Method Brief

Thailand: Vulnerability assessment and prioritization of EbA measures in river basins

Rationale

Increasing and repeating flood and drought events pose additional threats to the rural population of Thailand causing freshwater scarcity, lack of income from agriculture and damage to infrastructure. The Government of Thailand supported by GIZ has applied a stepwise method for assessing key vulnerabilities and identifying feasible EbA measures in three river basins to improve adaptive capacity of the rural population. The method has potential for further replication. Based on its successful application the government allocated additional 20 million Euro for a further replication of EbA measures.

Hazards addressed
Floods, droughts

Ecosystem type
Freshwater ecosystems, rivers

Scale
Local, watershed, national level

Target audience
Project planners & managers

Phase of adaptation cycle

Scope & entry points

The approach was designed by the Government of Thailand with support from GIZ to identify major vulnerabilities and prioritize ecosystem-based adaptation measures for flood & drought risk reduction in three river basins (pilot areas). It supports the implementation of sustainable and locally adapted approaches in partnership with existing river basin comittees and addresses the Nationally Determined Contribution (NDC) adaptation priority 1 to 'promote and strengthen integrated water resource management practices'. It is also in line with the King of Thailand's Sufficiency Economy Philosophy to apply technologies based on local resources and know-how.

Actors

The leading instution for the method application was the Department of Water Resources (DWR) of the Ministry of Natural Resources and Environment of Thailand under the Project *Improved Management of Extreme Events through Ecosystem-based Adaption in Watersheds* (ECOSWat) supported by GIZ and SYDRO Consult Germany. Local universitities including Khon Kaen University and Walailak University played a key role in the piloting of this method and further replication.

River basin committees, communities as well as private sector representatives were involved during the process including the provision of expert knowledge on potential measures and their feasibility as well as local acceptance.

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

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

How it works

The method was piloted in a participatory approach involving government agencies, universitites, communities and private sectors. It followed a six-step approach to identify key vulnerabilities and assess potential adaptation options. The approach was based on the Global International Water Assessment Methodology (GIWA) and Hydropower Sustainability Assessment Protocol (HSAP) as follows:

