Socio-economic Assessments of Technologies for Adaptation

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Technology Needs Assessments

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Socio-economic Assessments of Technologies for Adaptation

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1. Introductory remarks

- **Technologies for Adaptation** are defined as "All Technologies that can be applied in the process of adapting to climatic variability and climate change." (UNDP Handbook)

- A typology of adaptation technologies:
  - Hard technologies / hardware: tools, equipment, physical facilities etc.
  - Soft technologies / software: knowledge to use the tools and machinery.
  - Orgware: institutional framework or organisation required to implement the technology.

- Sectors commonly used: freshwater resources, forests and ecosystems, agriculture, coastal systems, industry, and health (IPCC AR4).

1. Introductory remarks
Differences between Adaptation and Mitigation Technologies

- Climate adaptation is often the continuation of an ongoing process where the same techniques have been used for generations (e.g. houses on stilts);
- Few technologies are specifically designed for adaptation, rather they respond to broader sustainable development needs (e.g. improved water quality) ;
- Adaptation technologies are generally less capital intensive, suitable to small-scale interventions and local variations and context;
- The effects/outcomes of adaptation cannot be measured by a single indicator (such as CO_2e emissions), are dependent on future projections;
- Transfers of adaptation technologies does not necessarily follow a north-south approach of equipment and practises. Technologies may already be in place but face barriers to implementation and use.

1. Introductory remarks
Starting Point

National Communications under the UNFCCC: Vulnerability and Adaptation Assessments (V&A)

- Address baseline socio-economic scenarios, climate change scenarios, coastal resources, water resources, agriculture, human health etc.
- Provide essential information on their vulnerability to adverse effects of climate change, and on adaptation measures arising from these effects.

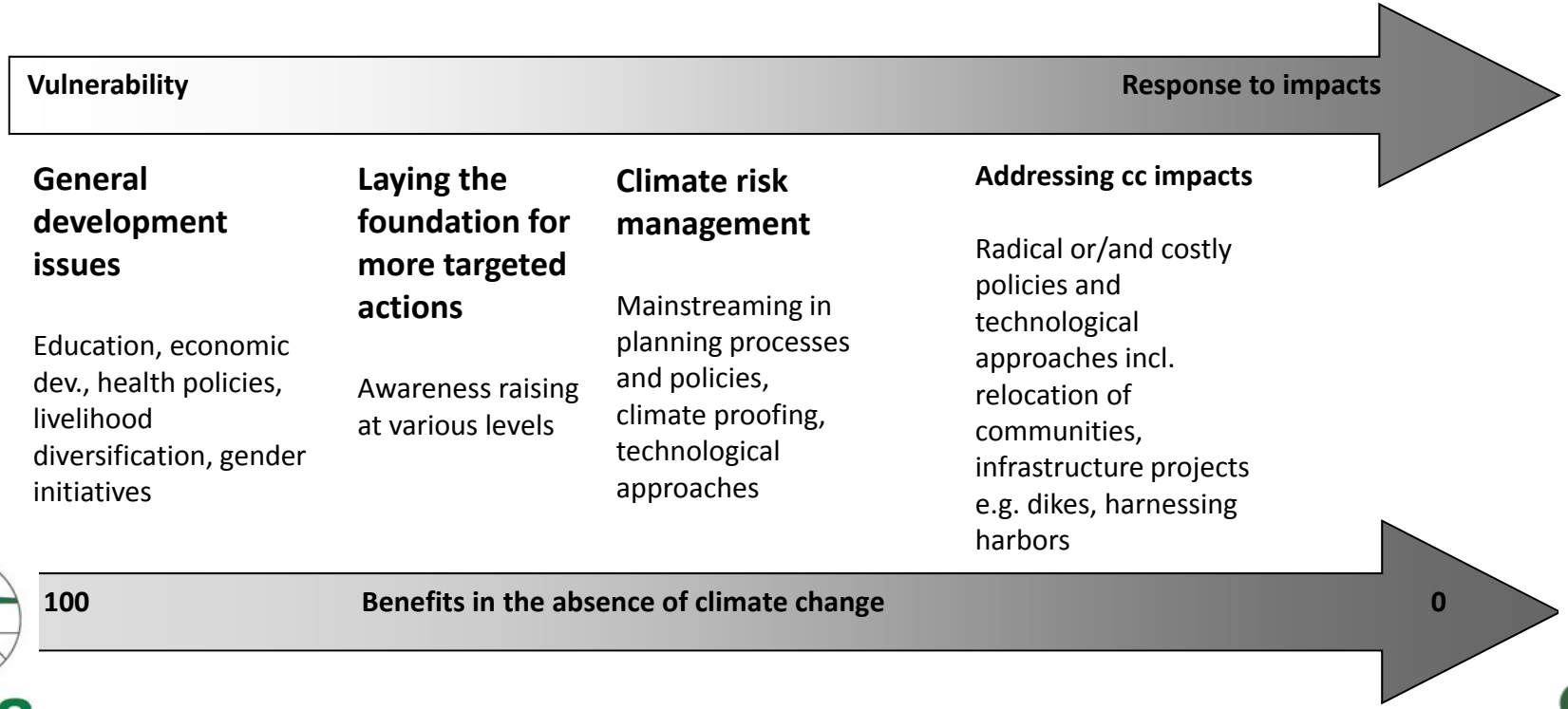
National Adaptation Programmes of Action (NAPAs) enable Least Developed Countries (LDCs) to identify priority adaptation activities.

