Sustainable management of urban water systems based on macromodelling – the case of the megacity of Lima/Perú

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Challenges – Water in megacities

Water and wastewater in megacities (general):

- Complex water supply and wastewater systems
- Multitude of stakeholders, conflicting interests
- Interactions with other critical lifeline systems (e.g. energy, …)
- Social, environmental-technological and economic aspects
- Water tariff system
- Challenges of the future (e.g. climate change, population growth)
- Uncertainty of future developments
- Neutral, un-biased evaluation of potential options to act

Lima Metropolitana:

- Urban growth centre: 8.5 million inhabitants, growth rate: about 2 % p.a.
- Desert region, almost no rainfall (9 mm p.a.)
- Water supply mainly from Andean mountains; Trans-Andean tunnels
- 91 % of population connected to supply network; 86 % to sewerage
- About 20 % of wastewaters treated; some reuse of wastewaters
- Institutional framework; National water company, many governmental institutions involved in water issues, 43 district municipalities

Aims and objectives

- Supporting informed discussions and participatory decisions for Lima's urban water system – coping with climate change and urban growth
- Provision of neutral advice, considering the water system in its entirety
- Facilitation of sustainable development of Lima

The „LiWa" approach

Within the "LiWa" (Lima Water) project, Peruvian and German partners have jointly developed this approach, including tools and methods:

- Consistent scenarios: "How could Lima look like in 2040?"
- Regionalisation of Global Climate Models
- Macromodelling: the entire water system in one model
- Informed discussions, stakeholder participation
- Analysis of water tariffs
- Capacity building, including professional development courses
- Urban planning: Green infrastructure in a desert context