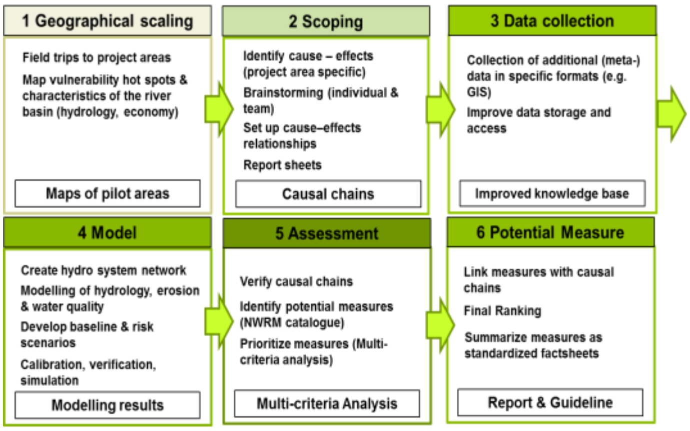


Figure 1: Steps and outputs of the approach

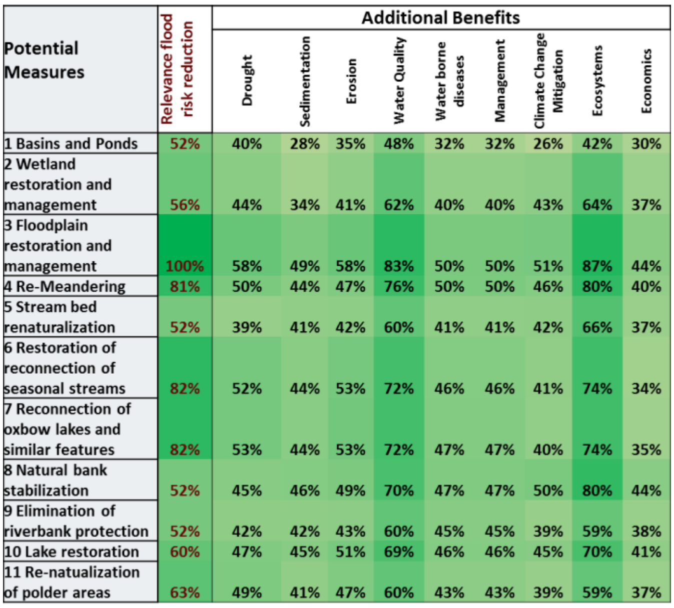
Step 1 – Geographical scaling: The work started with field trips to the three river basins in order to define the geographic boundaries and sub-regions of the assessment area. Major hydrological system features and economic activities as well as highly affected areas (vulnerability hot spots) were mapped out. ***Output: Maps of pilot areas***

Step 2 – Scoping: Through a series of meetings with representatives from local governments, river basin committees, communities, universities and the private sector, the assessment team conducted an analysis of environmental and socio-economic vulnerabilities as well as previous and potential flood/drought impacts. Major concerns of stakeholders were explored and underlying root causes of flood and drought risk analysed. Primary data was collected on sector activities (e.g. land use), damage to property (e.g. infrastructure and farmland), observed trends in weather and seasonal patterns (e.g. increase in rainfall intensity during wet season) and potential root causes (e.g. lack of integrated watershed planning, unstustainable land use). Based on this bottom up assessment, project area specific cause & effect relationships (impact chains) were establised. ***Output: Causal chains for major concerns (impacts)***

Step 3 – Data collection: To verify the observations and the assumptions made for the causal chains, additional data (climate, topography, land use, etc.) was collected in specific formats (e.g. GIS) to allow for further hydrological modelling as a scientific basis for the assessment. ***Output: Improved dataset (GIS and hydrological models) & knowledge base for further assessment.***

Step 4 – Modelling: This step allowed a verification and quantification of cause and effect relationships with physically deterministic or conceptual models covering
a) hydrologic modeling with the TalsimNG software 2.2,
b) erosion and sedimentation modeling using the Modified Uniform Soil Loss Equation (MUSLE), and
c) water quality modeling with the Global Integrated Sustainability Model (GISMO) software.
The modelling established a baseline scenario and a series of potential risk scenarios for water availability and water flow intensity in relation to floods and droughts; modelling was based on various parameters such as precipitation, land use and economic activities. Different scenarios were applied for land use change and crop patterns, erosion/sedimentation, water quality and water management. The climate change modelling as part of the vulnerability analysis was carried out with observed hydro-meteorological time series, covering past and present conditions. The future hydrological regime was modelled by using global circulation models (GCM) that have been downscaled and applied to hydrological models. The simulation covered a time period of 90 years, from 2010 up to 2100, representing a possible pathway for future conditions. ***Output: Hydrological model with different risk scenarios***

Step 5 – Assessment & prioritization of potential measures: Based on the improved hydrological model, the cause and effect relationships could be verified by taking into consideration risks and uncertainties. Potential ecosystem-based adaptation measures were identified based on a decision making tool inspired by the European Natural Water Retention Measures (NWRM) Platform that a guidance document and a catalogue of more than 40 natural water retention measures structured along the sectors agriculture, forest management, hydro-morphology and urban planning. The decision making tool was an Excel-based matrix for the Multicriteria Analysis (MCA).