- The NAPAs focus on urgent and immediate needs, are action-oriented, country-driven and based on national circumstances.
- Short profiles on priority adaptation activities designed to facilitate the development of proposals for implementation.

1. Introductory remarks
The Development – Adaptation Continuum

Two main categories of adaptation impacts

1. direct climate change risk impacts + indirect development benefits
2. direct impacts on climate risks



TNA Prioritisation Process and Criteria for selection of adaptation technologies: the case of Cambodia

Prioritization criteria based on the Royal Government of Cambodia's development priorities.

Cambodia has made a clear choice of selecting "no regrets" options.

The technologies are already justified by current climate conditions and would provide real and tangible social and economic benefits for local communities if implemented.

TNA Criteria
Reduction of Vulnerability to Climate Change
§ Reduction in human casualties § Reduction in physical damage to property, infrastructure and economic output
Economic Benefits
§ Support for sustainable development § Provision and maintenance of infrastructure § Increase in productivity
Social Benefits
§ Creation of employment and income generation opportunities § Improvement of public health § Improvement of education and public awareness § Improvement of local living conditions
Environmental Benefits
§ Improvement of air and water quality § Avoidance of soil pollution § Conservation and sustainable use of resources § Use of appropriate and environmentally friendly technologies

TNA Prioritisation Process and Criteria for selection of adaptation technologies: the case of Cambodia

Sector	No.	Technologies
Coastal Zone	1	Mangrove Management (Conservation, Restoration, Sustainable Use)
	2	Seawalls, Dikes, Barriers
	3	Storm and Flood Early Warning
	4	Flood Proofing
	5	Community Flood Preparedness
	6	Vegetation Buffer
	7	Flood Drainage
	8	Flood Hazard Mapping
	9	Emergency planning
	10	Beach Nourishment
	11	Desalination
	12	Coastal Setbacks
	13	Managed Realignment
	14	Saltwater intrusion barriers
	15	Awareness Raising and Education on Climate Change Issues

Sector	No.	Technologies
Water	1	Rainwater Harvesting from Rooftops
	2	Small Reservoirs, Small Dams and Micro-Catchments
	3	Wells for Domestic Water Supply
	4	Community Irrigation Systems
	5	Household Water Treatment and Safe Storage
	6	Water Use Efficiency
	7	Leakage Management
	8	Water Gates and Water Culverts
	9	Upper Mekong and Provincial Waterways
	10	Water Reclamation and Reuse
	11	Community Flood Preparedness
	12	Water User Communities
	13	Community and Household Flood Safe Areas
	14	Drainage for Roads
	15	Awareness Raising and Education on Climate Change Issues

1. Introductory remarks
TNA Approach

Stage 4

Step 1: Identify technologies

which can be used to make current and future development states better adapted to climate change, in order to measure the costs and development impacts of implementing these options

Step 2: Prioritize and assess technologies with Multi Criteria Analysis (MCA): contribution to development goals, socio-economic aspects, and reduction in vulnerability

Step 3: Prepare Technology Needs Assessment

1. Introductory remarks
TNA Approach

- **MCA**: Decision criteria to maximise the project score on indicators with equal or different weights to all impacts.

