CLIMATE RISK ASSESSMENT FOR WATER INFRASTRUCTURES:

A decision support tool for Investors & Planners

Dr. Nguyen Thi Minh Ngoc
Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)
E-mail: ngoc.nguyen1@giz.de; Tel: +84389663366

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

…investment gap and annual losses in Vietnam

Vietnam invests in infrastructure:
400,000 billion VND or USD 20 billion per year or around 9% of GDP.

…meets only 30 % of the investment needs of ministries and localities (MoF Report 2018).

Between 1998 and 2013 average annual losses of 1.5 % of GDP due to extreme weather events in Vietnam
(Vietnam University of Economics 2013; World Bank Report 2013)

giz

Have this infrastructure considered impacts of climate factors yet or not?

Bank erosion on 21/5/2018 in Can Tho, leading to completely collapse of 7 houses and urgent excavation of tens of other houses

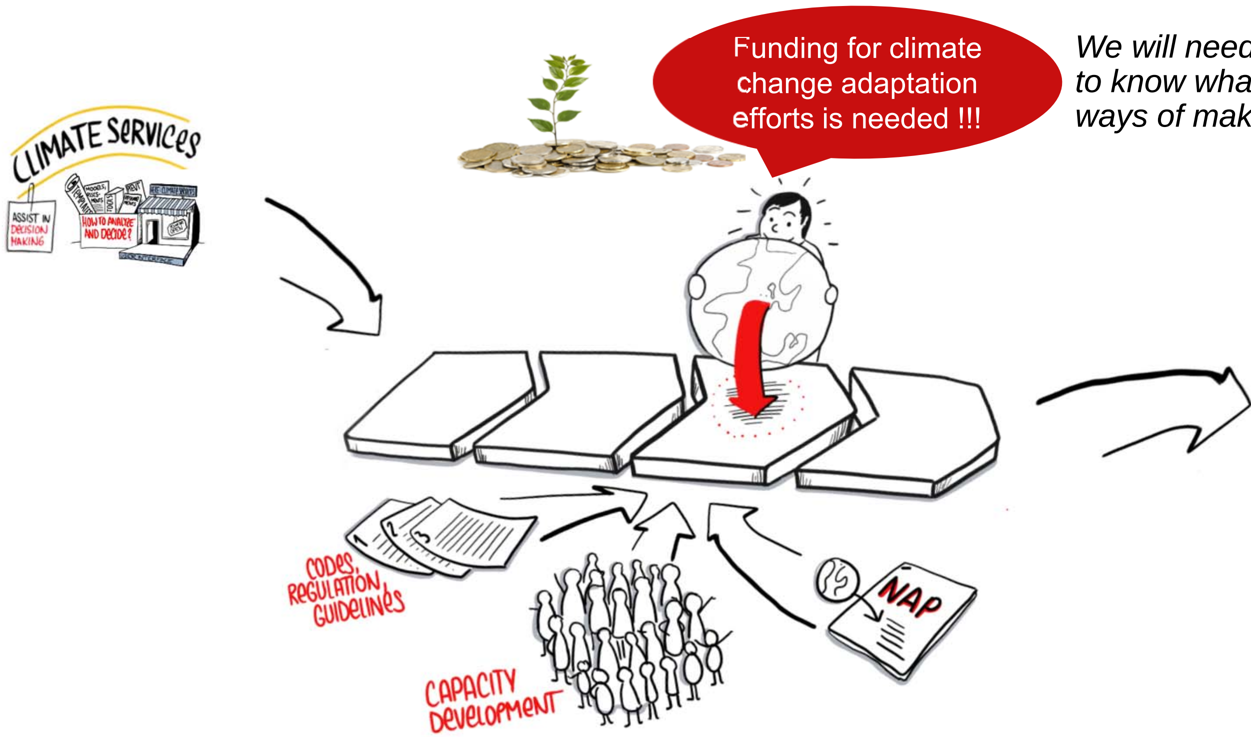
giz

"We have reached a pivotal moment. If we do not change course in the next two years, we risk runaway climate change. Climate change is moving faster than we are – and its speed has provoked a sonic boom SOS across our world. […] The real danger is not the threat to one's economy that comes from acting. It is, instead, the risk to one's economy by failing to act. Governments need to be courageous and smart. ***That means […] stopping investments in unsustainable infrastructure that lock in bad practices for decades to come****."*

UN Secretary General Guterres at UN General Assembly September 2018

Making infrastructure investments climate proof

Climate risk assessment as a means of National Adaptation Plan and Policy (NAP) implementation