Potential Measures	Relevance flood risk reduction	Additional Benefits								
		Drought	Sedimentation	Erosion	Water Quality	Water borne diseases	Management	Climate Change Mitigation	Ecosystems	Economics
1 Basins and Ponds	52%	40%	28%	35%	48%	32%	32%	26%	42%	30%
2 Wetland restoration and management	56%	44%	34%	41%	62%	40%	40%	43%	64%	37%
3 Floodplain restoration and management	100%	58%	49%	58%	83%	50%	50%	51%	87%	44%
4 Re-Meandering	81%	50%	44%	47%	76%	50%	50%	46%	80%	40%
5 Stream bed renaturalization	52%	39%	41%	42%	60%	41%	41%	42%	66%	37%
6 Restoration of reconnection of seasonal streams	82%	52%	44%	53%	72%	46%	46%	41%	74%	34%
7 Reconnection of oxbow lakes and similar features	82%	53%	44%	53%	72%	47%	47%	40%	74%	35%
8 Natural bank stabilization	52%	45%	46%	49%	70%	47%	47%	50%	80%	44%
9 Elimination of riverbank protection	52%	42%	42%	43%	60%	45%	45%	39%	59%	38%
10 Lake restoration	60%	47%	45%	51%	69%	46%	46%	45%	70%	41%
11 Re-natualization of polder areas	63%	49%	41%	47%	60%	43%	43%	39%	59%	37%

Figure 2: Multicriteria analysis matrix

It was used to compare the relevance of different potential measures for mitigating flood risk. In a second step the prioritization included an analysis of additional benefits of the measures for erosion prevention, water quality improvement, reducing the risk of water-bourne diseases, climate change mitigation, natural habitat provision and positive economic impacts. The result was a percentage based, index-like rating of measures reflecting the aggregated sums of all benefits, in which the highest score of 100% indicated the most suitable measures.Prioritization was done jointly with partners and local stakeholders. ***Output: Multicriteria analysis of potential measures***

Step 6 – Selection of measures: In a final step, the preselected measures were linked with the verified cause and effect chains by taking into consideration topographic features of the river basins (upstream, downstream, floodplain). EbA measures were selected based on the results of the multicriteria analysis, the state of ecosystems and a mapping of potential locations within the river basin to assess their feasibility based on the topographic features, land use and available space. Consequently a combination of different EbA measures that mutually reinforce each other were proposed for the pilot sites. Measures were summarized and documented as fact sheets in a specific format covering the following information: Name, location, illustration of measure, description, purpose, replicability, complementary measures, effects (on site, upstream, downstream), stakeholders, beneficiaries, legal concerns, structural work requirements, work plan, cost estimates, maintenance, pro- and contra arguments, possible location for implementation. ***Output: A catalogue of proposed EbA measures based on standardized factsheets***

Specifics of application

Input

Methods & data requirements:

- Available datasets (e.g. GIS) of digital elevation models and time series for water discharge, precipitation, temperature, humidity, evapotranspiration.
- Hydrologic modeling with TalsimNG software 2.2,
- Erosion and sedimentation modeling with Modified Uniform Soil Loss Equation (MUSLE)
- Water quality modeling with GISMO software.
- Excel spreadsheet for multicriteria analysis
- Drone technology for water monitoring (optional)

Time requirements: The entire piloting of the six-step process for all river basins took 2 years. For each basin, the vulnerability analsysis required up to 12 weeks. The MCA took 3 days. However, the systematic documentation of the process by the project will allow to save time during a further replication of the method in other sites. The time input very much depends on the size and complexity of the river basin, land use systems as well as sectors and actors involved.

Expertise required:

- Hydrological experts from government and/or universities, private sector
- Hydrological engineers from universities, private sector
- Natural resource management & legal experts from government and/or universities, private sector
- Experts from local organizations (e.g. river basin committees) with knowledge on local and traditional land use patterns, economic priorities

(Financial) resources required: For piloting the method in one riverbasin an average budget of 185.000 EUR was used including following items: stakeholder consultation (int. advisors: 20.000 EUR / local advisors: 15.000 EUR),vulnerability assessment (int. advisors: 50.000 EUR /local advisors: 15.000 EUR), multicriteria analysis (int. advisors: 25.000 EUR / local advisors: 15.000 EUR), economic evaluation (int. advisors: 30.000 EUR / local advisors: 15.000)