Criteria for prioritization of adaptation measures

General

- contribution to countries development priorities
- reduction of vulnerability to climate change
- performance of the technology (costs, maintenance, etc)

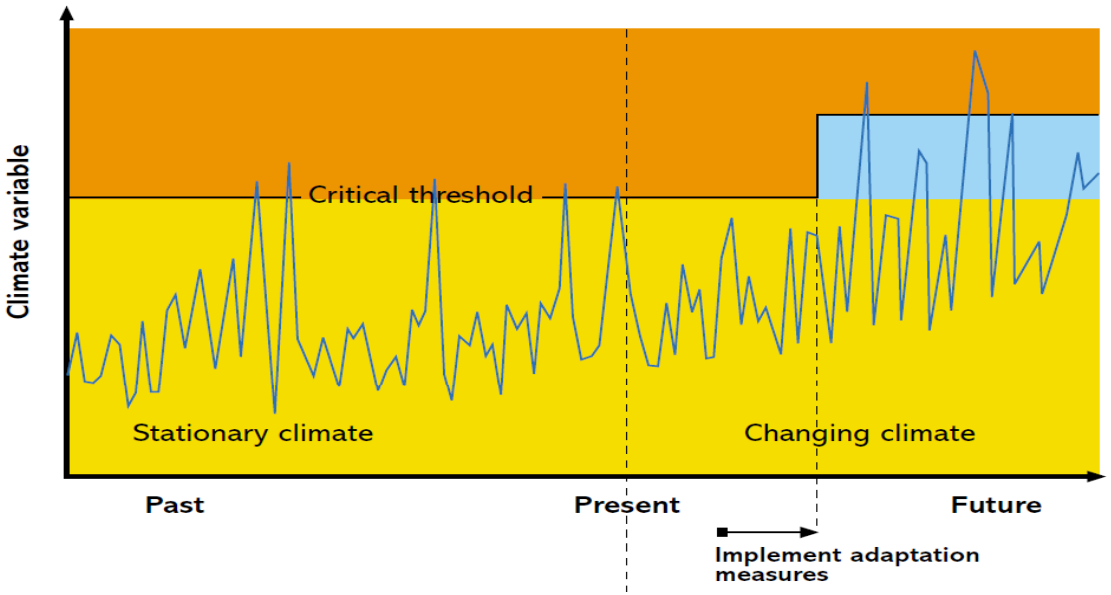
specific

- loss of live and livelihood
- human health
- essential infrastructure
- food security and agriculture
- etc

- Not all CC impacts can be represented by monetary values
  - but socio-economic analyses provide information which can be included in the the MCA

2. Socio-economic Assessment of Technologies for Adaptation

- Costs and benefits of adaptation
  - Benefits
    - Avoided damages/welfare loss by reduced CC impacts
  - Costs
    - Cost of planning, preparing for, facilitating and implementing adaptation measures
- Cost assumptions, indirect impacts, and valuation issues
- Uncertainty
  - projections of climate change
  - path of economic growth and technological change
  - behavior



2. Socio-economic Assessment of Technologies for Adaptation
Key Dimensions, Sustainable Development Contribution and Indirect Benefits

- **Economic**
  - GDP growth
  - Sectoral development
  - Employment
  - Foreign exchange
  - Investments
  - Regional structure
- **Environmental**
  - Air pollution
  - Water pollution
  - Waste discharge
  - Exhaustible resources
  - Biodiversity
- **Social**
  - Education
  - Health
  - Local participation and sharing of benefits
  - Income distribution
  - Information sharing systems
  - Institutional capacity building

2. Socio-economic Assessment of Technologies for Adaptation

Selection of indicators

	SD Theme	Indicator	Measurement standard
Economic dimension	- Investment and Costs - Employment - Energy - Water - Food	-Total capital cost -Labour employed -Access and affordability	-Financial cost - No of man hours skilled and unskilled - Energy supply to households and industry (quantity and share) and energy costs relative to income
Social dimension	- Poverty alleviation - Health improvements - Education	-Income generation -Health services -Primary and secondary school attendances	-Income to poor households - No. of people with access to health clinic - No of children, time spend on homework
Environmental dimension	-Air and water quality - Climate change	- Air pollution - GHG emissions	-Emissions of SO_2, NO_x and particulates. -Water pollution. - Climate Change impacts: crops, land etc. -GHG emissions

2. Socio-economic Assessment of Technologies for Adaptation

The Technology Fact Sheet

Capital costs	
Cost to implement adaptation technology	Cost of construction, incl. materials and labor input
Additional cost to implement adaptation technology, compared to baseline/"business as usual"	Cost of measure incl. adaptation technology – baseline measure without adaptation technology
Long term cost (i.e. 10, 30, or 50 years) without adaptation	Construction, maintenance and repair
Long term cost (i.e. 10, 30, or 50 years) with adaptation	Construction, maintenance and repair
Development impacts, direct and indirect benefits	
Direct benefits Long term cost without adaptation – long term cost with adaptation	Direct benefits Long term cost without adaptation – long term cost with adaptation
Reduction of vulnerability to climate change, indirect	Reduction in human casualties. Reduction in physical damage to property, infrastructure and economic output
Economic benefits, indirect	Employment, growth and investments
Social benefits, indirect	Income, education, health
Environmental benefits, indirect	Reduction in GHG emissions, local pollutants, ecosystem degradation

