

ACROSS INTERNATIONAL JOINT LABORATORY

ADVANCED COMPUTATIONAL RESEARCH FOR SUSTAINABILITY SCIENCE

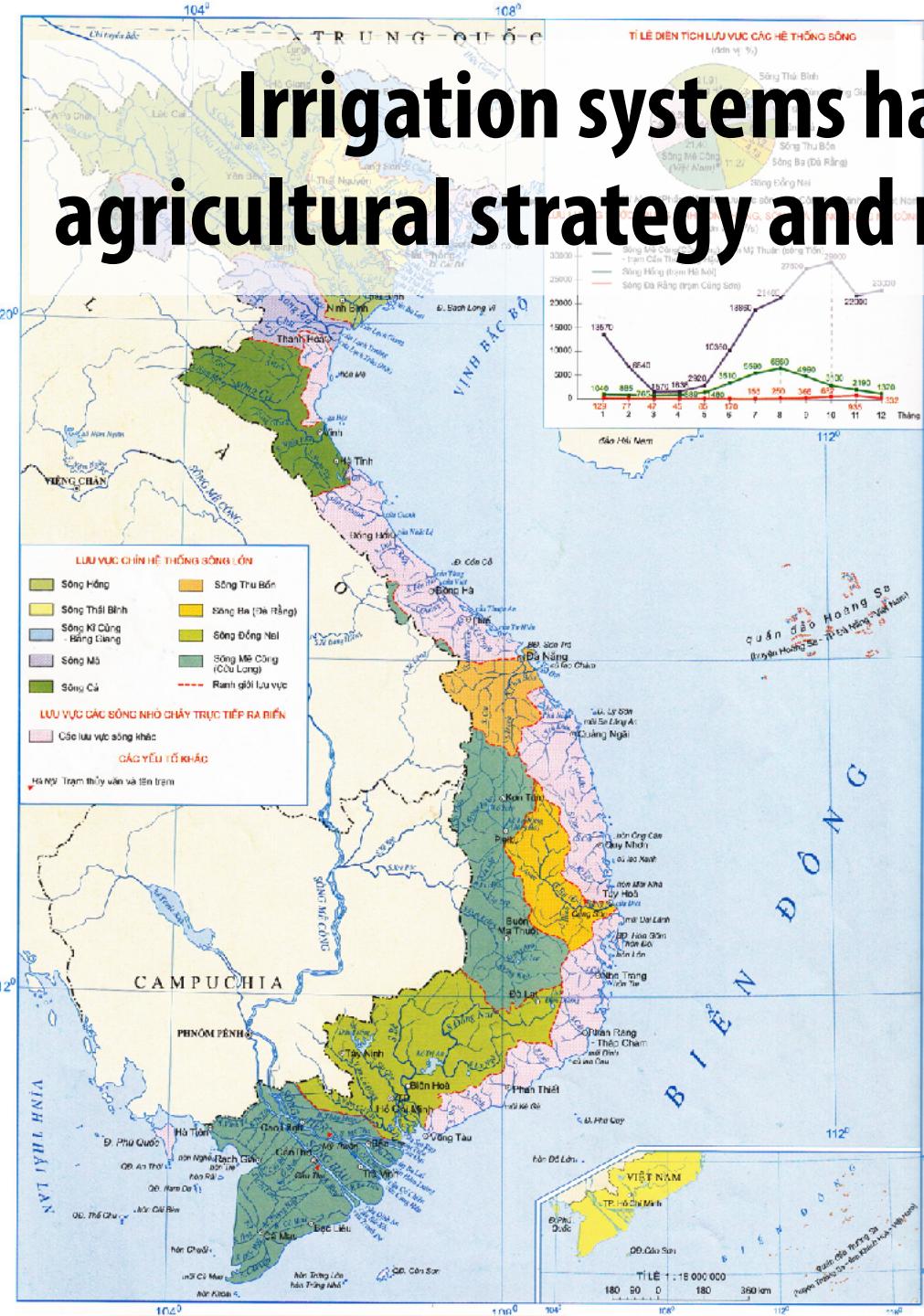
WITH APPLICATIONS TO THE SUSTAINABLE MANAGEMENT OF IRRIGATION SYSTEMS IN VIETNAM

NGUYEN-NGOC Doanh, Associate Professor, doanhnn@tlu.edu.vn

Alexis DROGOUL, Senior Researcher, alexis.drogoul@ird.fr



Irrigation systems have been at the heart of the Vietnamese agricultural strategy and now sustain a large number of activities



