VIETADAPT II

Climate change adaptation measures in Vietnam

Local adaptation measures developed with local authorities and stakeholders




Results of the Finnish-Vietnamese Institutional Cooperation

Developing and implementing climate change adaptation measures at local level in Vietnam (VIETADAPT II), 2015 – 2016

The VIETADAPT II project has successfully contributed to the implementation of the **Vietnamese National Target Programme to Respond to Climate Change** and the **Strategy on Climate Change.**

Key results:

- Training of Vietnamese experts in modeling, vulnerability and environmental impact assessments.
- Developing local climate change adaptation measures based on modeling results, vulnerability analysis and interviews.
- Analysing and evaluating given recommendations and climate change adaptation measures in close cooperation with local stakeholders.

VIETADAPT II – from assessment to implementation

The project enhanced the awareness of local stakeholders and decision makers to natural hazards, human induced risks and climate change impacts.
It successfully developed and implemented sustainable risk management and adaptation measures with the focus on the following key issues:

- Improving the knowledge of local hydrogeological and environmental conditions.
- Rising awareness of local vulnerabilities to natural hazards and climate change impacts.
- Understanding local socio-economic and climate change impacts on the living environment and water resources.
- Developing local risk assessment and climate change adaptation measures together with local experts, stakeholders and decision makers.
- Understanding the local policies and functions to water resource, natural hazards and climate change impact management.
- Focusing on the development of no-regret adaptation measures.
- Training of local experts and stakeholders.

Case study in the Ba Ria Vung Tau province – Tan Thanh district

- Tan Thanh district is located in the coast of South-East Vietnam in the north-west of the Ba Ria Vung Tau province, and has a good location and connections to shore and other southern provinces which favors industrial and economic development.
- Main economic fields are aqua- and agriculture together with industrial work.
- There are 1 town and 9 communes with about 137,000 residents. Area of Tan Thanh is approximately 340 km^2.
- Industrial and domestic waste treatment are potential threats to environment and groundwater quality. Water supply relies on groundwater and surface water from Da Den Lake.
- Topographically the area is relatively flat. Climate change and sea level rise will expose the low-lying lands to salinization, which is already detected in groundwater and in Thi Vai River.



Industrial park in Tan Thanh (left); flood inundation of Ba Ria Vung Tau with 1 m sea level rise (centre); poor domestic waste management (right)

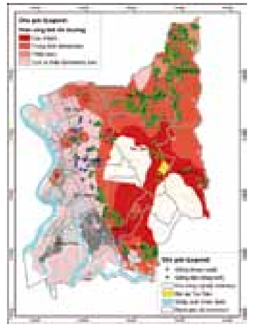
Case study in the Thanh Hoa province – Hau Loc district

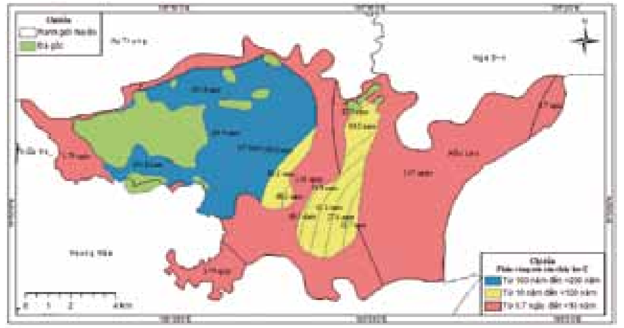
- Hau Loc district is located in the North Central Coast about 25 km north-east from the Thanh Hoa city and it is surrounded by river Len in the north and river Lach Truong in the south.
- Main economic fields are aqua- and agriculture, forestry, fishing, industry and services.
- There are 27 communes and about 184,000 residents, 57,600 of which on 5 coastal communes. Area of Hau Loc is approximately 142 km^2.
- Groundwater pumping and water intensive economy together with climate change induced droughts will increase saline intrusion into groundwater in the future.
- River salinization from tides is also reducing the amount of usable fresh water.
- Currently water supply relies on groundwater from tap and private wells, but its quality is often poor due to salinization. Groundwater is also impacted by numerous landfills.

Flood embankment in Hau Loc

Groundwater management

- Groundwater flow modeling was conducted with GMS software.
- Climate change impacts (precipitation, evaporation rate) were included into flow models.
- Future scenarios of groundwater flow till 2100 with estimated pumping rates were modelled.
- Saline intrusion into aquifers till 2100 was modelled with GMS-SEAWAT taking pumping rates, sea level rise and changing groundwater flow patterns into account.
- Modeling results were utilized to recommend feasible adaptation measures: relocation of pumping wells, managed aquifer recharge, controlled pumping rates.
- Results contributed in identification of additional water sources to groundwater as well as impacts of excessive pumping.
- Specific vulnerability analysis with AVI and GALDIT was utilized to identify most vulnerable areas.
- Saline intrusion to aquifers was detected in both case study areas. Especially in Pleistocene aquifer in Tan Thanh and Pleistocene and Pliocene aquifers in Hau Loc.

