United Nations Economic Comission for Europe

Workshop on water and climate change: how to develop an strategy in transboundary basins.

A preliminary methodological framework for developing climate-related risk indicators and adaptive capacity of developing countries

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Table of contents

- **Climate change vulnerability as a risk**
- **What is a climate hazard ?**
- **Which adaptation measures can be adopted?**
- **Why is important to identify climate-related risk indicators ?**
- **Proposed methodology framework**
- **Which open questions remain?**

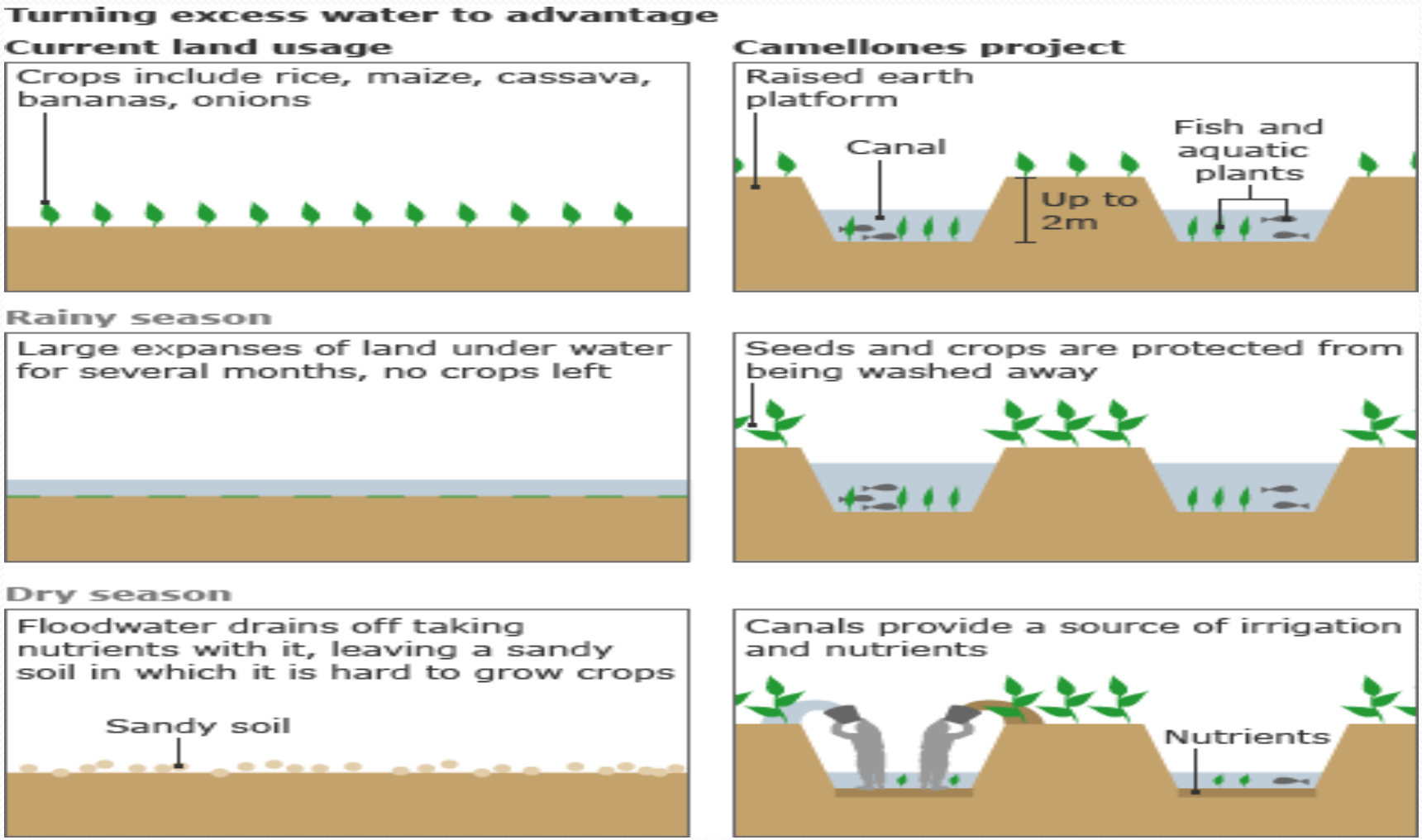
Climate change vulnerability as a risk

Risk =

Probability of occurrence of a climate hazard with significant loss of infrastructure and livelihoods.

Assuming that an extreme weather event (heavy rainfalls) or human activitiy happens.

Which adaptation measures can be adopted?



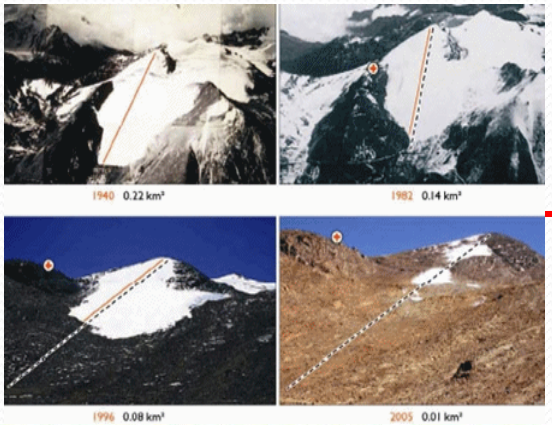
Source: Painter J., 2009

Why is important to identify climate-related risk indicators?