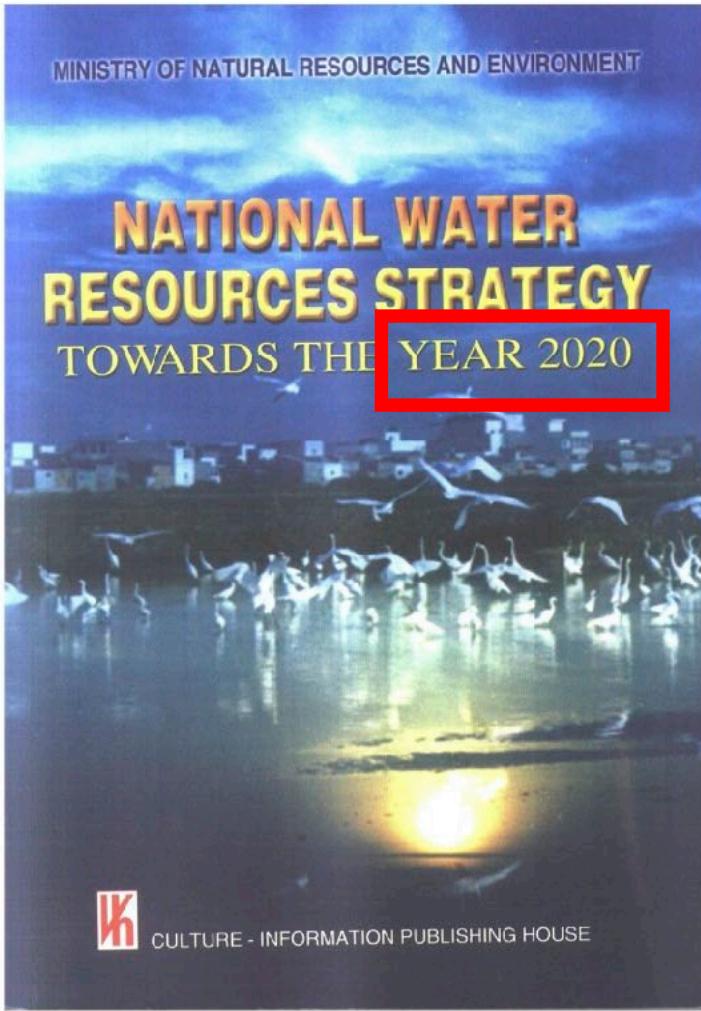
- The country is rich in water resources, with nearly 3,500 rivers more than 10 km long, over 16 major river basins (including 2 large deltas) and abundant rainfall (nearly 2,000mm/year)
- Irrigation systems are of primary importance for sustaining agriculture:
 - 90% of water used is for irrigation and aquaculture
 - 5,656 reservoirs; 8,512 weirs; 5,194 pumping stations; 23,000km dykes
 - Total capacity of 3.45 MH
- Vietnam was the first country in the region to develop such an extensive irrigation network, also during the colonial period, when civil engineers built a lot of infrastructures still used today.

They are however facing emerging issues, especially since the “Đổi mới” (1986) and the resulting economic boom



- **Conflicting demands:** hydropower, coal-fired power plants, industries, municipalities, river transport, and other high-growth, high-value uses
- **Underinvestment** in operations and maintenance has contributed to the deterioration of the irrigation network, which meets only about 50-60% of its nominal capacity.
- **Intensification and diversification of agriculture** creates constraints and challenges: overpassing of capacities, emerging water and soil pollutions,
- **Climate change and extreme weather conditions** highlight the low resilience and the need to improve disaster management capacities against drought, flooding, landslides
- **Urbanisation** creates a new generation of challenges: pollution, salinity, underground water pumping

The Vietnam National Water Resources Strategy promoted, in 2006, a "sustainability science" approach to irrigation systems management



Goals listed in the general objectives and implementation measures of the document emphasise the necessity to implement sustainable development of water resources at multiple scales by:

1. **promoting public participation** in their management
2. **integrating disciplines and expertises** to enable multi-sectoral analyses

However, strong criticism expressed because of the lack of methodologies/tools to reach these goals !



Prof. Vu Trong Hong
Former Vice Ministry of Agriculture
and Rural Development (MARD).
Chairman of the Vietnam Academy
for Water Resources

- "(...) there is a lack of mechanisms to take into account conflicting assessments and recommendations made by different sectors and contradictory demands from different actors."
- "(...) a lack of interdisciplinary discussions and of a national strategic irrigation agenda is threatening livelihoods, food security, health as well as economy in Vietnam."

