



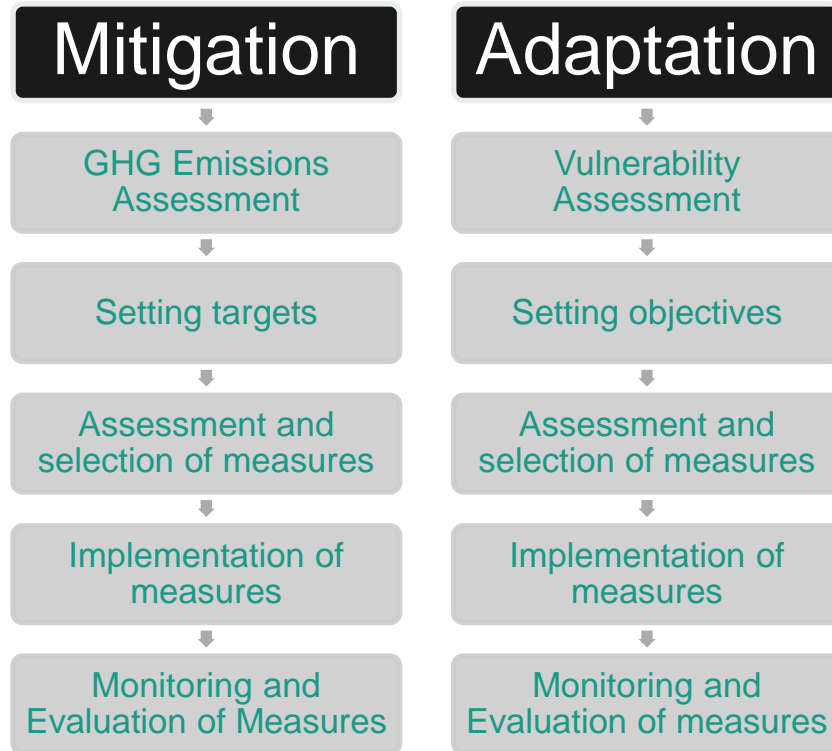
# Decision Support and Assessment Tools for Climate Change

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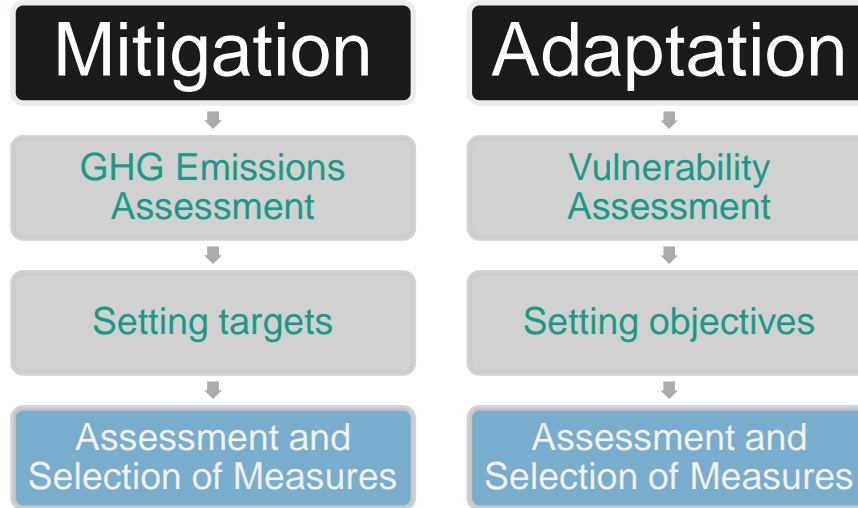
# Session Outline

- Steps for Climate Change Planning
- Decision Support and Assessment Tools
- Comparison of Tool Requirements
- Strengths and limitations
- Where have been these applied?
- Multiple Criteria Analysis (MCA)
- Main steps of MCA
- Challenges of MCA
- Applications of MCA

# Steps for Climate Change Planning



# Step 3: Assessment and Selection of Measures



Which actions (policies, measures, initiatives) can you identify to achieve the set targets or objectives?

After identifying the actions, how do you select which ones to implement first (a process called prioritization)?

# Decision Support and Assessment Tools

## Cost Benefit Analysis

The **benefits** of climate change actions should far outweigh the **costs**

However, is it **possible to monetize all costs and benefits?** **NO**

## Cost Effectiveness Analysis

Assessing the costs and effectiveness **in a comparable way**

If two (or more) actions can provide the **same benefits**, which one offers the **least cost**?