We will need the right tools and information in order to know what are the most effective and efficient ways of making out infrastructure climate proof.

giz

Infrastructure Case – Vietnam

Cai Lon – Cai Be Sluice Gate System

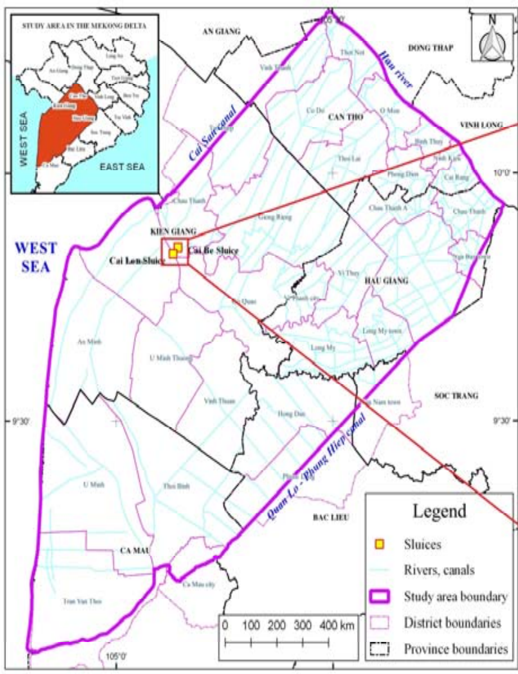
<u>Key facts</u>

- Mekong Delta an important region for rice cultivation, fishery & aquaculture
- Responsible for:
  - 90% of Vietnam's rice exports
  - 70% of aquaculture production
- Sluice gates needed to regulate water supply & for the separation of fresh and saltwater

Past climatic impacts in the Mekong Delta

- Heavy rain and extreme floods affect the region
- Damages of USD 71 million/year caused by storms and floods
- An extreme drought in 2016 caused massive crop failure, also through saltwater intrusion

- In this study, current and future climate risks have been assessed for the Cai Lon - Cai Be sluice gates project, which was classified into Group A of new construction works in Vietnam with a total state investment of 3,300 billion VND.
- The project was first proposed in 2006, and recently approved for investment by the Prime Minister and managed by the Hydraulic Project Investment and Construction Management Board No. 10 (PMU 10) under MARD
- The design life of the planned infrastructure is 100 years.



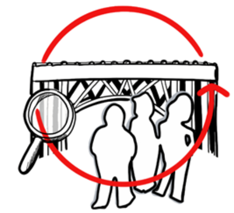
giz

Infrastructure Case – Vietnam Cai Lon – Cai Be Sluice Gate System

Summary of the Climate Information probability scores

Parameters	Threshold	Unit	Historical probability score	Future probability score
Climate				
High temperature	≥ 35^{0}C	Days/year	6	7
Heat wave	≥ 8 or more consecutive days with the maximum temperature ≥ 35^{0}C	Events/year	3	4
Heavy rain	≥ 100mm in a day	Days/year	4	5
Heavy 5-day total rainfall	≥250mm	Events/year	4	4
Tropical storms/depression	From level 8 (equivalent to the windy speed of 62 - 74km/h) or more	Events/year	3	4
Drought	K ≥ 4 in dry season	Drought events/30 years	5	6
High wind	≥ 20m/s	Days/year	4	4
Tornado	Fujita wind scale Based on the statistical data of the damages	Events/year	1	2
Thunderstorm/ Lightning	Based on the statistical data of the damages	Events/year	5	5
Hydrology				
Water level	0.9 m (design probability 5%)	Exceeding value/year	7	7
Salinity	3g/l	Exceeding value/year	7	7
Cumulative effects				
Salinity intrusion + high temperature	Salinity = 3g/l and high temperature ≥ 35^{0}C	Events/year	4	5
High water level + heavy rain	Water level ≥ 0.9 m and heavy rain ≥ 100mm/day	Events/year	2	4