Perspectives

Vietnam's lack of transparency on environmental issues is glaring

By Nguyen Dang Anh Thi July 21, 2020 | 06:32 am GMT+7

Vietnam needs transparency and actual public consultation on corporate environmental impacts; and clarity in regulations relating to the environment's capacity to withstand pollutants.

News

Inefficient use of water a problem for Vietnam in drought fight

By Vuong Duc Anh April 20, 2016 | 08:14 am GMT+7

using severe affects in many provinces in the South of

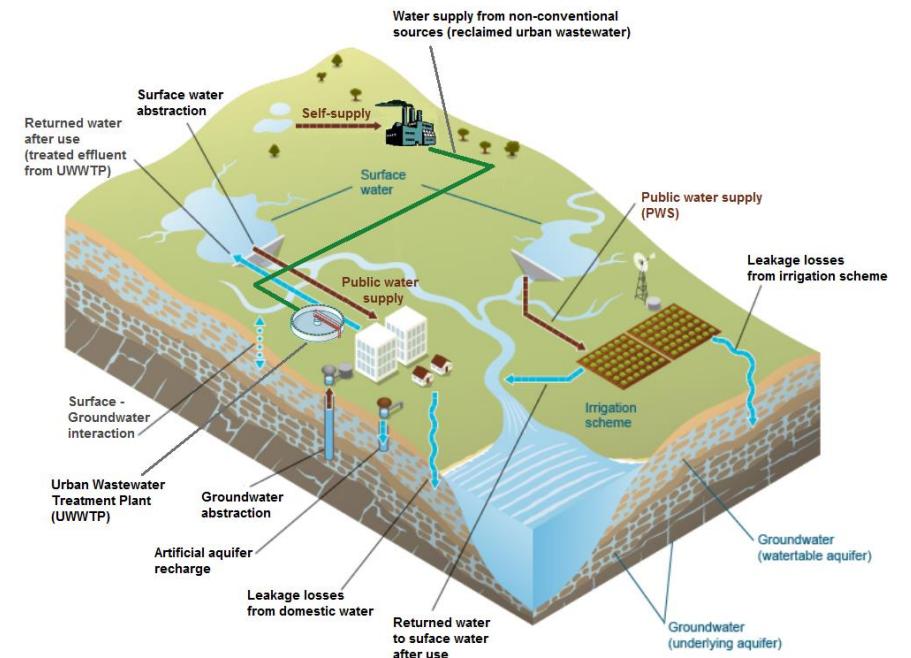
Promoting interdisciplinarity is necessary, but how to do it properly ?

- Irrigation systems touch all aspects of the human, environmental, political and economic spheres
- To address their problems, one needs to embrace an interdisciplinary perspective and integrate knowledge from fields as diverse as meteorology, hydrology, soil and vegetation science, medicine, agronomy, economy, law, sociology or anthropology
- No efficient, reusable methodology has emerged so far to support scientists to work together, connect their representations, esp. in Vietnam where the walls between disciplines are still very high.



Participation is also a key point

- The involvement of stakeholders was formalised by the concept of “participation in irrigation management” (PIM), defined in the 1990s by the World Bank as *“the participation of irrigation users in all aspects and at all levels of irrigation management”*
- A large literature exists on the subject, but how to concretely support the active participation of stakeholders of irrigation systems in Vietnam ?
 - **Different goals** (sometimes conflicting), different cultures, different representations.
 - **Political aspects** are sometimes sensitive
 - **Stakeholders are not always rational**, they evolve, they learn, they influence each other: all these aspects play a role in the decision-making processes regarding irrigation management