Output

- GIS dataset (digital elevation model, land use maps)
- Local climate change scenarios (2010-2100)
- Scenarios for land use change and crop patterns, erosion/sedimentation, water supply, storage, quality and management under different climate impacts
- Cause and effect chains for major concerns (impacts)
- Hydrological model with different risk scenarios
- Multicriteria analysis (MCA) of potential measures
- A catalogue of proposed EbA measures based on standardized factsheets
- Awareness for EbA-based flood risk reduction among decision makers and local stakeholders raised
- Expertise of local universities improved

Conclusions for replication

- Besides the expert knowledge of scientific institutions and hydrological engineers it was crucial to actively cooperate with local stakeholders to ensure that they are part of the decisions making processes and that their prioritized problems are tackled.
- The state of ecosystems and their ecosystem services needs to be carefully analysed in order to guarantee the functionality of the necessary ecosystems.
- Different data, e.g. on discharge, evaporation, humidity, temperature, etc., is owned by different institutions. Institutions tend to not actively share their data as there is rarely an incentive for it. This needs to be considered as early as possible in planning the assessment process.
- Local wisdom and knowledge needs to be systematically integrated into the method application to ensure ownership among local stakeholders.
- The project used drones to collect additional data on river discharge. Drone application is becoming increasingly popular and affordable but requires capacity building of local actors to manage the further application.
- Datasets were partly incomplete and often based on expert knowledge assumptions. The missing information does not allow to analyze and quantify

- certain effects, therefore the results of the assessments still include uncertainties.
- Addtional benefits of the measures need to be systematically considered during the prioritization phase.
- The options as identified by the MCA were not always the most feasible ones. Additoinal criteria were subsequently included in the analysis including public acceptance, land availablility, topography etc.
- The prioritization tool can only be applied for a rapid assessment (1-2 weeks) to provide a good indication on most feasible options but it can not replace a solid and full analysis with field visits including consultations of local actors.

References

H. Lohr. 2015. *Vulnerability analysis for the river basins of Huai Sai Bat, Tha Di and Trang,* Department of Water Resources, Ministry of Natural Resources and Environment, Thailand/GIZ, 2015, (link)

H. Lohr. 2015. *Pre-selection and Preparation of Ecosystem-based Measures in the Pilot Areas Huai Sai Bat and Tha Di for discussion and fina decision-making in collaboration with local water committees.* Department of Water Resources, Ministry of Natural Resources and Environment, Thailand/GIZ, 2015, (link)

P.Strosser, G.Delacámara, A.Hanus, H.Williams and N.Jaritt. 2015. *A guide to support the selection, design and implementation of Natural Water Retention Measures in Europe - Capturing the multiple benefits of nature-based solutions.* European Comission. Final version, April 2015. (link)

EbA Solutions Portal under the PANORAMA Web-Platform. *Ecosystem-based flood and drought management in river basins.* April 2017 (link)

Contacts for further information

- Roland Treitler, GIZ Project Director (roland.treitler@giz.de)
- Jaruwan Ngamsing GIZ Project Officer (jaruwan.ngamsing@giz.de)
- Dr. Hubert Lohr, Hydrological Expert (h.lohr@sydro.de)
- Mr Suthira Thongkao, Researcher, Walailak University (iamsuthira@gmail.com)

Published by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Office Bonn
Global Project “Mainstreaming Ecosystem-based Adaptation (EbA)”
Heinrich-von-Stephan-Str. 7-9,
53175 Bonn, Germany

www.giz.de
As at November 2016

GIZ is responsible for the content of this publication.

On behalf of Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)

Division: Environment and Sustainable Use of Natural Resources

Addresses of the BMUB offices
BMUB Bonn: Robert-Schuman-Platz 3, 53175 Bonn, Germany
BMUB Berlin: Stresemannstraße 128 – 130, 10963 Berlin, Germany

poststelle@bmub.bund.de www.bmub.bund.de