Infrastructure Case – Vietnam Cai Lon – Cai Be Sluice Gate System



Climate Risk assessment matrix for future conditions

Time Period 2080 - 2099	Climate and Other Variables and Events															
Infrastructure Components	High Temperature >=35oC				Heat Wave (8 consecutive days >=35oC				Heavy Rain / >100mm/day				5-day Total Rain / >=250mm			
	A				B				C				D			
	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
1-Administration																
Personnel	Y	7	3	21	Y	4	6	24	Y	5	4	20	Y	4	3	12
Transportation (Supplies Delivery)									Y	5	2	10	Y	4	1	4
2-Sluice Gate Structure																
Pile foundation																
Waterproof pile foundation																
Pillar footing																
Bottom beam																
Pillar					Y	4	3	12								
Gate tower / Gate hanger					Y	4	2	8								
Cast-in-situ concrete composition					Y	4	3	12								
3-Ship Lock																
Lock chamber					Y	4	2	8								
Lock head					Y	4	2	8								
Filling and discharge culverts					Y	4	2	8								
Leading jetty					Y	4	2	8								
4-Gates (large and small)																
Hydraulic Cylinder																
Gates (large and small)																
Water tight gasket	Y	7	3	21	Y	4	6	24								
5-Bridge																
Bridge Surface					Y	4	4	16	Y	5	2	10				
Hand Rail																
Lighting System																
Traffic Sign Post																
6-Retaining walls and connected embankments (upstream and downstream of sluice gates)																
Retaining walls					Y	4	2	8								
Gabion																
Connected embankments					Y	4	2	8								
Rip-rap embankments section					Y	4	2	8								
Riverbank																
Stilling basin																
7-Operation house					Y	4	2	8	Y	5	2	10				
8-Park					V	4	3	12	Y	5	2	10				
9-Electric Power																
Transmission Lines									Y	5	2	10				
Power Supply									Y	5	2	10				
Standby Generators																
10-Control and operation system																
Control Systems																
Operation systems									Y	5	2	10	Y	4	1	4
11-Monitoring systems									Y	5	2	10	Y	4	1	4
12-Fire extinguishing systems																
13-Communication system									Y	5	2	10	Y	4	1	4

Infrastructure Components	Tropical Storm/Depression				Drought				High Wind >=20 m/s				Tornado			
	E				F				G				H			
	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
1-Administration																
Personnel	Y	4	7	28	Y	6	3	18	Y	4	4	16	Y	2	7	14
Transportation (Supplies Delivery)	Y	4	7	28									Y	2	7	14
2-Sluice Gate Structure																
Pile foundation																
Waterproof pile foundation																
Pillar footing																
Bottom beam																
Pillar																
Gate tower / Gate hanger																
Cast-in-situ concrete composition																
3-Ship Lock																
Lock chamber																
Lock head																
Filling and discharge culverts																
Leading jetty																
4-Gates (large and small)																
Hydraulic Cylinder																
Gates (large and small)	Y	4	6	24					Y	4	5	20	Y	2	4	8
Water tight gasket																
5-Bridge																
Bridge Surface													Y	2	2	4
Hand Rail													Y	2	2	4
Lighting System																
Traffic Sign Post																
6-Retaining walls and connected embankments (upstream and downstream of sluice gates)																
Retaining walls																
Gabion																
Connected embankments					Y	6	4	24								
Rip-rap embankments section																
Riverbank																
Stilling basin																
7-Operation house	Y	4	3	12					Y	4	2	8	Y	2	6	12
8-Park	Y	4	7	28	Y	6	4	24	Y	4	4	16	Y	2	7	14
9-Electric Power																
Transmission Lines	Y	4	5	20					Y	4	4	16	Y	2	7	14
Power Supply	Y	4	3	12									Y	2	3	6
Standby Generators													Y	2	3	6
10-Control and operation system																
Control Systems	Y	4	7	28												
Operation systems	Y	4	5	20												
11-Monitoring systems	Y	4	7	28									Y	2	7	14
12-Fire extinguishing systems																
13-Communication system	Y	4	7	28					Y	4	4	16	Y	2	7	14

