

# Metrics for climate change adaptation projects

## Quantifying adaptive benefits

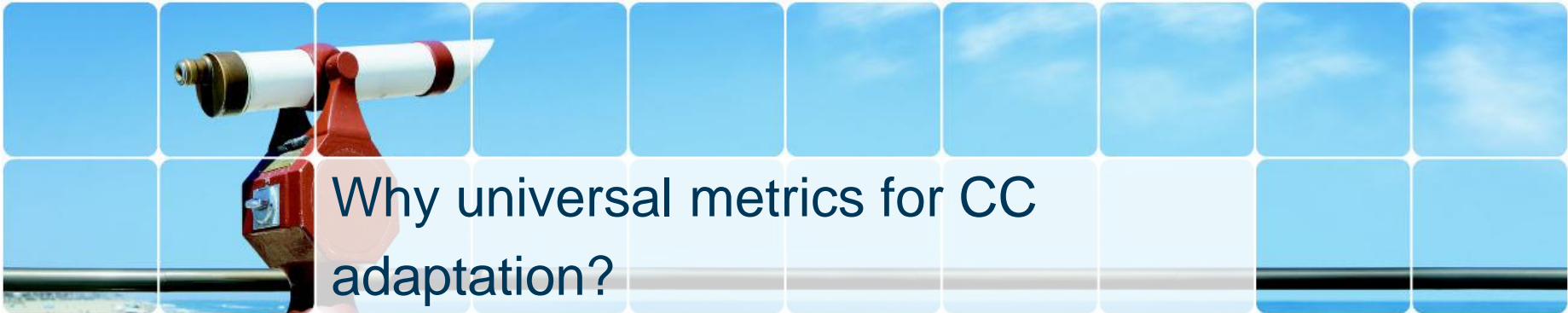
ECCA Conference: March 19<sup>th</sup> 2013, Hamburg

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## Overview

- **Why universal metrics for CC adaptation?** advantages and drawbacks
- **Metrics used (or not used)** by multilateral adaptation funds
- **3 possible indicators:** saved wealth & saved health + environmental benefit indicator
- **Application** to real world projects: Kenyan Case Study
- **Feedback and discussion**



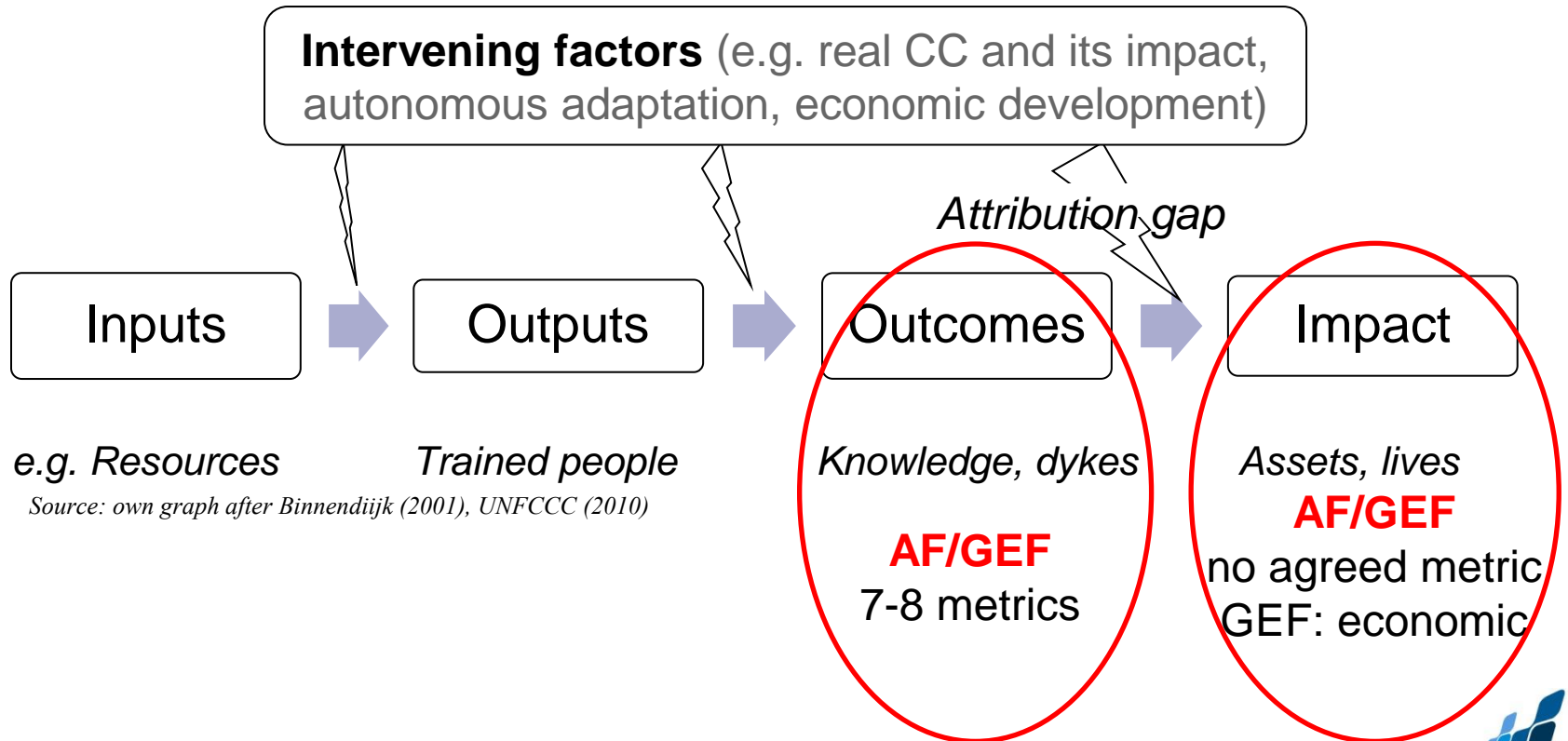
## Why universal metrics for CC adaptation?