## Multiple Criteria Analysis

In choosing **multiple actions (more than two)**, what **multiple objectives** can be met aside from climate adaptation or mitigation benefits?

How important are these objectives among **multiple stakeholders**?

# Strengths and Limitations

CBA

*Proven and widely used*  
*Project or policy specific*  
*Focused on the efficiency of options*  
*Limited only to impacts measurable in monetary terms*  
*Aims to minimize costs or maximize benefits*  
*Absolute quantification of costs and benefits*

CEA

*Focused on identifying the least cost option*  
*Quantification of costs in monetary terms*  
*Benefits can be quantified but not monetized e.g. reduction of climate risk or reduction of carbon emissions*  
*Time consuming (and data intensive) like CBA*

MCA

*Considers multiple objective or criteria*  
*Transparent and comprehensive analysis*  
*Costs and benefits can be quantified but not monetized*  
*Benefits cannot all be measured in quantitative terms, therefore the use of qualitative assessments*

# Comparison of Tool Requirements

Tools	Technical Capacity	Data Needs	Time	Cost \$	Participant Requirements
CBA	★★★★	★★★★	★★★★	★★★★	★★
CEA	★★★★	★★★★	★★★★	★★★★	★
MCA	★★★★	★★★	★★★★	★★★★	★★★

★ = Low Requirements ; ★★ = Medium Requirements  
★★★ = High Requirements; ★★★★ = Very High Requirements

# Where have these been applied?



		CBA	CEA	MCA
High Income	Mitigation			
	Adaptation			
Middle / Low Income	Mitigation			
	Adaptation			



# Relevance of MCA

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- MCA provides a great opportunity to link climate change policy with other development objectives, enhance participation of different stakeholders and increase the learning through the climate interventions prioritization process
- UNFCCC has proposed MCA as one of the most appropriate methods to support national governments to develop their National Adaptation Programme of Actions (the so called NAPAs)
- UN Habitat has also suggested MCA method as the main prioritization technique to support Local Governments to develop local climate change action plans.



# Multiple criteria analysis

“It is a **transparent process** which seeks to take explicit into account **multiple criteria** in helping individuals or groups to **evaluate different actions** and explore decision problems that matters”

# MCA: Structural Elements

Multiple  
Options

Aids the assessment  
of different of  
different policies,  
measures, or options

Multiple  
Criteria

Uses a set of  
different evaluation  
criteria (not just  
monetary)

Multiple  
Stakeholders

Integrates the  
perspectives of  
different  
stakeholders

# MCA: Characteristics

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Includes both  
quantitative and  
qualitative  
criteria