3. Examples

Example 1: Infrastructure planning in Mozambique

Climate change impacts:

Significant changes in magnitude and timing of water run-off → increase frequency and scale of flooding

Vulnerability

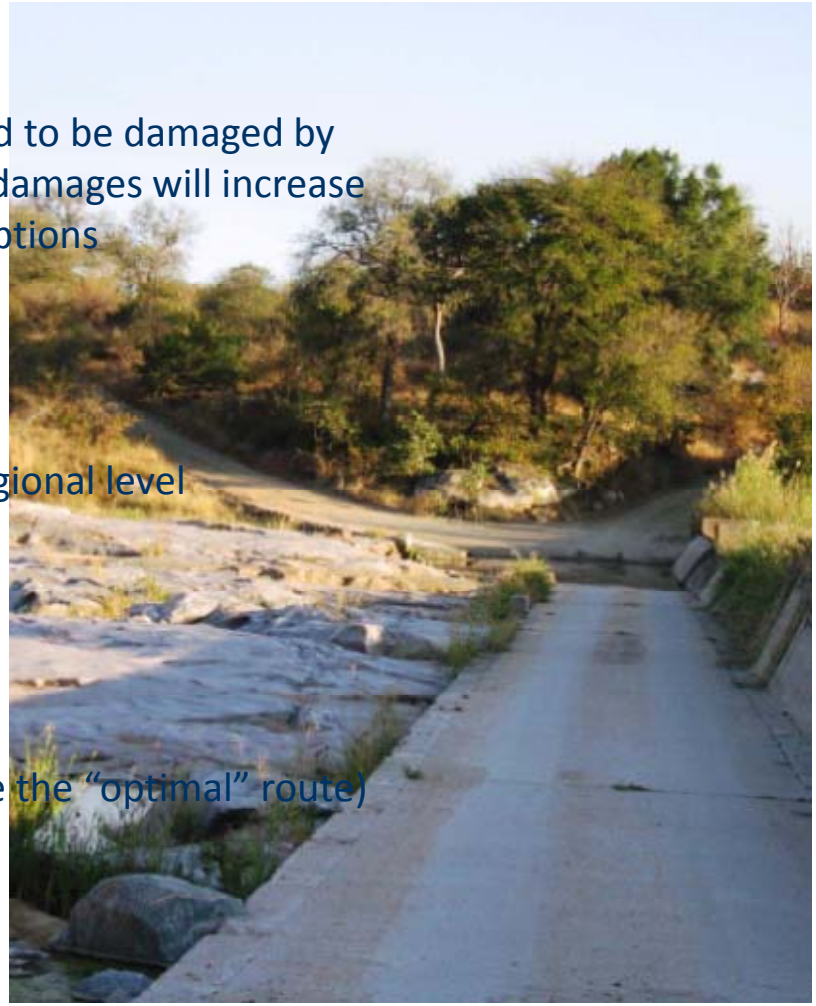
Highways and bridges in Mozambique are expected to be damaged by increasing magnitude and intensity of floods. The damages will increase maintenance costs and can cause temporary disruptions

Development impacts considered

- Maintenance and reconstruction costs
- Impacts of disrupted market access at local and regional level

Adaptation technology options

- Road drainage systems
- Stronger foundation and bridges
- Alternative routes (use of technology to determine the "optimal" route)



3. Examples

Example 1: Infrastructure planning in Mozambique, socio-economic impacts

Indicator	Unit	Total cost of damage per unit, USD	Total cost of damage, mill USD	Cost of re-construction per unit, USD	Total cost of recon-struction
Number of people displaced	295,500				
Number of villages displaced	78				
Number of houses damaged	47,000	580	27.0	872	41
Number of schools damaged	60	37,400	2.2	37,400	4

Indirect impacts

- Food price increases of 70 % for three months
- Average normal monthly consumption per person USD 229 per months → USD 390
- Impact on household consumption expenditures and level of food intake, if households adjust to lower consumption levels
- High numbers of morbidity and mortality