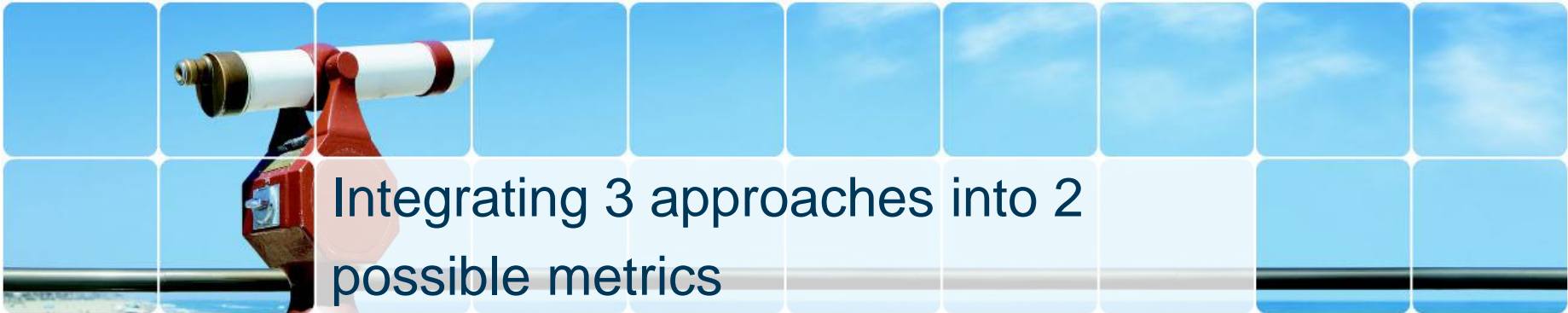
- **Universal metrics currently missing** (IPCC 2007, UNFCCC 2010, 2012)
- **Advantages**
  - Ex-ante: identification of promising projects (Noble 2008)
  - Ex-post: M&E leading to corrections / adjustments and lessons learned (Hallegate et al. 2011)
- **Drawbacks**
  - Difficulty of political agreement (Hinkel 2008)
  - Value judgements involved (Hinkel 2008, Klein 2009)
  - Uncertainty in measurement (Hinkel 2008, Hallegate et al. 2011)