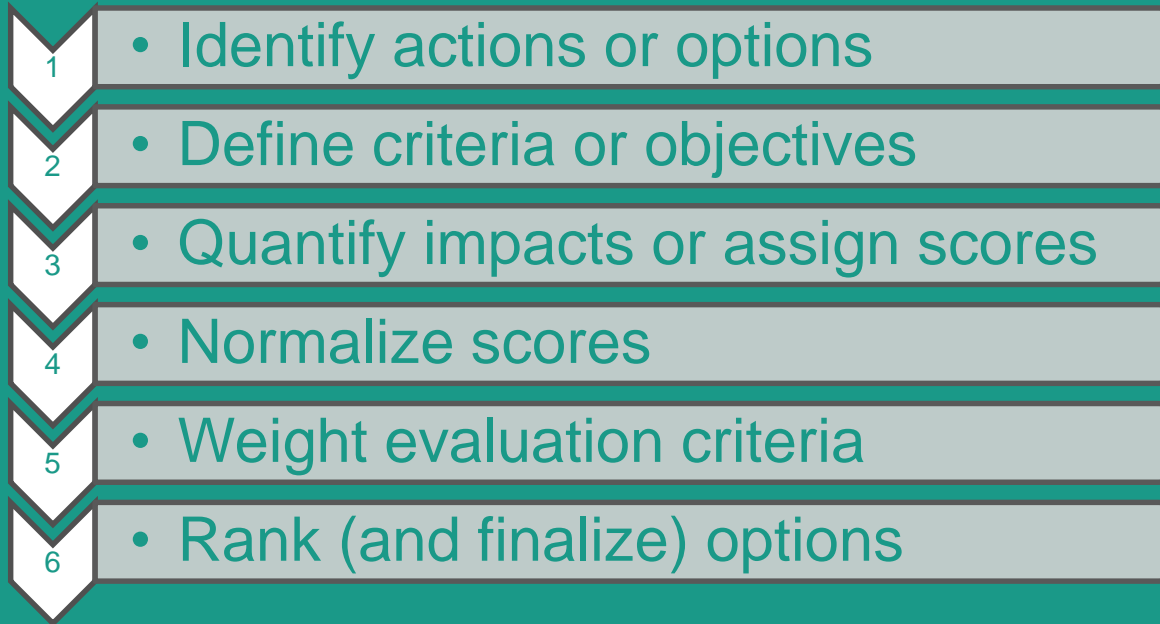
Stimulates  
dialogue and  
engagement

Learning and  
knowledge  
generation

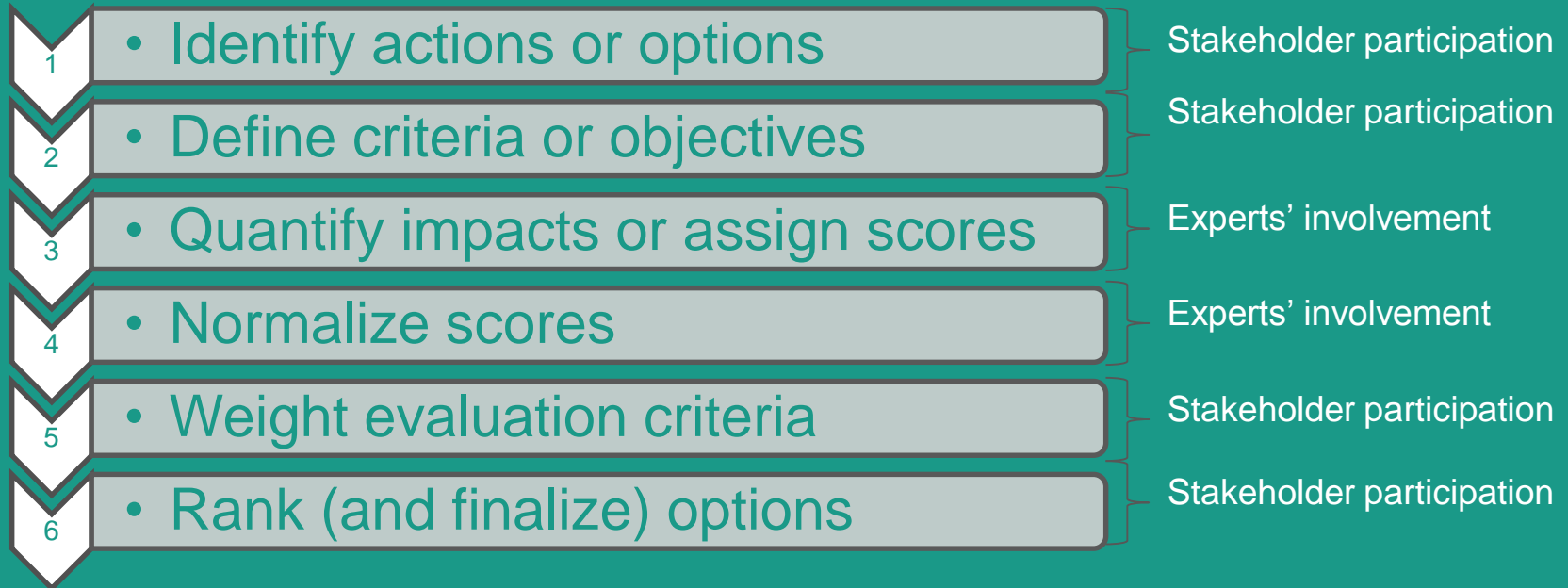
Certain degree  
of subjectivity in  
the process

Brings together  
different  
stakeholders  
together

# Main Steps



# Main Steps



# Hypothetical Case Study

Decision Problem: City A is facing problems with riverine flood. Due to climate change, the flood problem is expected to be intensified in the future. What potential actions could help reduce vulnerability within the city?



