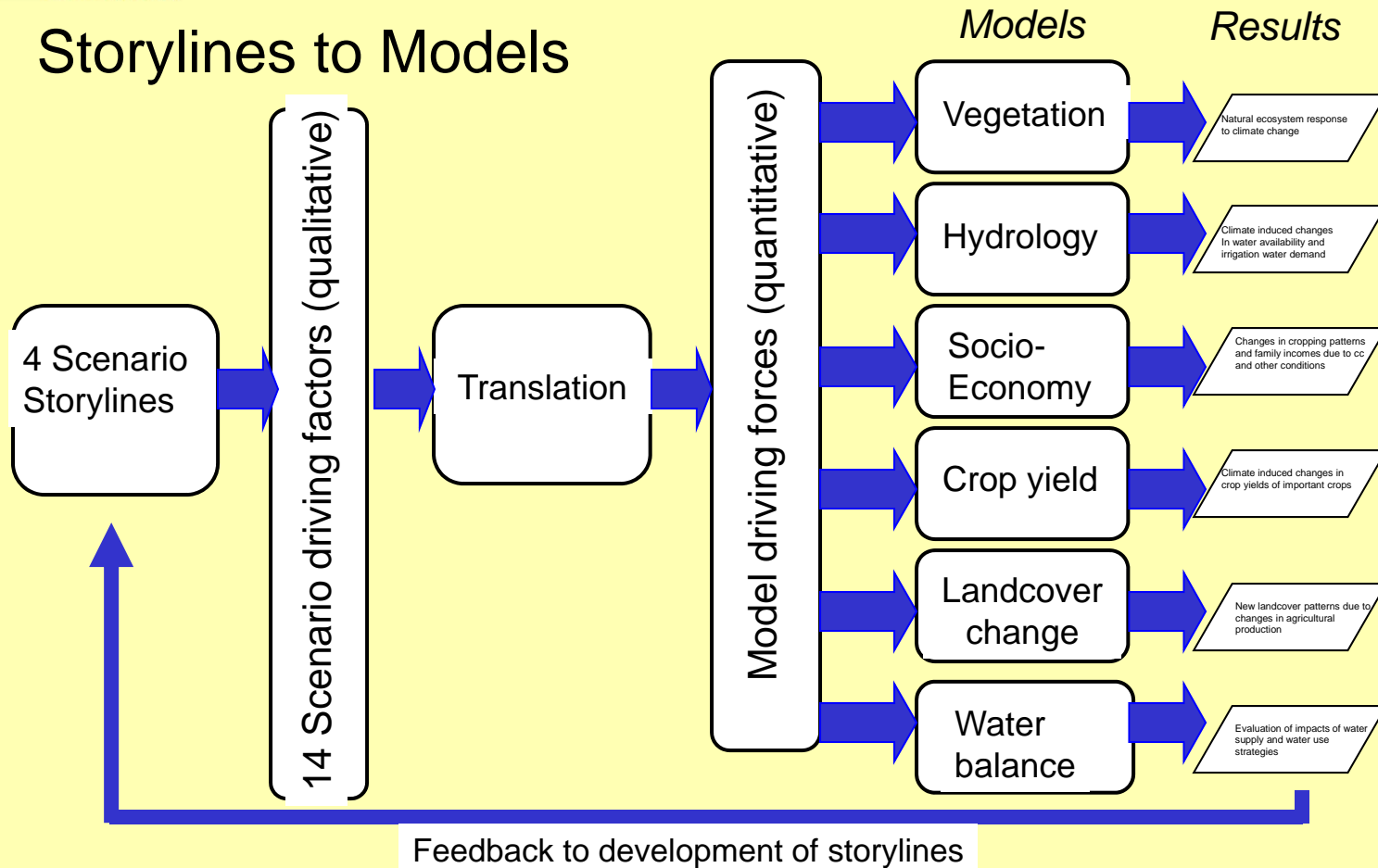
- Regional climate scenarios (P3)
- Regional agricultural and land use scenarios (P1, P2)
- Future water requirements for agriculture (P4, P11)
- Future water availability (P5, P6)
- Future wastewater management and water quality (P7, P8)
- Future changes in ecosystems (P9, P10)



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Second Scenario Panel Meeting and Follow-up