# Metrics used by multilateral adaptation funds

- **Result-based management; result chain**





## Integrating 3 approaches into 2 possible metrics

### Vulnerability assessment

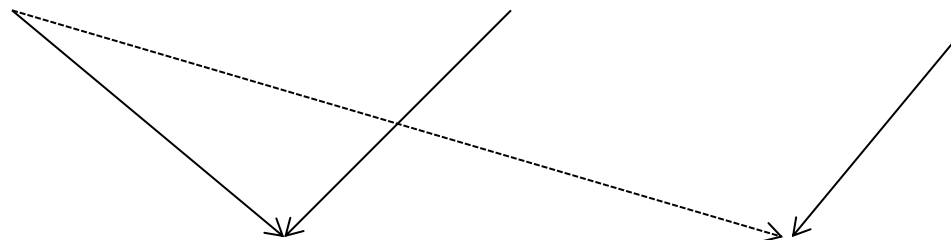
- + Politically accepted
- Multiple tools/metrics

### Cost-effectiveness analysis

- + Various metrics
- no comparability

### Cost-benefit analysis

- + economic, 1 metric
- value judgments, e.g. health, ecosystems)



### Saved Health

[Disability-adjusted Life Years – DALYs]

### Saved Wealth

[\$ absolute and/or relative]

**+ Environmental benefit** for ecosystems, (cultural assets)

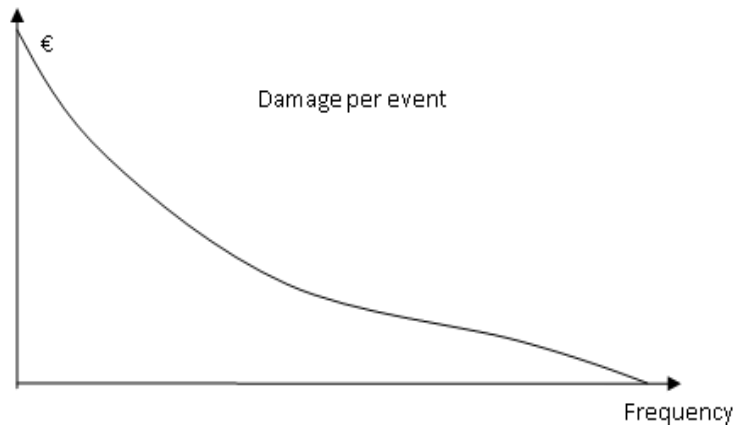


## Metric 1: Saved Wealth

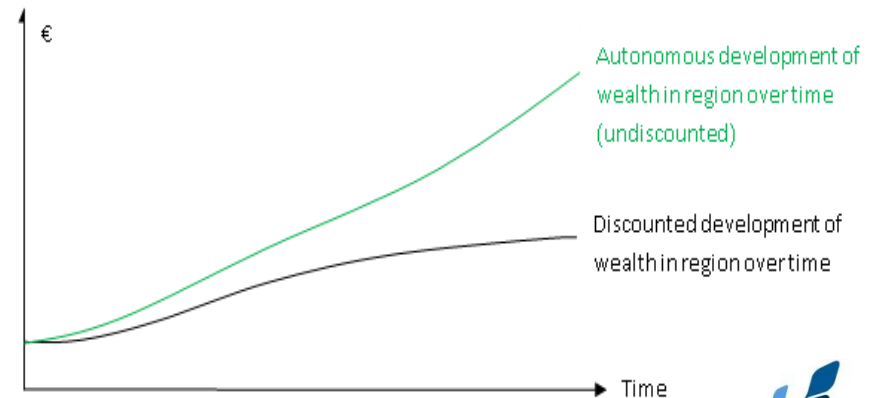
- Applied for:
  - Public **infrastructure**
  - Private **property**
- **Natural resources** and services are included in public property
- Frequency distribution of **damage from climate change driven extreme events** taken into account for the baseline



*Figure I: Frequency*



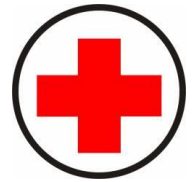
*Figure II: change of wealth over time*





## Metric 2: Saved Health

- Valuation of human life is fraught with **ethical challenges**
- Alternative quantification indicator: **DALYs**



$$DALY = N \cdot L + \sum_i I_i \cdot DW_i \cdot D_i$$

- Where:
  - DALY      Disability-adjusted Life Years (Introduced by World Bank (1993); used by the WHO)
  - N          Numbers of deaths
  - L          Standard life expectancy at age of death (in years).
  - $I_i$         Cases of disease / injury i
  - $DW_i$      Disability weight of disease / injury i.
  - $D_i$         Average duration of disease / injury i (years)