# MCA: Identify actions or options (with stakeholders)



Different city stakeholders recommended three adaptation actions to tackle the flood problem:

- Flood wall
- Flood wall with green area
- Green area (for water retention)



# MCA: Define criteria or objectives (with stakeholders)

Criteria	Indicators	Flood wall	Flood wall with green area	Green area
Cost	Total cost (million \$)			
Effectiveness	Risk reduction (---/+++)			
Flexibility	Level of adaptiveness (1-5)			
Co-benefits	Green public space (km2)			
Implementation	Ease of implementation (---/+++)			

Use of different indicators with different measurement units and scales that could be either quantitative and qualitative

# MCA: Quantify impacts or assign scores (with experts)

Criteria	Indicators	Flood wall	Flood wall with green area	Green area
Cost	Total cost (million \$)	40	25	20
Effectiveness	Risk reduction (---/+++)	+++	++	+
Flexibility	Can be based on impact studies, modelling approaches, or expert judgments	2	3	4
Cost-effectiveness	Scores are in different measurements scales – which brings us to the next step: normalization!	1	7,5	10
Implementation	Ease of implementation (---/+++)	-	--	---

# What is normalization?



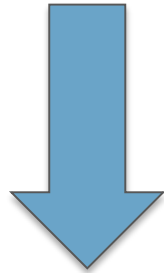
Normalization is converting different measurement scales into one unit-less scale to make the different aspects comparable.

# MCA: Normalize scores

Criteria	Indicators	Flood wall	Flood wall with green area	Green area
Cost	Total cost (million \$)	40	25	20

All these needs to be translated into a unit less scale, from 0 to 1, with 0 being the highest cost option and 1 being the least cost option. Note: 1 is the best, 0 is the worst.

Criteria	Indicators	Flood wall	Flood wall with green area	Green area
Cost	Total cost (million \$)	40	25	20



$$x = \frac{\max - 25}{\max - \min} = \frac{40 - 25}{40 - 20} = 0,75$$

Criteria	Indicators	Flood wall	Flood wall with green area	Green area
Cost	Total cost (million \$)	0	0,75	1

# MCA: All normalized scores

Criteria	Flood wall	Flood wall with green area	Green area
Cost	0	0.75	1
Effectiveness	1	0.67	0.33
Flexibility	0	0.5	1
Co-benefits	0	1	0.5
Implementation	0.67	0.33	0

# MCA: Weighting evaluation criteria (with stakeholders)



- Weighting is necessary as not all criteria will have the same importance depending on the context.
- Not every city and local government prioritize criteria in the same way.
- Similarly, stakeholders involved in such decisions have different priorities and therefore allocate different importance or weights against the criteria.
- NGOs and private sector representatives will have different priorities than corporations and governments.
- Stakeholders therefore should express their preferences within the process and state the reasons behind the importance of their objectives.

# MCA: Methods for weighting evaluation criteria



## Pairwise Comparison

(How more important is x criterion than y criterion?)

## Direct Allocation

(Assigning 100 points among the criteria based on their relative importance)



# MCA: By direct allocation method

Rank	Criteria	Weight
1	Cost	0.36
	Effectiveness	0.36
2	Implementation	0.16
3	Flexibility	0.06
	Co-benefits	0.06

High Priority

100 points = 1.0

1.00

# Calculating Weighted Sum

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**Weight of the  
criterion**

**×**

**Normalized  
Score**

**=**

**Weighted  
Sum**

# MCA: Outcomes of the MCA Process

Criteria	Green Area		
	Weight of the criterion	Normalized score	Weight of the criterion x Normalized Score
Cost	0.36	1	0.36
Effectiveness	0.36	0.33	0.12
Implementation	0.16	0	0
Flexibility	0.06	1	0.06
Co-benefits	0.06	0.5	0.03
		Weighted Sum	0.57

Criteria	Green area			Flood wall with green area			Flood wall		
	Weight of the criterion	Normalized score	Weight of the criterion x Normalized Score	Weight of the criterion	Normalized score	Weight of the criterion x Normalized Score	Weight of the criterion	Normalized score	Weight of the criterion x Normalized Score
Cost	0.36	0.33	0.12	0.36	0.67	0.24	0.36	1	0.36
Effectiveness	0.36	1	0.36	0.36	0.75	0.27	0.36	0	0.11
Implementation	0.16	0	0	0.16	0.33	0.05	0.16	0.67	0.05
Flexibility	0.06	1	0.06	0.06	0.5	0.03	0.06	0	0
Co-benefits	0.06	0.5	0.03	0.06	1	0.06	0.06	0	0
		Weighted Sum	0.57		Weighted Sum	0.65		Weighted Sum	0.52

0.65

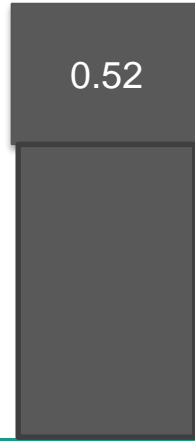
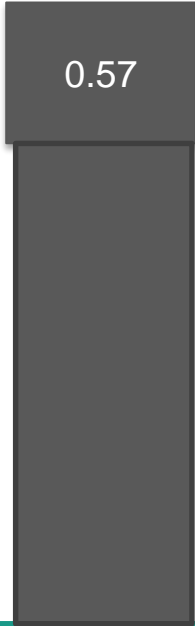
0.57