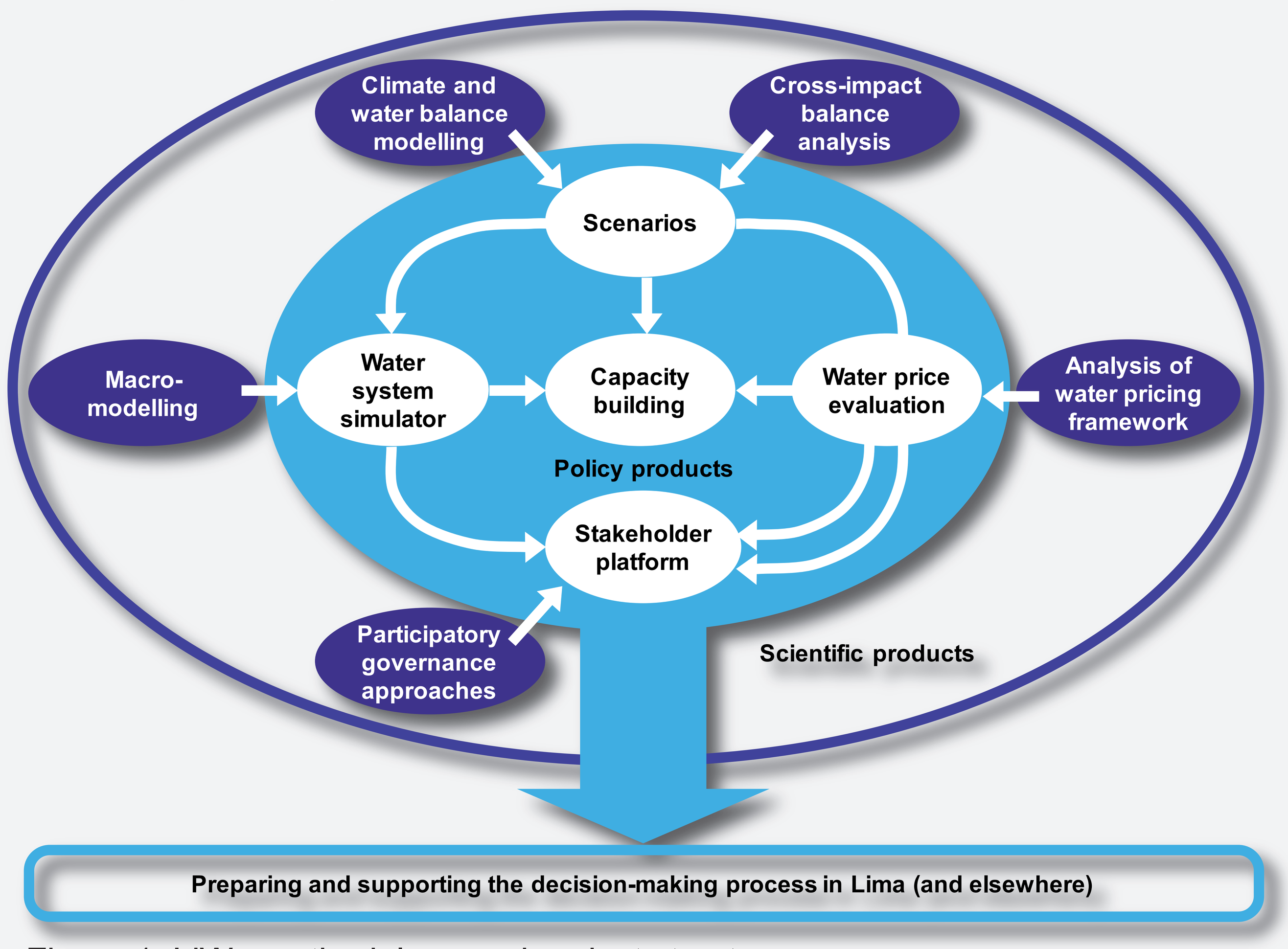

Figure 1: LiWa methodology and project structure

A Water System Simulator for Macromodelling

- Modelling of water and wastewater system, pollution, energy…
- Based on principles of resource flux modelling
- Solvers: Newton-Raphson, Levenberg-Marquardt, …
- Highly flexible in definition of processes, parameter and variable sets: User can modify and extend the simulator and also add new modules
- Categories of costs (capital and operational expenditure), revenues by tariffs
- Test and visualisation of scenarios and variants
- Output options: Sankey diagrams, Excel, HTML, Reports, Google Earth
- Model development and integration of data in close cooperation with local water company and other stakeholders

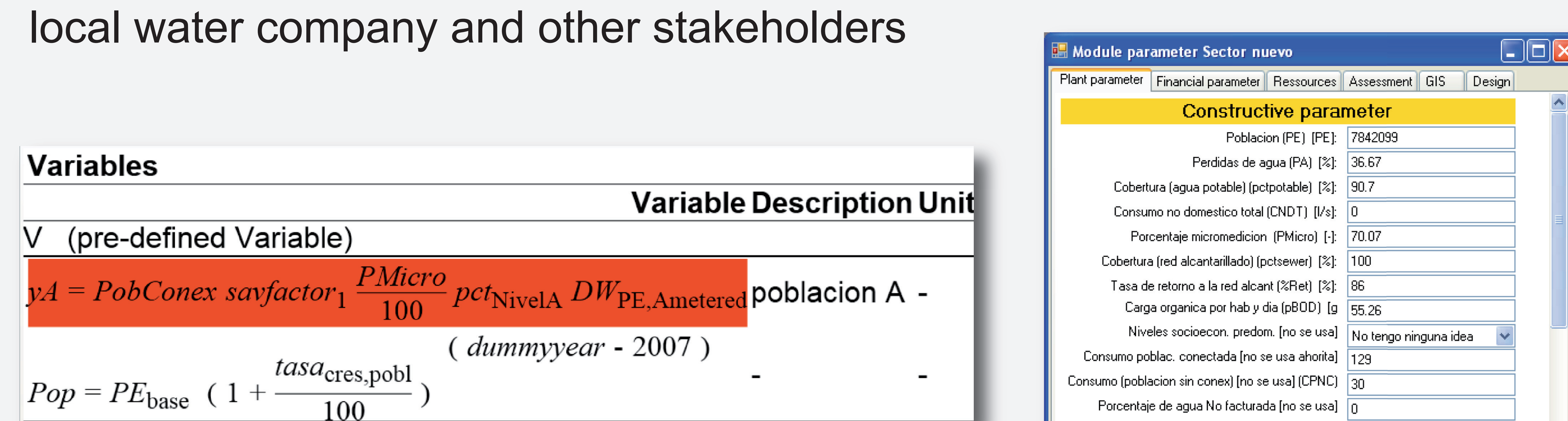

Figure 2: User-friendly specification of funcional relations and of block parameters