Storylines to Models

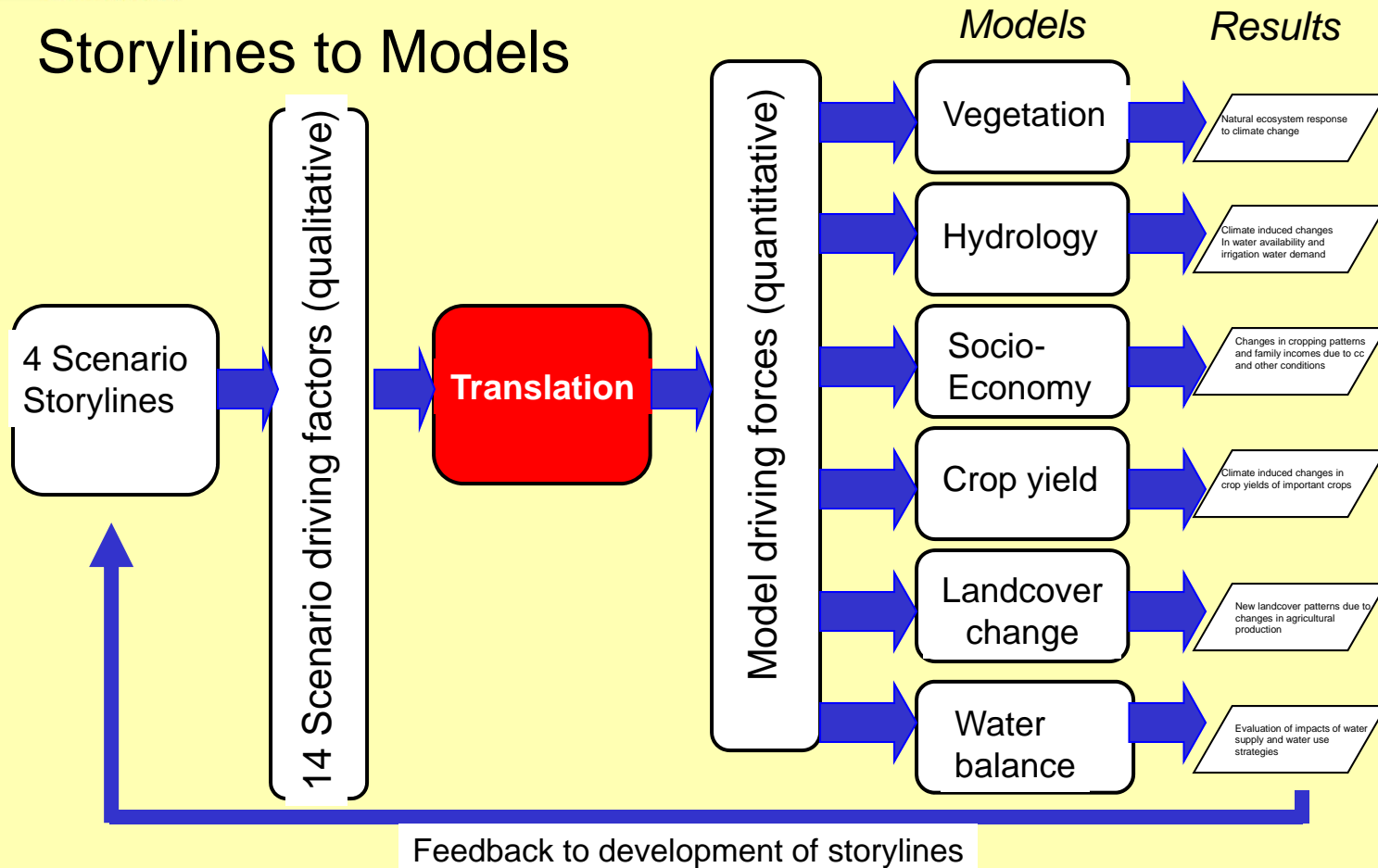




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Second Scenario Panel Meeting and Follow-up

Storylines to Models





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Second Scenario Panel Meeting and Follow-up

Translating Storyline Driving Forces to Model Driving Forces & Inputs

Demography → Population growth rate (*High? Medium?*)

Finance & pricing → GDP per capita (*High increase? Small decrease?*)

Water pollution & treatment → Treated Wastewater Production
(*Medium increase? Small decrease?*)

Trade → Area dedicated to fruit production (*High decrease? Small increase?*)

Water supply → Desalination capacity/technological improvement
(*Small increase? High increase?*)