3. Examples

Example 1: Infrastructure planning in Mozambique, improved road construction

	Costs per km (USD)	
	Without adaptation / Baseline	With adaptation
Cost of construction		
Road surface	190,000	190,000
Drainage work	96,970	174,393
Total cost of construction	**287,121**	**364,545**
Incremental/additional cost		77,424
Total cost of construction, maintenance, and repair	**1,182,273**	**755,455**
Net benefit of mainstreaming the adaptation technology option		426,819

*NPV over 50 years with a 3 percent discount rate

- upfront costs increase but will be offset by lower maintenance costs over a period of 50 years
- Avoided impacts are considerable and additional to the net benefits in the table

3. Examples

Example 1: Infrastructure planning in Mozambique,

Technology Fact Sheet

Capital costs	
Cost to implement adaptation technology	USD 364,545 per km
Additional cost to implement adaptation technology, compared to "business as usual"	USD 77,424 per km
Total cost, 50 years, NPV, without adaptation	**USD 1,182,273 per km**
Total cost, 50 years, NPV, with adaptation	**USD 755,455 per km**
Development impacts, direct and indirect benefits	
Direct benefits	USD 426,819 per km
Reduction of vulnerability to climate change	Roads more resilient to flooding Areas with maintained road access stabilize and return to normal conditions faster than in cut-off areas.
Economic benefits, indirect	jobs for construction, reliable market access and investments in the road construction industry
Social benefits, indirect	Income, training of new employees, reduction in morbidity and mortality since road access will facilitate easier access for emergency and relief
Environmental benefits, indirect	Using alternative routes may impact less on ecosystems. Reduction in GHG emissions if using asphalt that gives less resistance to vehicles

3. Examples

Example 2: Rainwater Harvesting for crop irrigation in Tanzania

Climate change impacts:

Climate change is expected to influence the magnitude and time distribution of precipitation in Tanzania

Vulnerability

Water shortage limits the quantity and variety of crops and also has a negative influence on the possibilities for enhanced crop or livestock production in relation to emerging markets. Demand for water storage is extended compared to a situation without climate change. Agriculture can be increasingly dependent on irrigation.

Development impacts considered

Crop yields

Employment

Income

Adaptation technology options

Increased water storage capacity for irrigation purposes

Improved water management

Adjustment of planting dates

3. Examples

Example 2: Rainwater Harvesting for crop irrigation in Tanzania socio-economic impacts

Indirect impacts

- Food price increases
- Food availability decrease
- Impact on household consumption expenditures and level of food intake, if households adjust to lower consumption levels
- Increased morbidity

Adaptation technology: Improved and extended water storage capacity utilizing water run-off for paddy rice production

Example 2: Rainwater Harvesting for crop irrigation in Tanzania, Scenario

Baseline	Units, Yield (kg/ha)	Price/ Unit	Total value per year, USD				
			Year 1	Year 2	Year 3	…	Year 10
Revenue	1,800	0.20	351.6	351.6	351.6	…	351.6
Total costs			257.8	257.8	257.8	…	257.8
Gross return to average plot			66	66	66	…	66

With adaptation technology	Units	Price/ Unit	Total value per year, USD				
			Year 1	Year 2	Year 3	…	Year 10
Revenue, Yield (kg/ha)	3,000	0.20	585.9	585.9	585.9	…	585.9
Total costs			364.5	257.8	257.8	…	257.8
Gross return to average plot			154.97	229.7	229.7	…	229.7

3. Examples

Example 2: Rainwater Harvesting for crop irrigation in Tanzania Technology Fact Sheet

Capital costs	
Cost to implement adaptation technology	USD 365 per rainwater harvesting technology
Additional cost to implement adaptation technology, compared to "business as usual"	USD 106
Annual cost, without adaptation 10 years	USD 330
Annual cost, with adaptation 10 years	USD 365
Development impacts, direct and indirect benefits	
Direct benefits, without adaptation per year	USD 66
Direct benefits, with adaptation	USD 230
Net benefits, average plot per year	USD 164
Net Present Value of total investment	USD 1555
Reduction of vulnerability to climate change	Improved water management can alleviate the effect from decreased rainfall during crop growing season
Economic benefits, indirect	Increased income
Social benefits, indirect	Improved health conditions from decreased malnutrition (which is also a key vulnerability factor in relation to malaria). Improved food security.
Environmental benefits, indirect	Less depletion of soil

Concluding remarks

- Important to illustrate the benefits, direct and indirect of adaptation technologies

- There is a large potential for integrating climate change adaptation technologies into already existing and on-going development programmes, projects and planning efforts
  - this can be done for relatively low costs
  - but needs to consider context specific conditions

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Thank you !

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