Infrastructure Components	Thunderstorm/ Lightning				Water Level				Water Salinity				Salinity intrusion combined with high temperature				High water level combined with heavy rain			
	I				K				L				L				L			
	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R	Y/N	P	S	R
1-Administration																				
Personnel	Y	5	7	35																
Transportation (Supplies Delivery)																				
2-Sluice Gate Structure																				
Pile foundation																				
Waterproof pile foundation																				
Pillar footing																				
Bottom beam																				
Pillar						7	2	14	Y	7	2	14	Y	5	4	20	Y	4	2	8
Gate tower / Gate hanger																				
Cast-in-situ concrete composition									Y	7	2	14	Y	5	3	15				
3-Ship Lock																				
Lock chamber						7	4	28	Y	7	2	14	Y	5	4	20	Y	4	5	20
Lock head						7	4	28	Y	7	2	14	Y	5	4	20	Y	4	5	20
Filling and discharge culverts									Y	7	2	14	Y	5	3	15				
Leading jetty									Y	7	2	14	Y	5	3	15				
4-Gates (large and small)																				
Hydraulic Cylinder									Y	7	3	21	Y	5	4	20				
Gates (large and small)					Y	7	4	28	Y	7	3	21	Y	5	4	20	Y	4	4	16
Water tight gasket									Y	7	2	14	Y	5	4	20				
5-Bridge																				
Bridge Surface																				
Hand Rail																				
Lighting System																				
Traffic Sign Post																				
6-Retaining walls and connected embankments (upstream and downstream of sluice gates)																				
Retaining walls									Y	7	2	14	Y	5	3	15				
Gabion																				
Connected embankments									Y	7	2	14	Y	5	3	15				
Rip-rap embankments section									Y	7	2	14	Y	5	3	15				
Riverbank																				
Stilling basin																				
7-Operation house	Y	5	1	5																
8-Park	Y	5	7	35																
9-Electric Power																				
Transmission Lines	Y	5	7	35																
Power Supply	Y	5	7	35																
Standby Generators	Y	5	7	35																
10-Control and operation system																				
Control Systems	Y	5	7	35																
Operation systems	Y	5	7	35																
11-Monitoring systems	Y	5	7	35																
12-Fire extinguishing systems																				
13-Communication system	Y	5	7	35																

Risk = Probability x Severity

Climate risk based Recommendations

Order	Infrastructure components under risk	Proposed measures for climate proofing the infrastructure
1	Pillars, ship locks, etc.	To refer to the materials that have been applied for reducing concrete corrosion in Vietnam; for example, using sulphate resistant cement, anti-corrosion additive mixture, or high grade concrete (M50);
2	Hydraulic cylinders, gates, etc.	To study on mechanisms and causes of metal corrosion in the MKD to have the suitable prevention measure such as using a stainless steel as applied to bridges;
3	Pillars, ship locks, hydraulic cylinders, gates, etc.	To consider the use of the high-quality paintings for concrete and metal to prevent corrosion, such as epoxy painting method as recommended by Vietnam Academy for Water Resources and US Army Corps of Engineers (USACE).
4	Operation systems (Group C)	To consider underground wiring designs to ensure safety under thunderstorms/lightning, tornado or in the rainy season, and no splices/cable junctions at risk (i.e. wet) areas;
5	The whole infrastructure	To design lightning protection systems for the whole infrastructure as applied for Rach Chanh sluice gate in Long An Province;
6	Monitoring system	To select SCADA system (sensor) with high tolerance, as experienced in the sluices gate in Tra Vinh Province;
7	Operation and maintenance staff	To have trainings for staff about the climate/hydrological risks on the infrastructure, and how to cope with the extreme events with the low probability scores (e.g., tropical storms and tornado);
8	Operation and maintenance staff	To use protective equipment and clothing as working outdoors under the high temperature, heavy rain, tropical storms, high wind, tornado or thunderstorms/lightning;
9	Operation and maintenance staff	To use the automatic operation mode or choose the time of proper maintenance in the condition of heat wave, for example, in the afternoon when the temperature is reduced.

FROM RECOMMENDATION TO ADJUSTMENT

(Adjustment of the Cai Lon – Cai Be Sluice Gate Project during Technical Design and Blueprints)