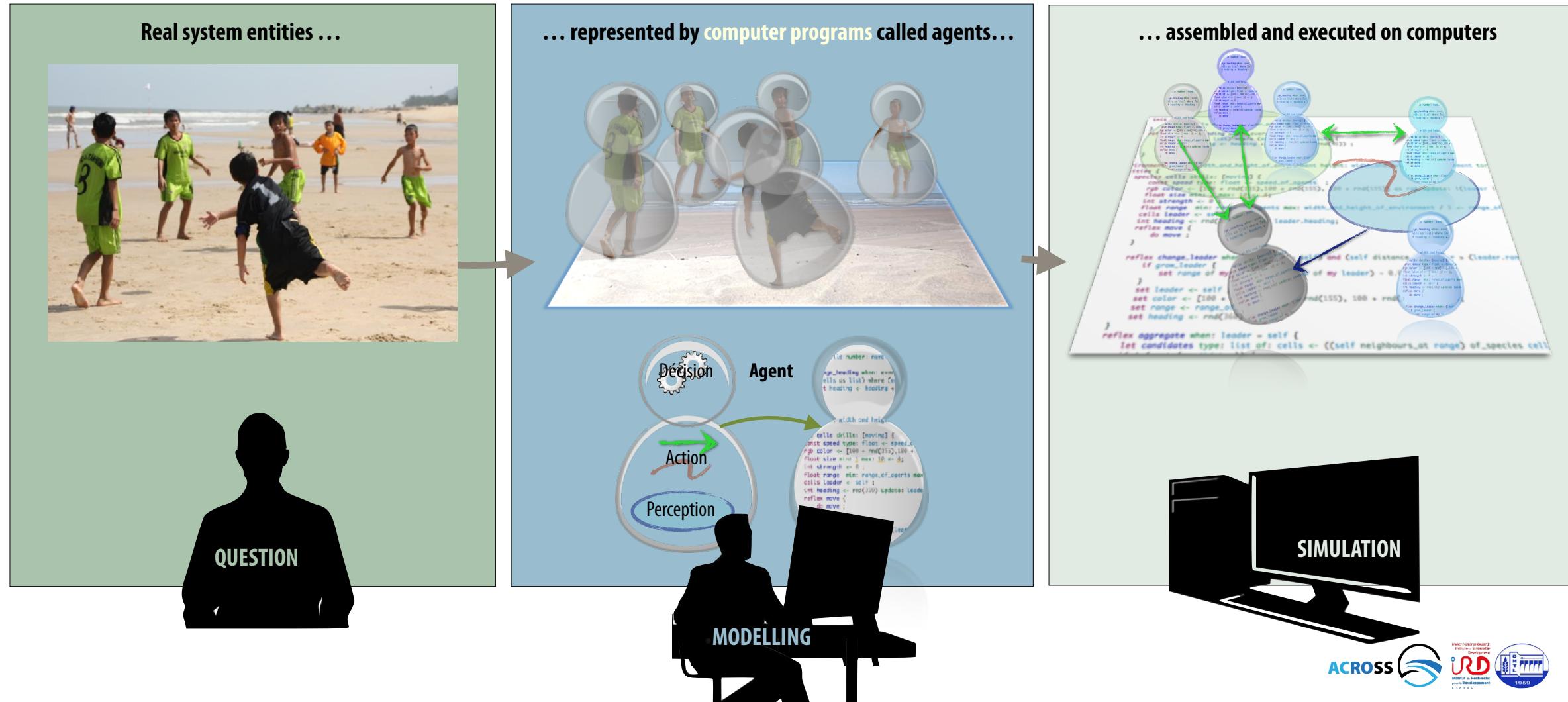


ACROSS will address these challenges by supporting interdisciplinarity and participation through a combination of computational technologies and participatory approaches

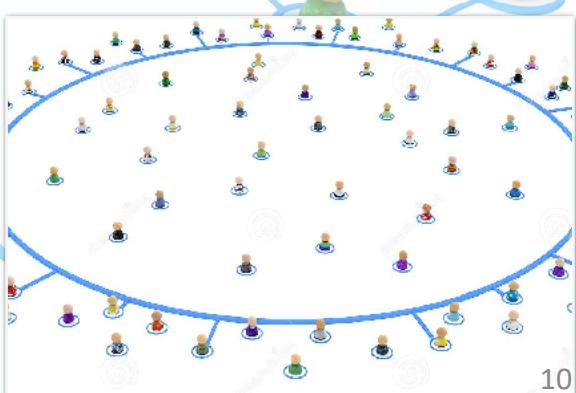
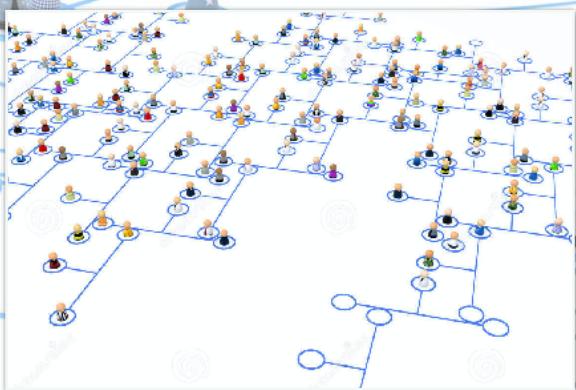
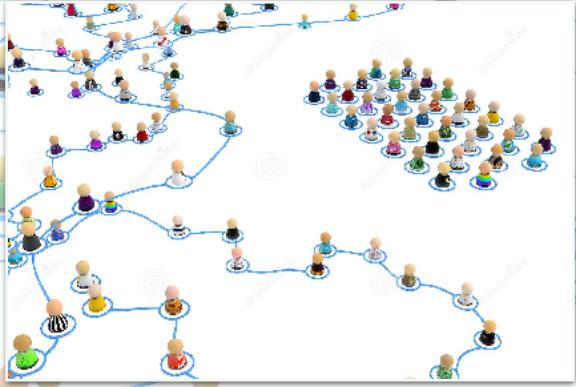
1. Design technological solutions in the form of **integrated modelling environments** that can support interdisciplinary research by facilitating the representation, exploration and understanding of the coupled evolution of social and environmental systems in selected case studies;
2. Design methodologies based on **participatory simulation and serious games** that can support interactions between researchers, policy makers and stakeholders so that they can explore and compare plans and scenarios before implementation