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Second Scenario Panel Meeting and Follow-up

Driving forces

Climate change
Population
Crop production
Livestock farming
Water availability
Water price
Crop yield

Models

Vegetation
Hydrology
Socio-economy
Crop yield
Landcover change
Water balance

Results

Response of nat. ecosystem to climate change
Changes in water availability and irrigation water demand
Changes in cropping patterns and family incomes
Yield changes of selected crops
New landuse/-cover patterns
Impacts of water supply and water use strategies



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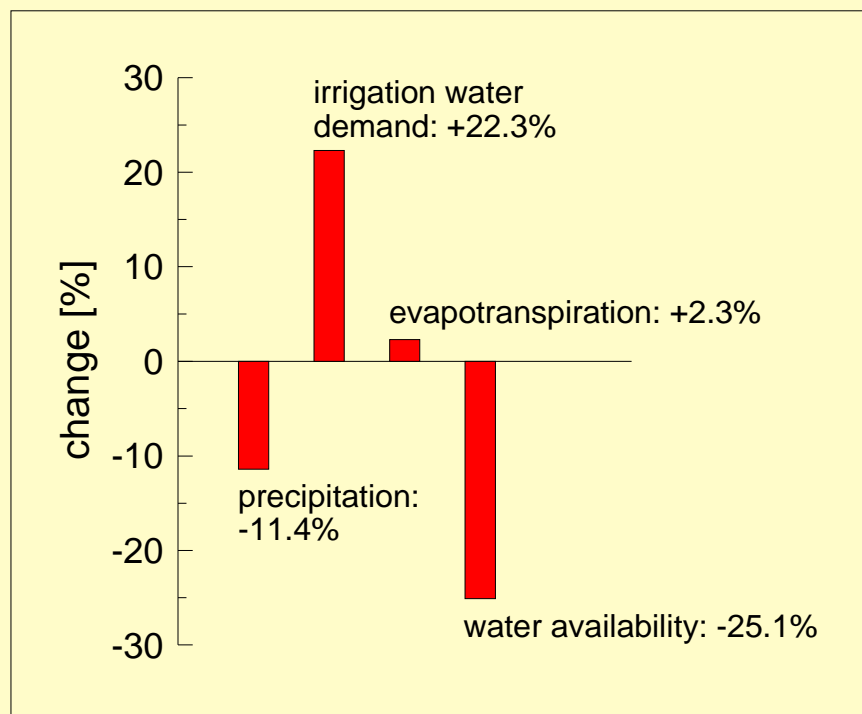
Second Scenario Panel Meeting and Follow-up

Example modeling results:

What is the impact of expected climate change on irrigation water demand in the Lower Jordan River Region?