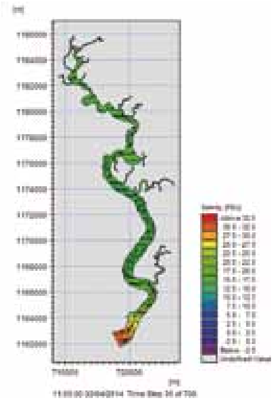
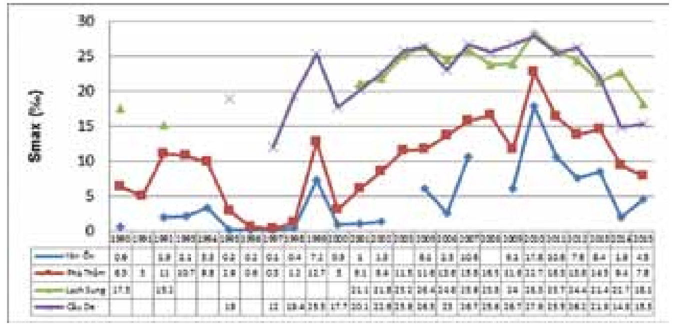




Risk sites in Tan Thanh (left); cross section of modeled area in Tan Thanh (centre); transport time to aquifer in Hau Loc (right)

Saline intrusion and pollution in main rivers

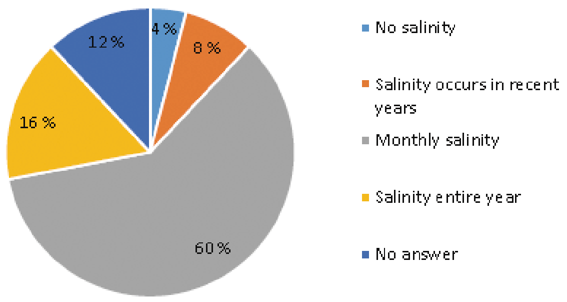
- MIKE-SHE was used for river flow modeling.
- Salinity and pollutant concentrations follow the seasonal water flows and tides.
- Concentrations of BOD_5, DO, NO_3^-, NH_4^+, PO_4^{3-} and salinity were modelled in Thi Vai River in Tan Thanh. Most of the pollutants did not exceed Vietnamese guideline values for surface water quality, but salinity makes the water unusable at times.
- Salinity in Len River in Hau Loc was modelled based on measurements on monitoring stations along the river. All of the river is saline, and it cannot be used for agriculture nor domestic use. New groundwater sources and upstream surface water intake are considered.


Saline intrusion in Thi Vai River (left); saline intrusion in Len River (centre); scattered landfill in Hau Loc (right)

Vulnerability assessments and interviews in Hau Loc and Tan Thanh

- Interviews with local people and stakeholders on climate change, natural hazards, water use and pollution, saline intrusion and gender sensitivity were conducted.
- Joint analysis of local vulnerability to natural hazards and climate change was made.
- Studies on exposure to relevant natural hazards, socio-economic sensitivity and adaptive capacity were conducted to evaluate overall vulnerability.
- Recommendations how to improve coping capacity and minimize overall vulnerability today and in future climatic and socio-economic conditions.



Exposure to saline intrusion in Hau Loc according to interviews (left); calculated vulnerability index for Hau Loc coastal communes (right)

Best practices for climate change adaptation – from Finland to Vietnam

- The National Climate Change Adaptation Plan of Finland gives advice on overall strategy and measures.
- Water balance studies: Groundwater recharge and demand in changing climate and socio-economic development.
- Enhancing the use of managed aquifer recharge: securing water supply for example during prolonged droughts.
- Groundwater protection plans: Hydrogeological studies on aquifers, vulnerability analysis, minimizing risk activities, land use restrictions to protect aquifers and water intakes, saving future reserves.
- Emergency preparedness for crisis situations: securing and improving drive ways for rescue services, ensuring accessibility of emergency routes for residents.
- Sectoral co-operation: Actor specific risk assessment and preparedness plans.
- Nature based solutions: Favoring natural conditions in flood protection.
- Evaluation: Maintenance, reparations and revisions of existing measures by new analysis and scenarios.
- No-regret adaptation measures: multi-functional, cost-effective, social acceptance.

Heightened storm surge dyke (left); storm water infiltration pond (centre); managed aquifer recharge by sprinkling (right)

Capacity building in Vietnam

- Producing informative maps and reports for both scientists and stakeholders.
- Hydrogeological and environmental studies: climate change impacts to groundwater recharge patterns, environmental impact assessment, contamination studies, techniques for remediation and monitoring.
- Groundwater and surface water modelling: steady state groundwater flow, hydrodynamic flow modeling for rivers, salt water intrusion modelling, future scenarios modelling.
- Vulnerability assessment: DRASTIC-, SINTACS-, AVI- and GALDIT-methods for groundwater, socio-economic studies for sustainable land use planning.
- Climate change impact studies: groundwater, surface water, environment, natural hazards.
- Developing local climate change adaptation methods and measures.
- Risk assessment and management : Providing feasible recommendations for local stakeholders.