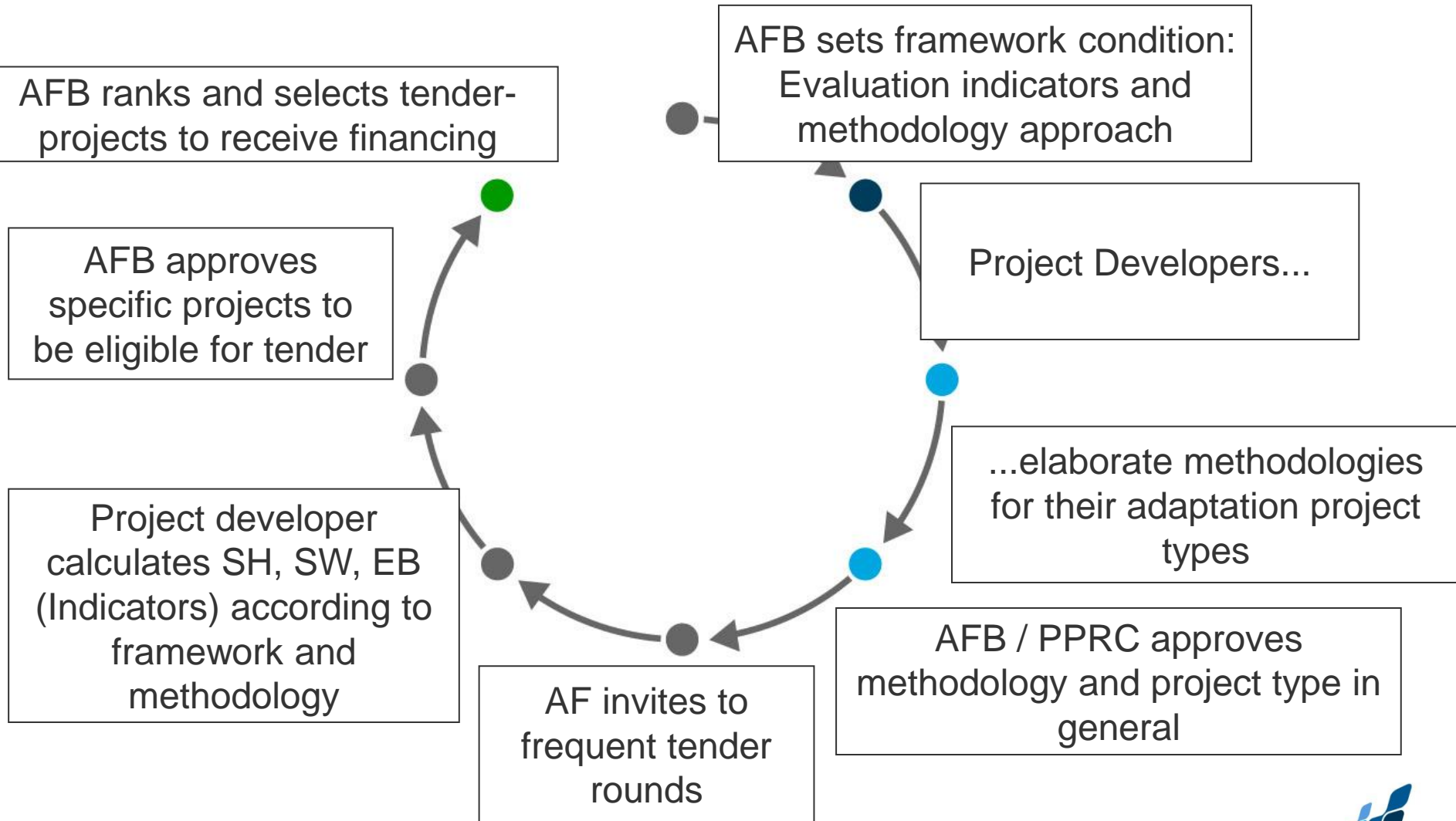
## Indicator 3: Environmental Benefit

- **Qualitative assessment** considering biodiversity, endangered species, habitat secured, air, water
- **Three options for using EB**
  - a) Compensation of damages
  - b) Non-eligibility benchmark
  - c) Multiplier for SW and SH