Both will be based on **agent-based modelling**, an approach on which UMMISCO and TLU have been extensively working the last 10 years.

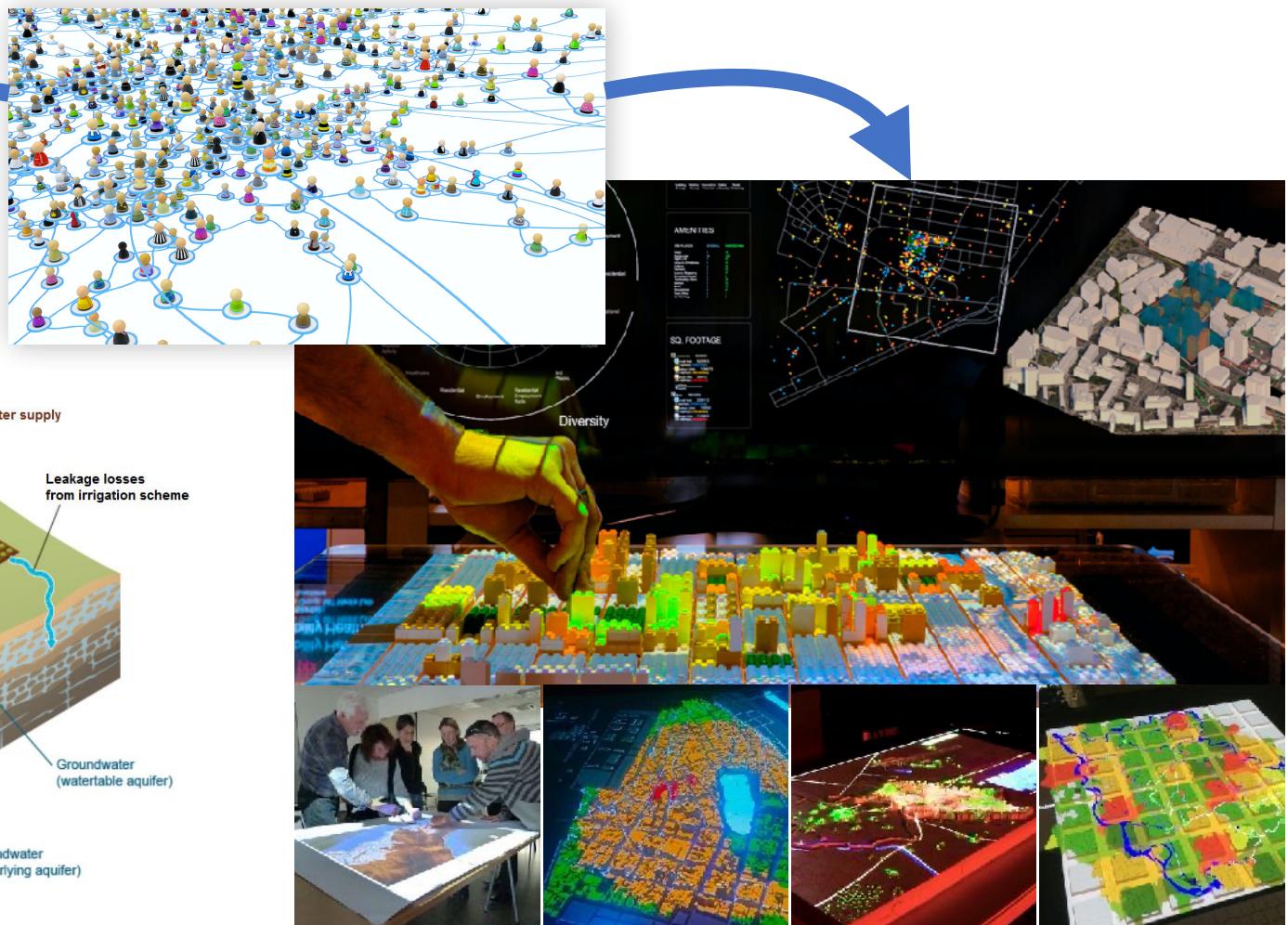
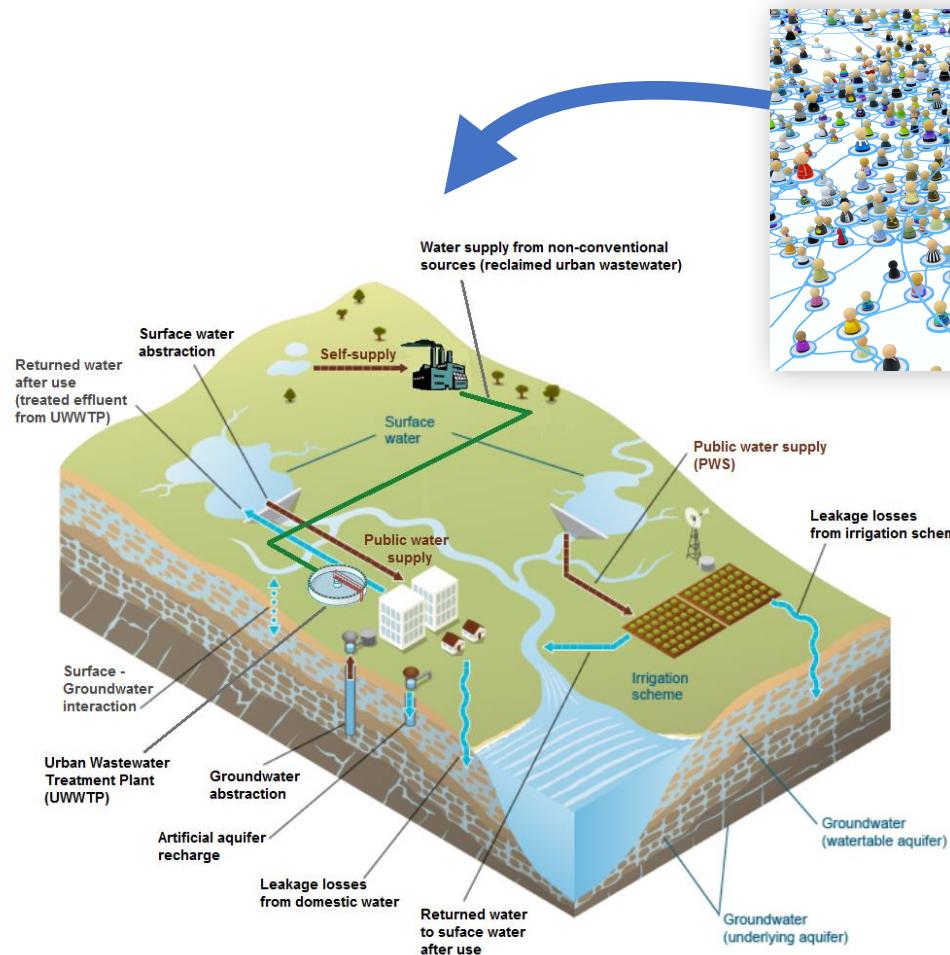
Agent-based modelling (ABM) is based on the design of models whose dynamics are the result of interactions between active entities of the modelled system (actors, institutions, environment, represented as computational agents).