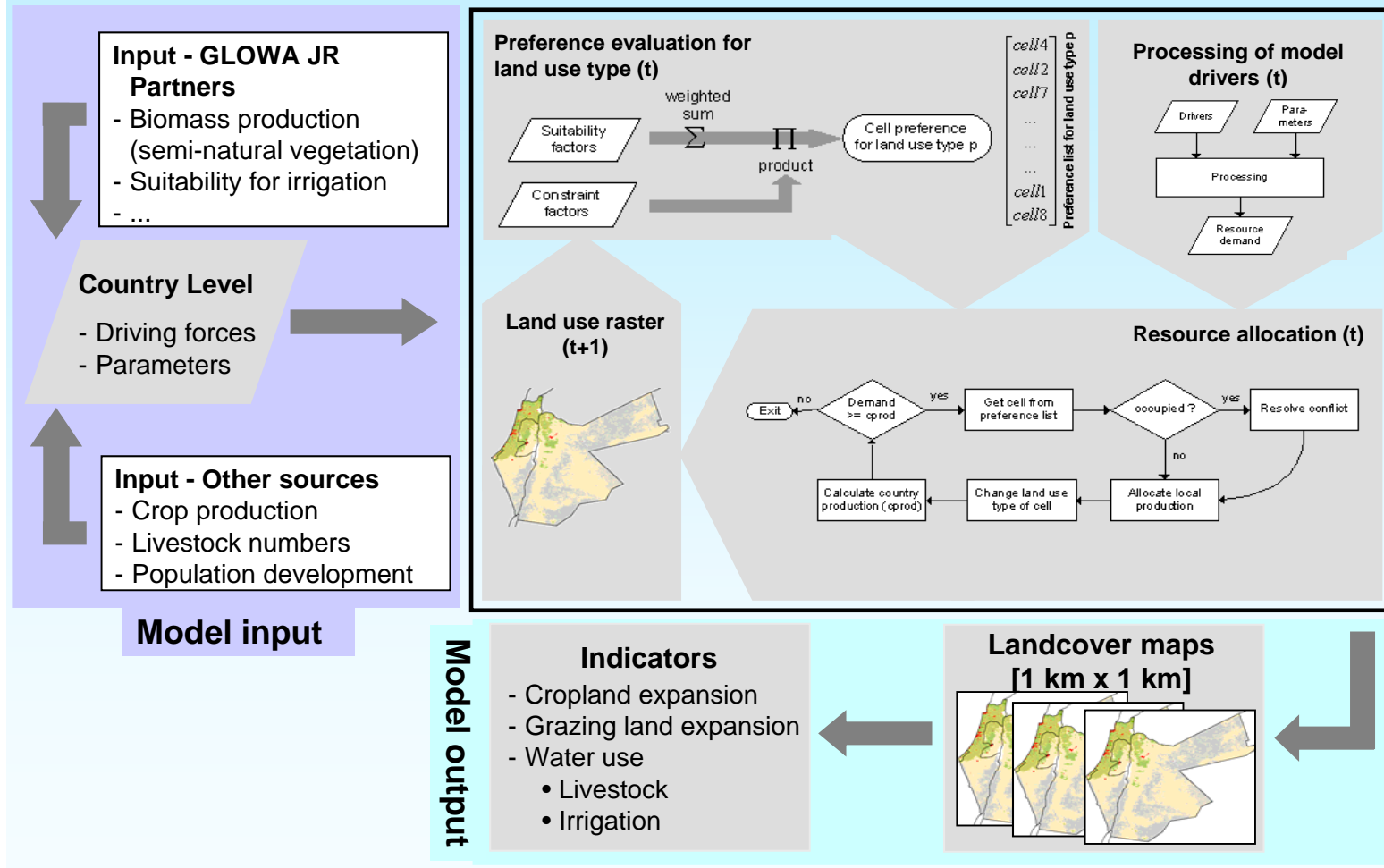
Source:
Menzel, P4
(Lange et al.
P5)

With climate
inputs from P3
and other inputs
from P9, P11.



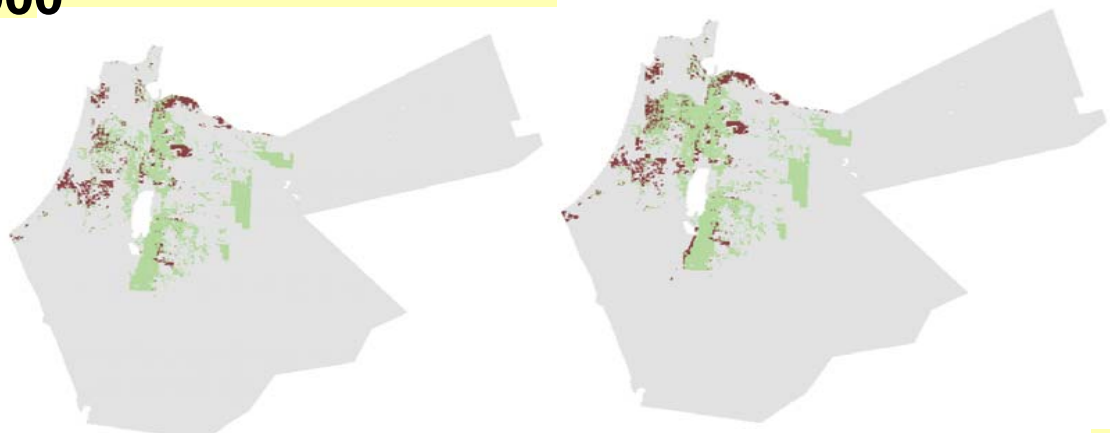
B2
Scenario
2070s

LandSHIFT Model (Source: Schaldach, Koch, et al., P1)