# How to use the concept? Overview of approach (Example for Adaptation Fund)





## Case Study: Kenya

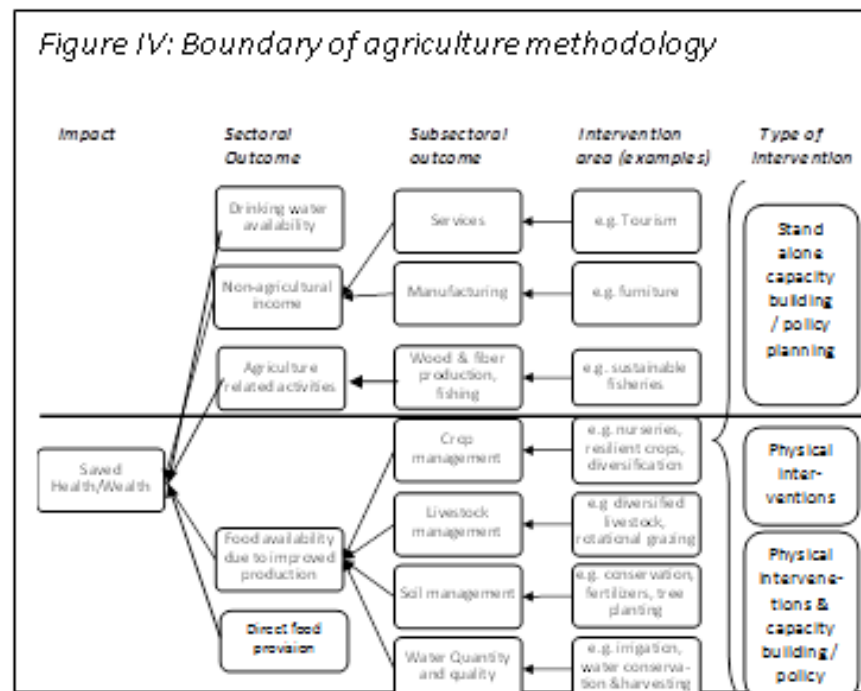
- Kenyan agriculture project
- Highlands: normally receive adequate rainfall sufficient to raise crops like maize, bananas, cassava
- Lowlands: utilize water from rivers during rainy seasons which allows small-scale irrigation and ranching
- Area was among areas hit worst by the drought in October 2004; an agricultural adaptation project was implemented in 2007 (includes irrigation canals, soil conservation and water retention ditches)
- Overall aim of the project is to guarantee a reliable and sustainable food supply in the context of climate change.



## First step: Methodology development

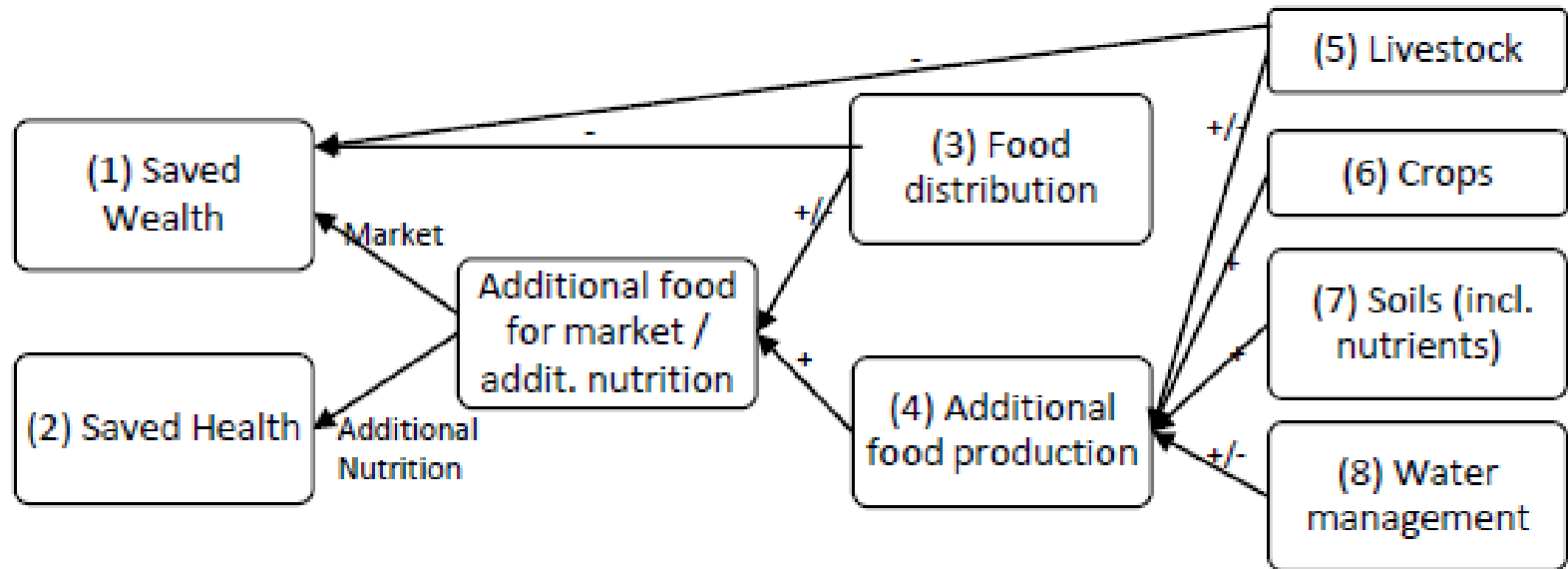
- “Methodology for estimating wealth and health benefits of climate change adaptation projects in the agriculture sector”
- Methodology defines data requirements and includes relevant formulas for assessing a baseline and project situation
- Locally derived data are preferred; in case they are not available international data can be applied
- Tool includes database containing relevant information