When simulated, ABM become virtual «micro-worlds» that can be explored in any number of scenarios



In our proposal, ABM constitute the foundation of both ...



a shared representation and a medium of interaction to enable different disciplines to work together

participatory simulations to engage stakeholders in negotiating their shared future in various scenarios

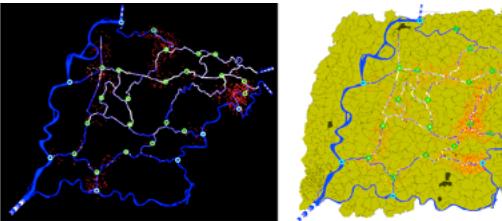
This formalises into 4 main research activities

Activity 1 Assessment



Design a methodology to assess and elicit the socio-environmental context, identify stakeholders, users, list issues and areas for improvement, feeding the design of integrated models in Activity 2 and the definition of scenarios of evolution in Activity 3.

Activity 2 Participatory modelling



Design a participatory modelling environment, supporting interdisciplinary interaction of researchers through a shared representation of irrigation systems, and constituting a basis for the simulation of its evolutions in Activity 4.

Activity 3 Scenarios



Design a methodology to support the definition of scenarios of social, economic and environmental evolutions, together with the elicitation of desired plans of action and the design of sustainability indicators, in order to feed Activity 4.