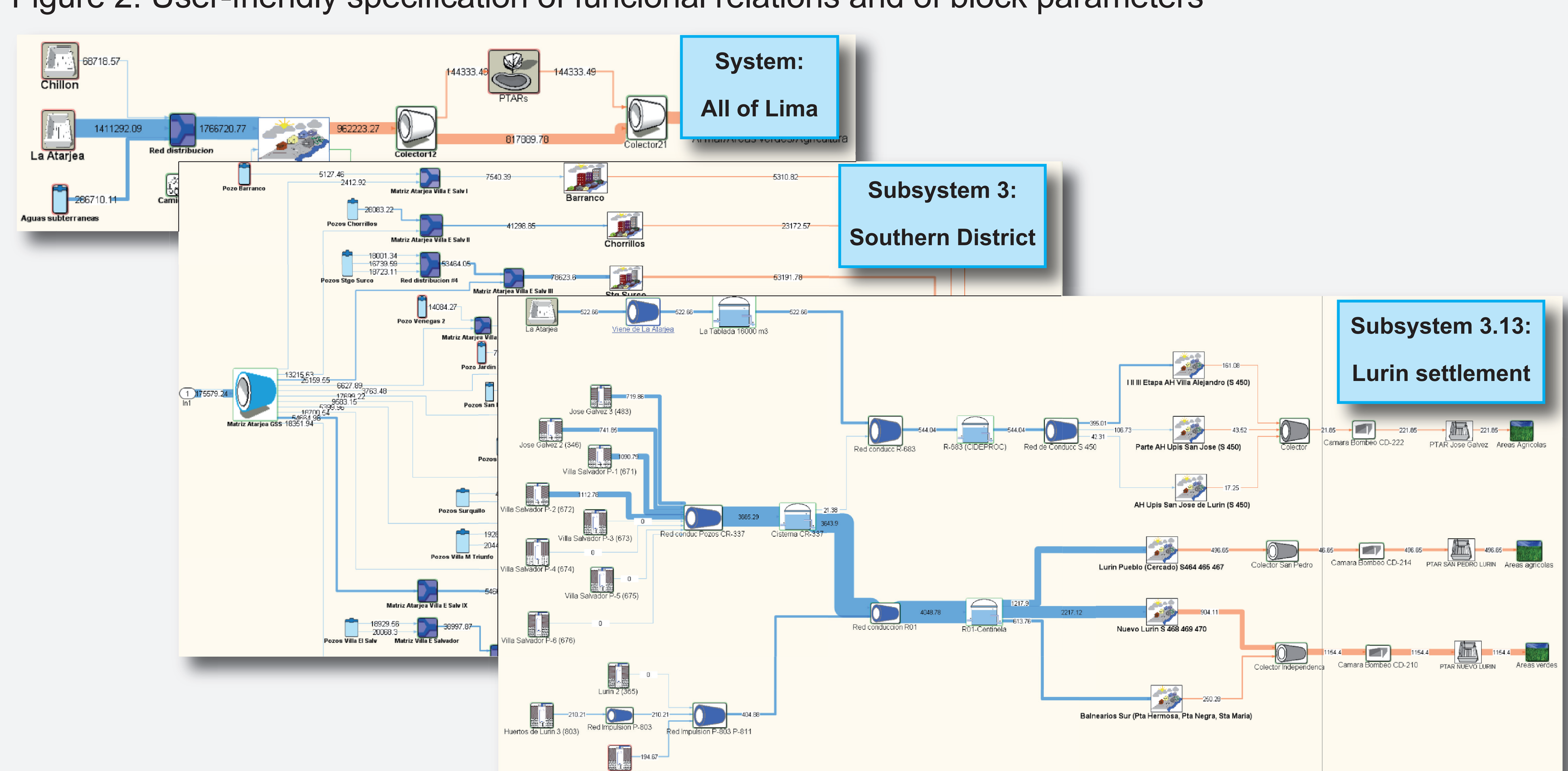

Figure 3: Sankey diagrams as results of macromodelling

Application example: The Lurín settlement of Lima

The case: Lurin: 63000 inhabitants

- Area of future urban development
- Population connected: Water supply: 34 %; Wastewater network: 29 %
- Significant groundwater abstraction
- Exemplary assessment with regard to: water availability, energy consumption, pollution discharges into the ocean, revenue by water tariffs

Conclusion: More uniform utilisation of groundwater and reduction of energy consumption appears to be possible. However, need for additional sources of water will arise anyway.

Conclusions

- Enabling environment for fruitful discussions and cooperation of stakeholders (e.g. water company and NGOs)
- Macromodelling assists in the analysis of scenarios and acting options
- Ongoing simulator extensions: storage effects, additional solvers (including ODEs), improved visualisation, extended connection to GIS, increased user-friendliness
- First Round Table in Lima: envisaged for autumn 2011

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