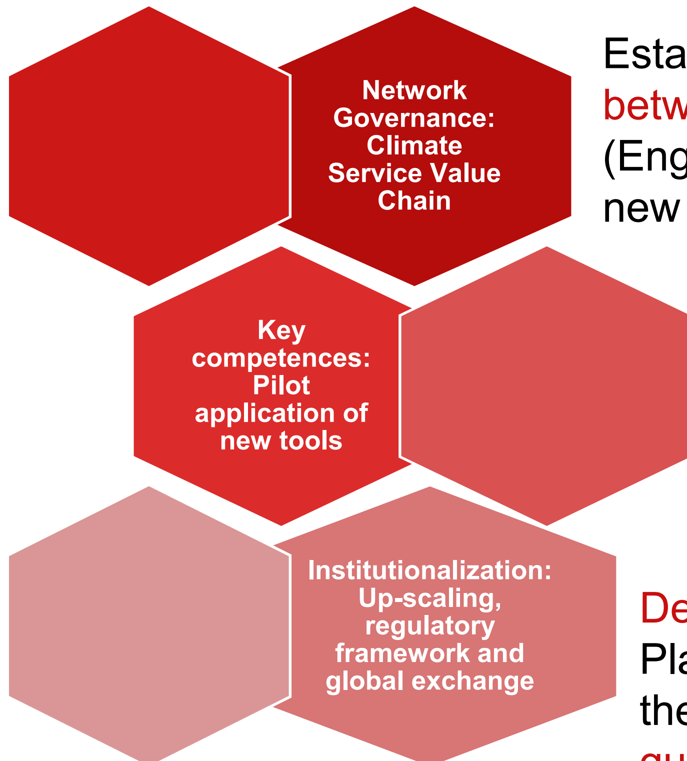
giz

Success Factors and Results so far

Pilot application, testing, learning, experience sharing of a new climate risk assessment protocol for infrastructure;

User-provider exchange on needed climate information;

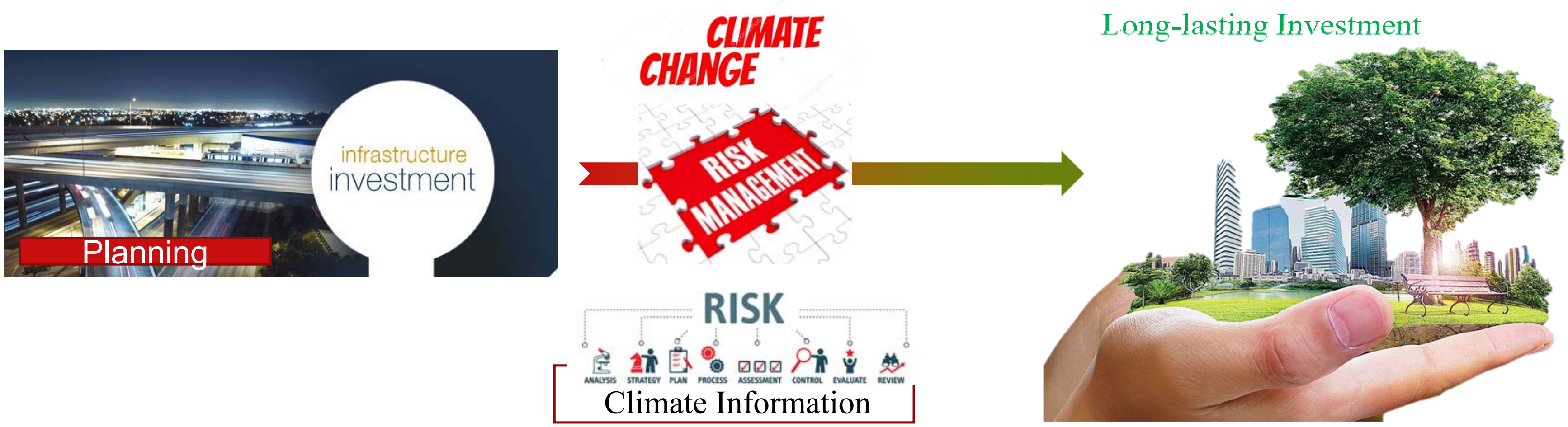
Application of international tools to elaborate extreme weather projections



Established new cooperation between NHMA, MARD (Engineers); Multipliers for new approaches and tools

Integration into Plans: Decree 37 Planning of the Planning Law; Irrigation Plan for the Mekong Delta and SEDP guideline in 3 MKD provinces

This showcase proved that tools, like climate risk assessments, can help infrastructure investors and planners to find out where best to spend adaptation funding and find both, critical components in a single infrastructure as well as highly vulnerable infrastructures in national portfolio.



OUTLOOK FOR FUTURE

- *To pilot and demonstrate a service of climate risk assessment for infrastructure in Vietnam*
- *To recommend adaptation measures for managing climate risk on infrastructure projects*
- *To mainstream consideration of climate risk in planning process and policy framework, for future climate-informed investment decisions*

Thank you!

Email: csi@giz.de

Find out more about what GIZ does on climate change adaptation at www.adaptationcommunity.net

Check out our video to learn more about CSI: https://www.youtube.com/watch?v=4sTBWQEC2TA

Contact Vietnam

Mrs. Nguyen Thi Minh, Ngoc
Advisor

Ngoc.nguyen1@giz.de
in Hanoi

Mr. Benjamin Hodick
Head of project

Benjamin.hodick@giz.de
in Bonn

www.giz.de

https://twitter.com/giz_gmbh
https://twitter.com/adapt_community

https://www.facebook.com/gizprofile/