Activity 4 Participatory simulations



Design participatory simulation/serious game environments exploiting virtual reality, tangible interfaces and HPC to support interactions between stakeholders and allow them to explore and compare the impact of various plans in different scenarios.



CS1 - Red River Delta: Bac Hung Hai Irrigation System
water pollution and salinity

CS2 - The center: Bac Nghe An Irrigation System
fragile ecosystems and disaster management

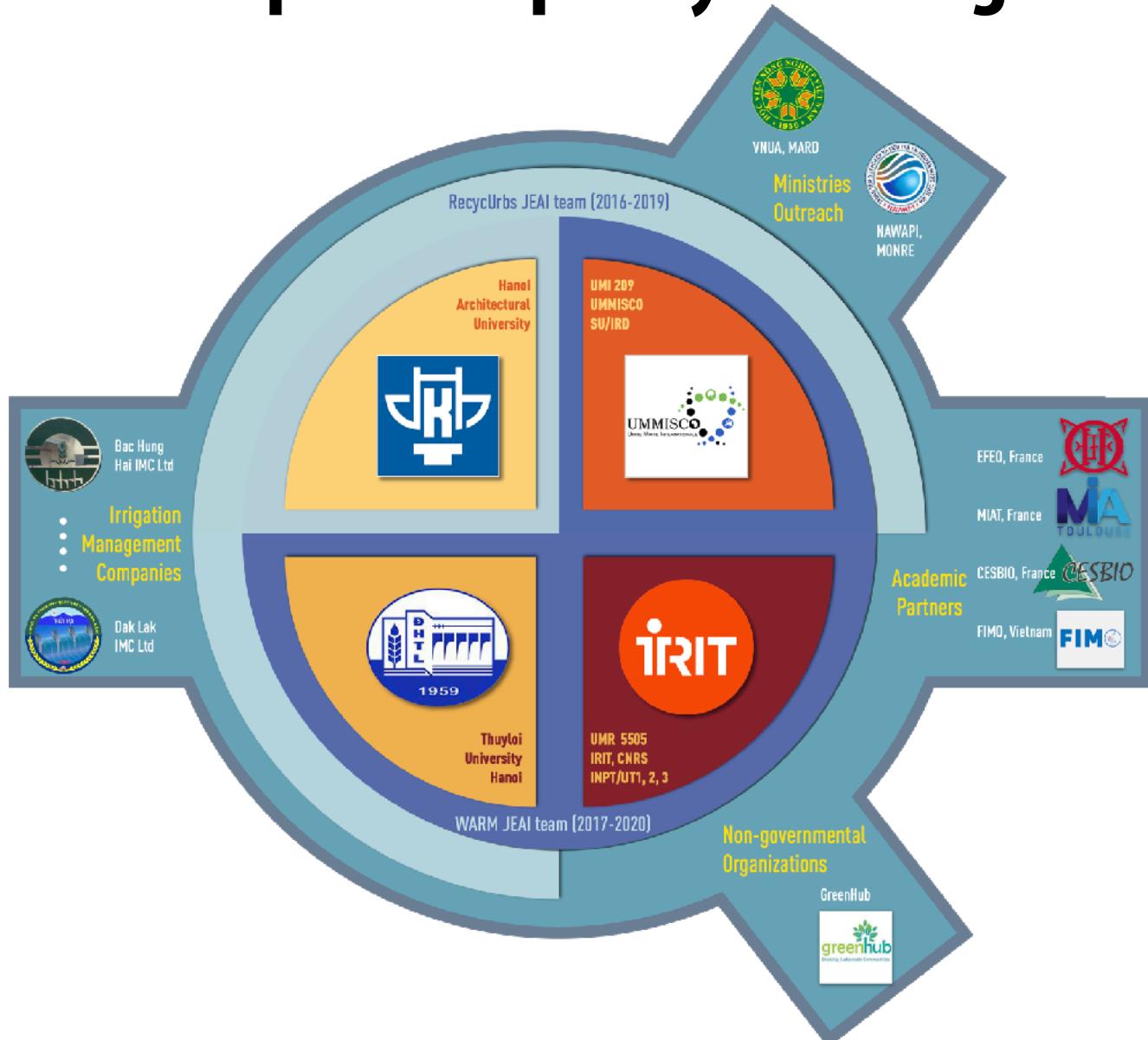
ACROSS will support these activities in 4 case studies, which have been chosen based on their characteristics and the general issues they illustrate



CS3 - The highlands: Dak Lak Irrigation system
management and operations

CS4 - The Mekong Delta: Duc Hoa Irrigation system
balanced access to water and salinity