0.52

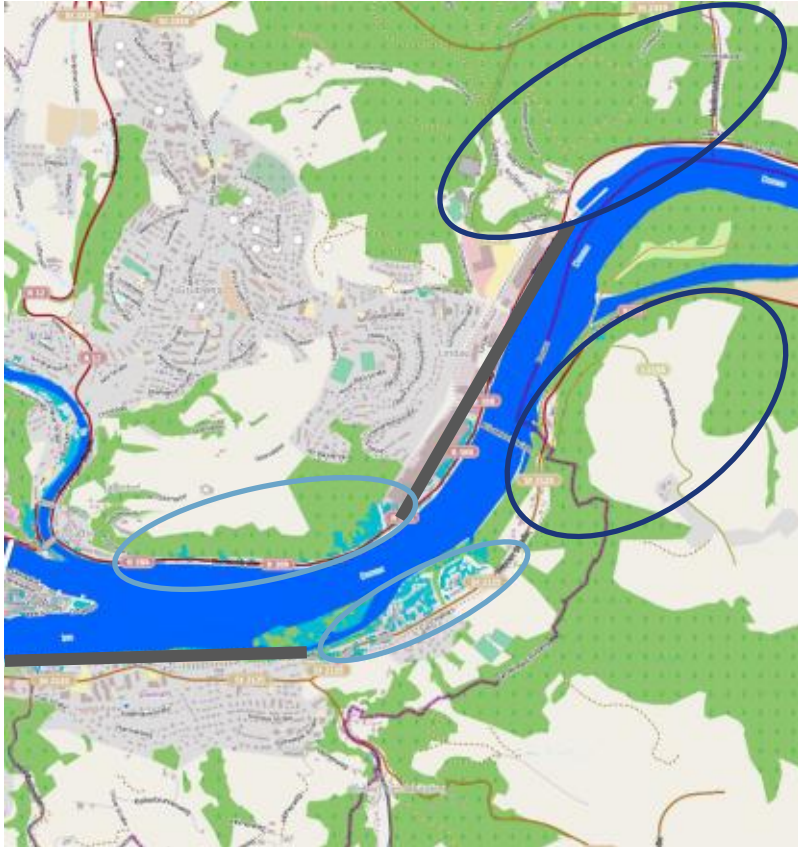
Flood Wall With Green Area

Green Area

Flood Wall



# Which action is the most suitable to implement?



- Flood wall
- Flood wall with green area
- Green area (for water retention)

## Action: Flood Wall With Green Area

0.65

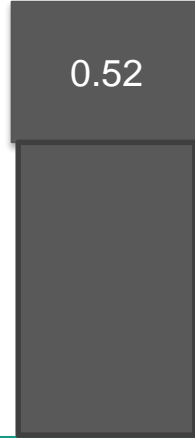
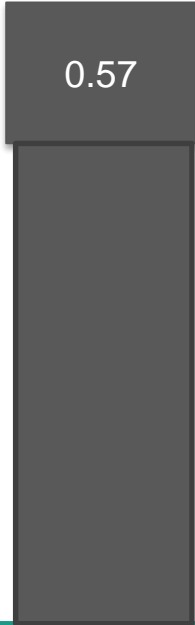
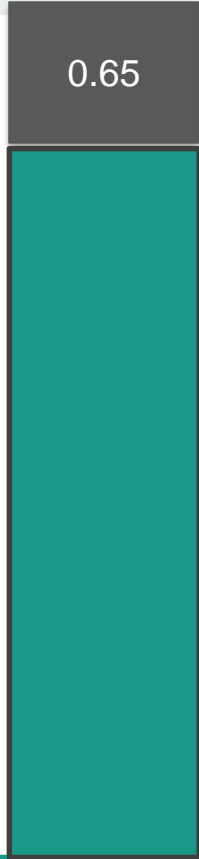
0.57

0.52

Flood Wall with Green Area

Green Area

Flood Wall





## Notes:

- Final ranking is dependent on input variables, scores, and weights
- Final ranking is determined by subjective factors e.g. criteria weights
- During the scoring, an objective quantification is conducted
- The weighting is the subjective part of the process
- Decision makers and/or stakeholders state the relative importance of the evaluation criteria