Figure IV: Boundary of agriculture methodology



# First step: Methodology development

- **Methodology** (22 pages)
  - 8 modules to calculate saved wealth and health



# Second step: Applying methodology and quantifying adaptation benefits

- **Calculation tool:** xls, automatic calculations, >30 (national) default values

The screenshot displays a Microsoft Excel spreadsheet titled "CC\_adaptation\_Food methodology\_V11.xlsx". The spreadsheet is organized into several key sections, each with a table of parameters, values, and sources. A central box labeled "Food availability" is connected to various parameters in the other sections by lines, indicating its role as a central calculation point.

**Project situation (Rows 1-13):**

Parameter	Value	Source
Project country	Kenya	Project document
Project region/community	aveta District	Project document
Project year	2009	Project document
Total project area in ha	16995	Project document
PB: Project budget in 2009 USD	\$794'593	Project document
PLT (project lifetime in years)	5	Assumption
POP (population in start year)	23998	Project document
PGR (POP growth rate per year)	2.6%	Kenya mean, 08-10, from World Bank
WPCs: Baseline income (\$/p.c./y)	744	Kenya, 2009, mean, from World Bank
IGR: Income p.c. growth rate (%)	1.9%	Kenya mean, 2006-10, World Bank

**Crop management (Rows 14-18):**

Parameter	Value	Source
AREA <sub>CM</sub> : Area (in ha) with improved crop	0.0	Project document
SP <sub>2</sub> : Baseline soil prod. (t/ha)	1.2	Default value, Kenya
SP <sub>3</sub> : Project soil prod after Crop improve	0.0	Project document
FD <sub>CM</sub> : Additional food by improved crop	0.0	Project document

**Livestock management (Rows 19-28):**

Parameter	Value	Source
LU <sub>0</sub> : Livestock units(LU) in baseline	0.0	Project document
LU <sub>1</sub> : Livestock units(LU) in project	0.0	Project document
LP: productivity (kg/LU)	0.05	meat 0.41 min- 0.000006 egg
PRO <sub>meat</sub> /min-: proetine content (%)	17%	3.3% 12.6%
FAT <sub>meat</sub> /min-: fatcontent (%)	25%	3.7% 9.5%
PRO <sub>LS</sub> : proetine production (t/y)	0.0	0.0 0.0
FAT <sub>LS</sub> : fat production (t/y)	0.0	0.0 0.0
DEG <sub>LS</sub> : share of pastures degrading due to	20%	Worldwide default (20% of pastures degraded through livestock (FAO 2006))
FEED <sub>LS</sub> : t feed / LU/ year	0.04	Default, Kenya
LC <sub>LS</sub> : land competition (share of livestock	0%	Default to be justified
N-FD <sub>LS</sub> : Food leakage due to livestock (t/y)	0.0	Calculated
PU <sub>LS</sub> : Pasture use of livestock (ha/LU)	1.2	Worldwide median: 1.2 ha per LU (mean would be 2.3 ha per LU)
CO <sub>2</sub> <sub>LS</sub> : tCO <sub>2</sub> eq/LU/year	2.5	Worldwide default
DEF <sub>LS</sub> : ha deforested / ha used for agricul	25%	Worldwide -2 % deforestation in Kenya 2005-2010
CO <sub>2</sub> <sub>per</sub> : tCO <sub>2</sub> per forest area in ha	400	Worldwide default
CO <sub>2</sub> <sub>price</sub> : Social costs, USD/tCO <sub>2</sub>	50	Worldwide default
N-CC <sub>LS</sub> : Climate change costs of livestock	0	Calculated