Partnership and capacity building



Activity 1 Assessment

PhDs: 3 planned + 10 Master theses



Activity 2 Participatory modelling

PhDs: 2 planned + 8 Master theses



Activity 3 Scenarios

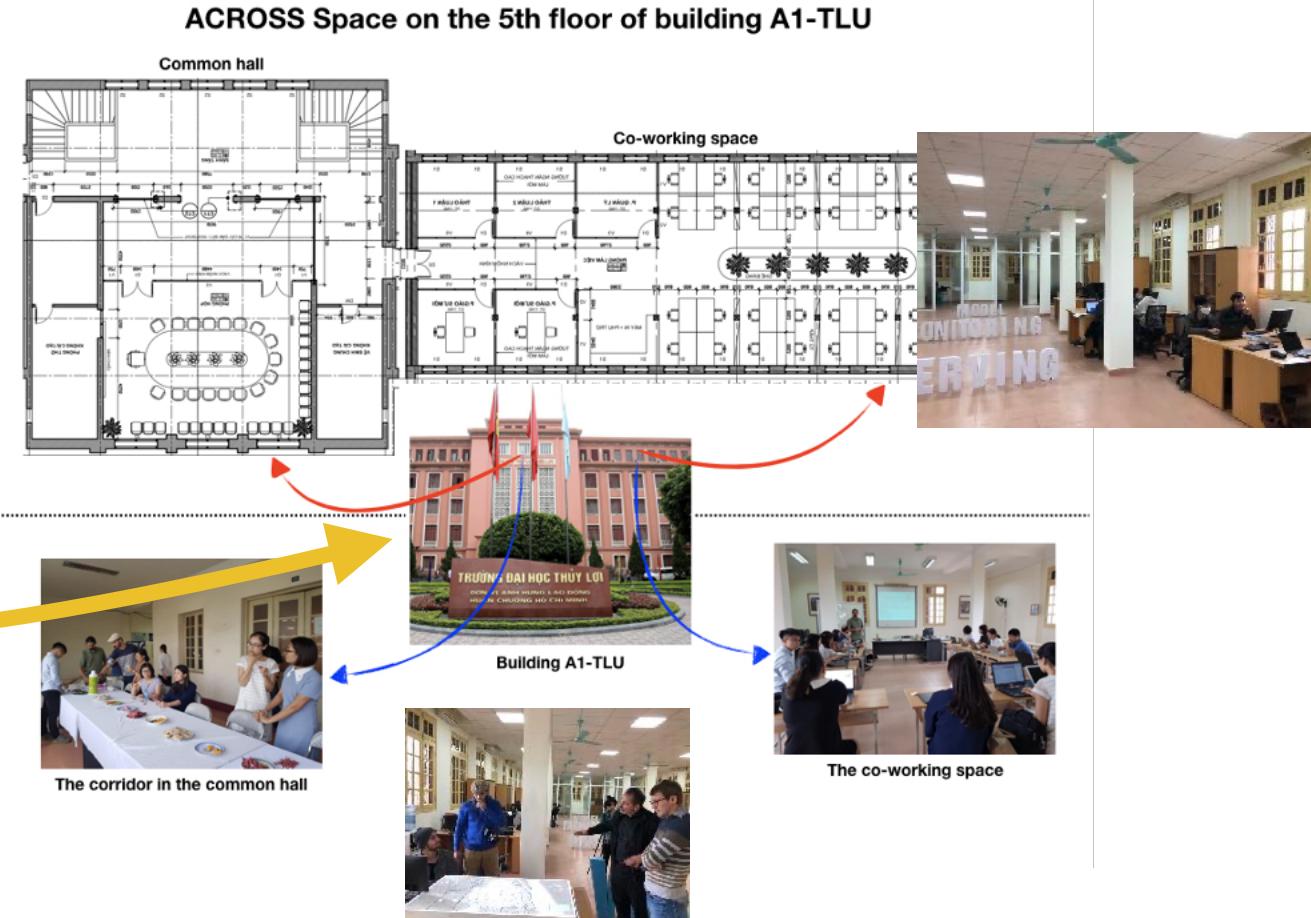
PhDs: 3 planned + 10 Master theses



Activity 4 Participatory simulations

PhDs: 2 planned + 4 Master theses

Thuyloi University has already built a space dedicated to the IJL, on the 5th floor of its main building



ACROSS

TOWARDS SMART & SUSTAINABLE IRRIGATION SYSTEMS
INTERNATIONAL JOINT LABORATORY ON SUSTAINABILITY SCIENCE