Groundwater modeling training (left); field visit (centre); training certificate (right)

Capacity building in Finland and South East Asia

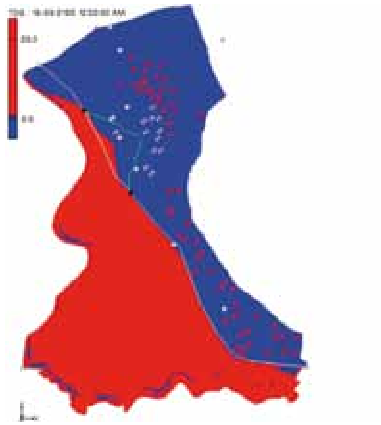
- Two weeks training in Finland / June 2016
  - Lectures on vulnerability assessment and groundwater modeling.
  - Field visits to groundwater facilities including managed aquifer recharge areas.
  - Following and studying groundwater sampling with new techniques (multi-layer sampling with backer) and soil drilling work related to hydrogeological studies.
  - Visiting and sharing information with Finnish research institutions and other cooperation bodies: Finnish Meteorological Institute, Finnish Environment Institute, Natural Resources Institute Finland, Finnish Water Forum.
  - Visiting Finnish companies with expertise in weather monitoring, environmental monitoring and waste treatment sectors: Vaisala Oyj, Ekomo-Ämmässuo eco-industrial centre, Vantaa Energy, SCATMAN Ltd.
  - Learning on the experiences of municipalities: environmental awareness raising in the city of Lahti.
- International share of information and capacity building via workshops in South East Asian countries (in cooperation with Coordinating Committee for Geosciences Programmes in East and Southeast Asia - CCOP).



Studying drilling samples (top); groundwater sampling (centre); drilling site (below)

Recommended adaptation measures for Tan Thanh

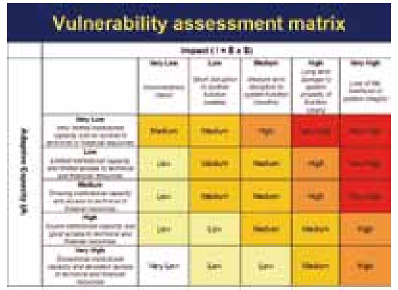
- Adjusting groundwater pumping rates to better meet sustainable water management.
- Relocating pumping wells to prevent saline intrusion into aquifers.
- Extending groundwater monitoring network and making preparedness and action plans for extreme weather events and other crisis situation.
- Using fresh water from Da Den Lake to managed aquifer recharge in the areas with saline groundwater.
- Monitoring the river water quality regularly for salinity and providing guidelines on sustainable water use for citizens.
- Managing industrial waste waters to Thi Vai River: stricter monitoring and guidelines in the future.
- Coastal forest protection and restoration.
- Reducing domestic and agricultural waste littering with centralized waste collection systems.



Relocating pumping wells (left); stakeholder meeting (centre); improving management of domestic waste (right)

Recommended adaptation measures for Hau Loc

- Improving water supply system to secure drinking and irrigation water quality.
- Increasing emergency routes and shelters, reducing exposure of citizens to storms and floods.
- Establishing centralized garbage container systems.
- Controlling and management of scattered small landfill sites to protect aquifers and secure good groundwater quality.
- Protecting most critical flood prone areas with dykes.
- Re-planting mangroves to protect the coastline.
- Environmental awareness raising for citizens
  especially in waste disposal and sustainable water management.




Vulnerability matrix (left); stakeholder meeting (centre); coastal protection with mangroves (right)

Further steps and way forward

- The methodologies, tools and results of VIETADAPT II project will be applied in other areas in Vietnam.
- CEWAFO and SIHYMECC utilize new skills and experiences from Finland to estimate local adaptation measures for other provinces as well. This has already started in the Mekong Delta.
- Co-operation with stakeholders to implement the suggested adaptation measures.
- Measures will be prioritized based on their feasibility, short- and long-term benefits and cost efficiency by applicable participatory approaches.
- Research results and monitoring are implemented to action plans and targeted guidelines.
- Dissemination of results continues ranging from local level stakeholder communication to international scientific community.
- Rising public awareness plays a key role and involvement of citizens to climate change adaptation and environmental protection is enhanced.



Managed aquifer recharge (left); waste treatment (centre left); landfill bottom lining (right)

Partnership

The VIETADAPT II project was funded by the Ministry for Foreign Affairs of Finland under the Institutional Cooperation Instrument (ICI). It was conducted by the Geological Survey of Finland (GTK), the Sub-Institute of HydroMeteorology and Climate Change (SIHYMECC) and the Center for Water Resources Warning and Forecast (CEWAFO).



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