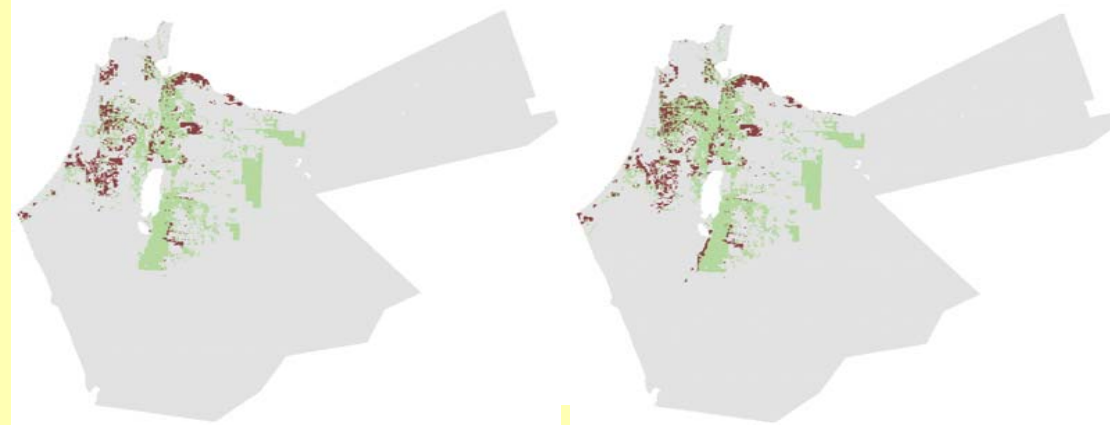
LandSHIFT Model Results: New cropland/grazing land compared to 2000

Willingness & Ability



2025  Grazing land  Cropland  Other **2050**

Suffering of the Weak & the Environment



grazing, pop.



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Second Scenario Panel Meeting and Follow-up

What are findings from modeling analyses of different Glowa-J subprojects?

- B2 scenario (2070s) → increase mean annual temperature $\sim 3.5^{\circ}\text{C}$ by end of the century
- Winter precipitation decreases, spring precipitation increases.
- Significant reduction of snow water equivalent in UJRC
- Decrease in precipitation + increasing temperature → disproportional increase of irrigation water demand in order to sustain current agriculture
- Increasing demand for agricultural commodities → additional stress on water resources and natural ecosystems (grazing)

Storylines ↔ **Modeling Results**

How much are they integrated?

Answer: Not much

- Scheduling problems
- Information not requested or not needed by stakeholders
- Stakeholders need guidance on interpreting results

Information requested by stakeholders

(from Second Scenario Panel Meeting; Workshop Report)

Poverty & Peace

Further Research Needs

	Priority
1. Crop water requirement (local environment)	* 8
2. Capital investment per job created in: <ul style="list-style-type: none">• irrigated agriculture• industry• tourism	* 1
3. Returns of unit flows in each	* 1
4. Socio-economic and environmental impacts of: <ul style="list-style-type: none">• water shortage / availability for the various sector users• re-use of treated municipal waste water• groundwater depletion	* 1
5. Optimum cropping patterns on land irrigated with treated waste water	* 1
6. Study of the predicted frequencies of extreme climatic events (7-year drought, 40 °C heat wave, heavy flood, etc.)	* 2
7. Health expertise on climatic change impacts: cholera, vegetable pest, livestock diseases	* 5
8. Network of experts in the region on water and agriculture	* 4
9. Gene-modified, drought-resistant crops	* 3
10. Run-off coefficient for Jordan side of the catchment	* 6
11. Impact of sea level rise => salinity of coastal aquifers	* 2



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Second Scenario Panel Meeting and Follow-up

Steps to increase integration of models and storylines in the GLOWA-Jordan scenarios in this project phase

- Timely delivery of inputs from one model to another.
- Production of model results far enough in advance of 3rd Scenario Panel meeting (November, 2007)
- Preparation of briefings and recommendations regarding modeling results for stakeholders. → How could storylines be extended/revised based on model findings?
- Make Phase 3 stakeholder-driven



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Conclusions

- Developed framework for combining qualitative and quantitative information to examine future of water resources in the region.
- Produced four (first draft) visions of how the future may play out in the region. Developed by stakeholders from 3 states in the region.
- Took first steps to integrate information from many GLOWA-Jordan sub-projects → input to scenario exercise.
Better cooperation and coordination needed here.
- Computed land cover scenarios consistent with future changes in crop production, grazing rates, other factors.
- All in all, scenarios engage stakeholders and provide opportunity to synthesize important work from GLOWA-J subprojects.



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