# MCA: Opportunities

- Allows multiple perspectives or views (stakeholder engagement)
- Incorporates different measurement scales
- Provides transparency and structure
- Triggers discussion between stakeholders
- Knowledge generation



# MCA: Challenges

- High degree of subjectivity
- Difficult to reach consensus on weights of criteria
- Requires intensive participation process
- Depends on stakeholders willingness to participate

# MCA: Applications in Climate Change Adaptation



- **National level**
  - National Adaptation Programmes of Action (NAPAs), 46 Least Developed Countries (LDCs)
  - National Climate Change Adaptation Strategy, the Netherlands
- **Sub-regional and local level**
  - Developing Local Climate Change Action Plans, the Philippines
  - Demonstration of the Eco town Framework, San Vicente, Palawan, the Philippines
  - Climate Change Adaptation Strategy, Vancouver, Canada
  - Climate Change Adaptation Planning, Durban, South Africa

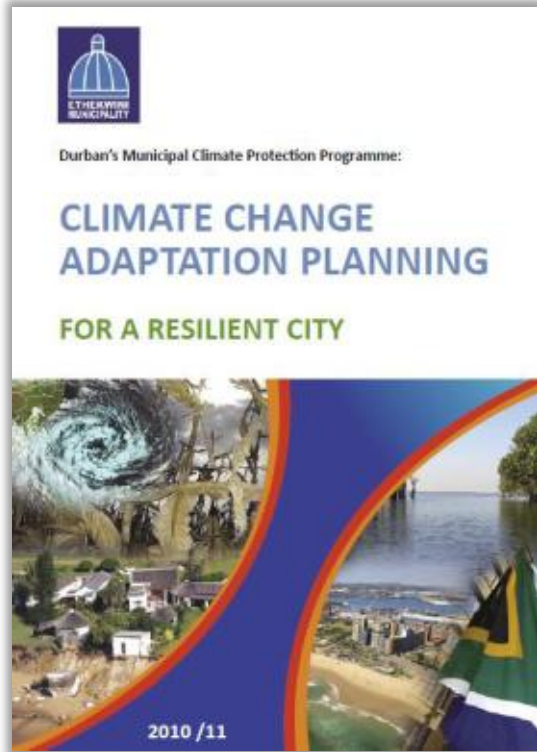
NAPA (Ethiopia)	NAPA (Bhutan)	National Climate Change Adaptation Strategy (Netherlands)	Local Climate Change Action Plans (Philippines)
<p>Impact on economic growth of the poor (poverty reduction potential)</p> <p>Complementarities with national sectoral plans</p> <p>Reduction of climate change risk (losses avoided by poor people per year)</p> <p>Synergy with action plans under multilateral environmental agreements</p> <p>Cost effectiveness (dollar figure based on project costs)</p>	<ul style="list-style-type: none"> <li>• Human life and health protected by the intervention</li> <li>• Arable land with associated water supply and productive forest saved by the intervention</li> <li>• Essential infrastructure, such as existing and projected hydropower plants, communication systems, industrial complexes, cultural and religious sites and main tourist</li> </ul>	<ul style="list-style-type: none"> <li>• Necessity of implementation</li> <li>• Possibility to postpone the action for a later</li> <li>• No regret possibility</li> <li>• Auxiliary benefit options</li> <li>• Mitigation linkages</li> </ul>	<ul style="list-style-type: none"> <li>• Feasibility</li> <li>• Cost effectiveness</li> <li>• Co benefits</li> <li>• Social acceptability</li> </ul> <p>Also:</p> <ul style="list-style-type: none"> <li>• Urgency</li> <li>• Resource requirement</li> <li>• Feasibility</li> <li>• Effectiveness</li> </ul>

# Based on San Vicente’s vulnerabilities, what are the viable adaptation measures to climate change?

	AGRICULTURE	COASTAL & MARINE
Technical/ Infrastructure	<ul style="list-style-type: none"> <li>• Construction of additional automatic weather stations</li> <li>• Construction of small scale irrigation facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of sea walls and dikes in Port Barton</li> <li>• Setting up of early warning system</li> <li>• Mangrove deforestation</li> </ul>
Governance & Policies	<ul style="list-style-type: none"> <li>• Training to introduce alternative livelihood (non-timber forest product)</li> <li>• Establishment of farmers’ field schools and programs</li> </ul>	<ul style="list-style-type: none"> <li>• Total fish-catch monitoring</li> <li>• Monitoring of illegal fish catch practices</li> <li>• Organizing and strengthening fisherfolk organizations</li> <li>• Coral rehabilitation (i.e., undertake herbivore seeding, establish the necessary mix of marine habitat types to enhance coral resiliency)</li> </ul>
Practices	<ul style="list-style-type: none"> <li>• Introduction of new crop varieties, including hybrids</li> <li>• Alteration of cropping pattern/calendar and practices</li> </ul>	<ul style="list-style-type: none"> <li>• Training for alternative livelihood</li> <li>• Promotion of private sector involvement in coastal planning and management</li> <li>• Trainings and orientation on disaster risk reduction and management</li> <li>• Enhanced public information campaign</li> <li>• Policy for water resource use conflict resolution</li> </ul>