**Soil management (Rows 29-33):**

Parameter	Value	Source
AREA <sub>SM</sub> : Area (in ha) with improved soil r	1190.4	
SP <sub>2</sub> : Baseline soil productivity (t/ha/ly)	1.2	Default value, Kenya
SP <sub>3</sub> : Soil productivity in project situation	1.4	Conservative value from F
FD <sub>SM</sub> : Add. food by improved soil manage	1190.4	Calculated

**Water: conservation / harvesting / irrigation (Rows 34-38):**

Option	Parameter	Value	Source
Option 1	NIA: Newly irrigated area (ha)	627.9	
Option 1	IRIN: Irrigation Intensity (m3/ha/yr)	5000	Conservative value from FAO 2002
Option 2	W <sub>0</sub> : Water baseline (m3 or 10hl per y)	0	
Option 2	W <sub>1</sub> : Water project (m3 or 10hl per y)	0	
	WP: Water productivity, additional food	0.8	Worldwide average
	FD <sub>WAT</sub> : Additional food by irrigation and	12557.6	Calculated

**Food availability (Rows 39-44):**

Parameter	Value	Source
FD: t food**	1407	11057
PRO: proteins in t	31	0
FAT: fat in tons	65	0
BEN: persons	26'736	20'000
PIT: project impact time in d/y	180	5.0
ED: Energy density of food (kcal)	350	350
FD <sub>calc</sub> ****: food kcal/cap/day	921.2	1075.0
PRO <sub>pc</sub> : prot g/cap/day	5.8	0.0
FAT <sub>pc</sub> : fat g/cap/day	12.1	0.0
CAL <sub>PRO,FAT,OTH</sub> : food kcal/cap/day	1053.4	1075.0
FR: Failure rate of measures, p	10%	20%
N-I <sub>perc</sub> : % less income generati	10%	

**Saved Health/Wealth (Rows 45-50):**

Parameter	Value	Source
LE: Life expectancy at birth	55.8	Default value, Kenya
FS <sub>DIR</sub> : % of direct food sold/used	16%	Assumption derived from food deficit and provision
FS <sub>IND</sub> : % of indirect food sold	18%	Assumption derived from food deficit and provision
FP <sub>STAPLE</sub> : Staple food price (USD/t)	380	Wheat price, Kenya, 2009
FP <sub>PROT</sub> : Proteine price (USD/t)	1026	Soy bean price, World median, 2009
FP <sub>FAT</sub> : Fat price (USD/t)	908	Palm oil price, World median, 2009
SH: DALYs saved	25'868	Calculated
SW: USD saved	751'433	Calculated
SH <sub>pers</sub> : DALYs / USD Mn budget	32'554	Calculated
SW <sub>pers</sub> : USD / USD Mn budget	0.9	Calculated
SW <sub>REL</sub> : + Yearly pers. Inc. Saved	19480	Calculated
SH <sub>acc</sub> : Saved health in relation to	12633.1	Calculated
SW <sub>acc</sub> : Saved wealth in relation	12.7	Calculated

**Legend (Rows 51-55):**

- Yellow: standard value, can be changed
- Green: calculated, can not be changed
- Red: Negative impact

**Footnote (Row 56):** \*\* Only food not included under proteins/fat



## Conclusions

- **Universal metrics for CC adaptation:** may enhance learning, accountability and efficiency but inherit equity and uncertainty challenges
- **Proposed metrics:** saved wealth, saved health + environmental benefit
- **Dealing with uncertainty:** Using consistent methodologies and disseminating lessons learned (particularly climate impact forecasts) can avoid maladaptation and subsidizing autonomous adaptation
  
- **Next steps required**
  - Examine process / indicators
  - Develop methodologies for other sectors (e.g. coastal protection, water) -> identify non-suitable sectors/projects
  - Apply and improve methodologies

**Thank you very much for your attention!**

**Questions & comments?**