Through multi-criteria analysis, several options were prioritized based on the following criteria: effectiveness, cost, technical feasibility, social/cultural feasibility, required time, and sustainability and overall impact.

# MCA: Applications in Climate Change Adaptation



# Durban, South Africa



Prioritization process to develop the city's  
Climate Change Action Plan

MCA allowed identification of the most urgent  
and beneficial interventions

Scoring system prioritized the interventions,  
combining an assessment of merit and urgency



## MCA Criteria

Impact on risk

Ancillary benefits

Reversibility and flexibility

Impact on emissions

Complementarity of options

Ease of implementation

Institutional complexity

Cost benefit

Risk of maladaptation



# Vancouver, Canada



GREENEST CITY 2020  
Climate Adaptation

**CLIMATE CHANGE ADAPTATION STRATEGY**



# MCA Criteria

Sustainability

Mitigation co-  
benefits

Equity

Implementation  
Cost

Effectiveness

Robustness

Risk and Uncertainty

Urgency

Opportunity

Ancillary benefits

No regret

Window of  
opportunity

Implementation

Funding sources

Institutional

# Vancouver, Canada



**MUST DO:** Actions relating to climate impacts already being observed or that a life safety component and actions with a high benefit to cost ratio

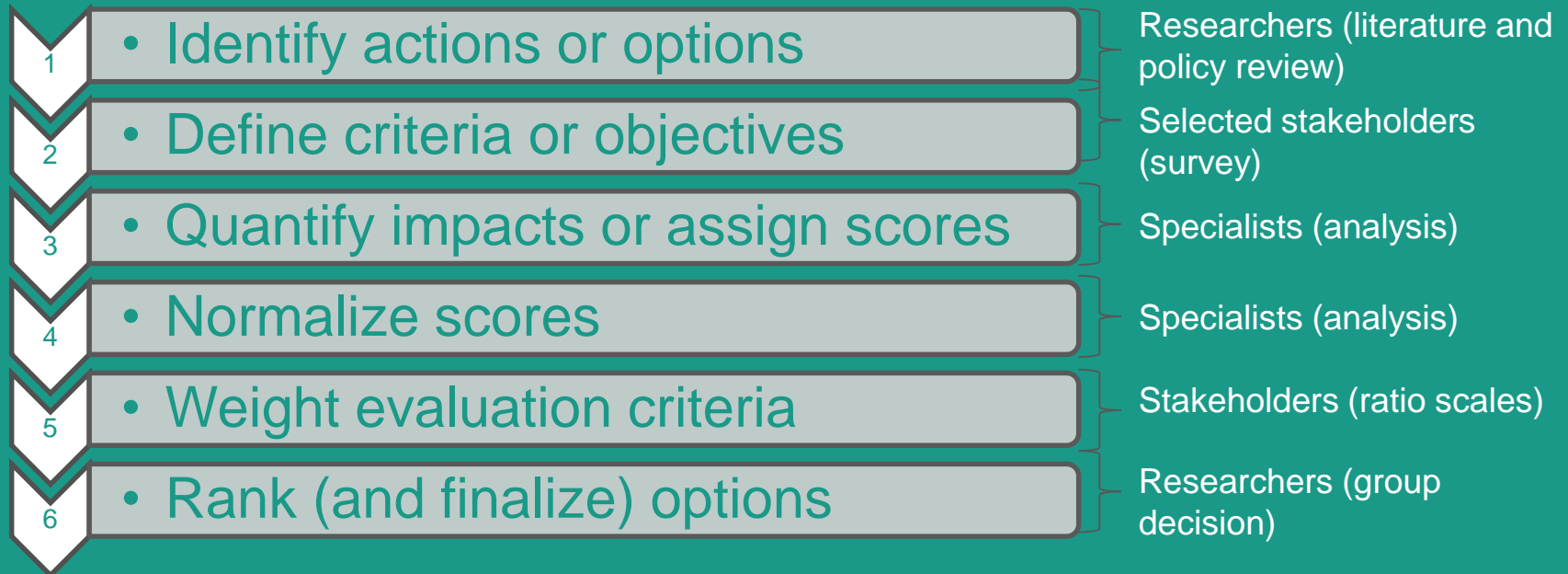
**MONITOR:** Actions relating to impacts that will be observed in the long term and that have a high benefit to cost ratio. Actions will be implemented when specific climate thresholds are surpassed or changes observed

**INVESTIGATE:** Actions relating to impacts that will be observed in the long term where the cost-benefit ratio is unknown

# MCA: Applications in Climate Change Mitigation

Author	Sector	Objective	Options	Criteria	Location
Sun, et al. (2015)	Transport	To evaluate and select the best low-carbon transport policies	Tax adjustment, pricing adjustment mechanisms, multi-operation mechanisms, environmental propaganda, traffic demand management, and state funding and subsidies	Accessibility, safety, environment, society, cost, profits and technology	Tianjin, China

# Extent and Mode of Participation



# MCA: Applications in Climate Change Mitigation

Author	Stakeholders Involved	Stakeholders' Objectives	Convergence of Preference	Final evaluation	Initiator	Application
Sun, et al. (2015)	Government supervisory authorities, end users, infrastructure operators and suppliers, academics, traffic management sector, technology division, planning department	Infrastructure operators and most government departments: safety and travel time End users: safety and convenience Government planning department: budget Suppliers and the technology division: Facility reliability, cost of maintenance, and technology reliability	Most stakeholders agree on state funding and subsidies as the most effective form of low-carbon transport policy, while academics and government supervisory authorities prefer traffic demand management policy	Best supported low-carbon transport policies are state funding and subsidies, and traffic demand management	Researchers	Testing of methodology



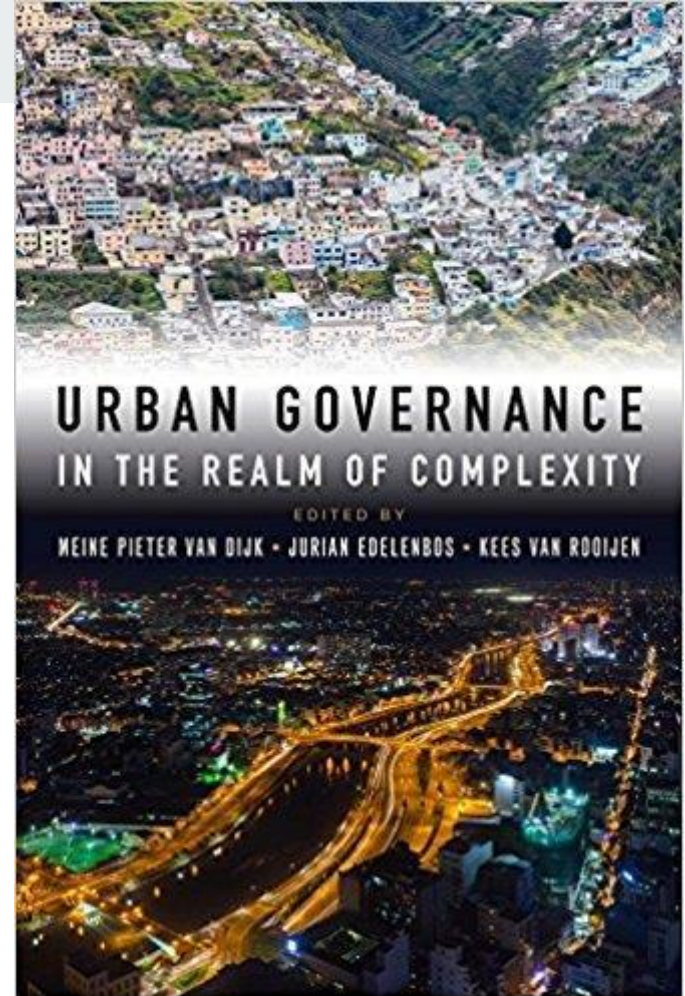
# VULNERABILITY AND RISK ASSESSMENT (VRA)

Communities For Resilience (CORE)



TRAINING MANUAL

[SESSION 4: Use of Multi-Criteria Analysis in Prioritization of Climate Change Adaptation and Mitigation and DRR Activities](#). Climate Change Commission (2017)



[CHAPTER 7: Multiple criteria analysis in low-carbon urban development: A review of applications in developing and transitional economies](#)  
Ensenado and Grafakos (2017)



**Thank you!**