- **Better allocate financial resources for adaptation programs.**
- **Identify the degree of climate-related risk of a particular population, community or sector.**

Proposed methodology framework

- **Identify the vulnerable system to climate change impacts (Fussel, 2007)**



Source: Ramirez E., 2005

Source: Costa A., 2007

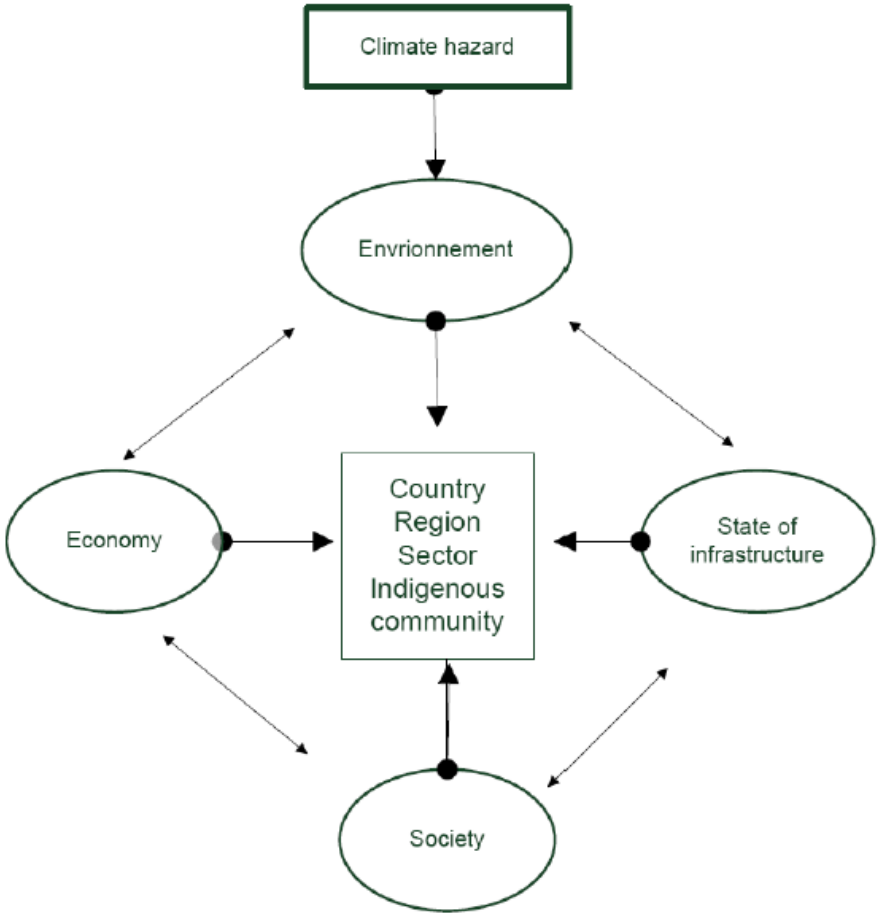
Source: Correo del sur., 2007

Source: Painter J., 2009

Source: NASA, 2006

Proposed methodology framework

Identify the main effects of climate hazard



Selection of extreme weather events or human activities

$$Pr\,(A \mid B) = \frac{PrA \cap B}{Pr(B)} = \frac{Pr(A)}{Pr(B)}$$

Pr (A): Let A be the event that a destructive flooding occurs with significant loss of infrastructure and livelihoods.

Pr (B): Let B the probability of ocurrence of a heavy rainfalls.

Overview of climate hazards hotspots in Tropical Eastern lowlands

Table 1: Overview of climate hazards hotspots in the Tropical Eastern Lowlands

Resources	Observed climate hazards [a]	Possible Consequences		
		Economy	Society	State of infrastructure and livelihoods
Water	Increased in precipitation produce more frequent inundations during ENSO events	Economic losses because of roads and bridge destruction	Loss of human life and cattle Indigenous poor communities are more vulnerable	Destruction of roads, bridges small dams. Loss of crops
	Reduction of water availability in rivers and lakes in the sub-tropical valleys (STV) because of more evapotranspiration	Loss of aquatic ecosystem services (e.g. freshwater, recreation, agricultural)	Farmers rely on ecosystem services for their livelihoods	Water supply for humans and cattle can be affected
	Longer dry seasons might reduce water availability for agricultural sector in STV	Economic losses for small farmers	Migration from rural to urban areas	Loss of arable land
Land	Increased of deforestation in south-eastern of Santa Cruz for soybean crops expansion	Forest loss could reduce water cycle and precipitation during dry seasons which impact in small farms	Negative effect on forest industry one of the main of the province	Shortage of timber and other food fiber for forest industry
	Deforestation threats Chapare tropical forest because of coca crops expansion	A possible inflationary effect on week and isolated communities because coca crops can generate fast and high earnings rather than other crops	Escalating violence and armed conflict spread by illicit drug business and international drug cartels	National parks are fragmented by coca crops causing deforestation, and erosion

(a) By order of appearance of each climate hazard, the sources are : (see Ronchail et al., 2005, pp 225) (see Montaño et al., 2006, pp 105) (see Mertens et al., 2004, pp 272) (see Gonzales et al., 2006, pp 133) (see Parry et al., 2007, pp 586,587).

Overview of climate hazards hotspots in the Altiplano western highlands

Resources	Observed climate hazards [a]	Possible Consequences Economy	Society	State of infrastructure and livelihoods
Water	Drought due to increased variability of ENSO	Monetary losses for small farmers	Population migration from east to west part of Bolivia	Reduction on high-altitude water stocks during dry season
	Temperature increases 4.5 - 5 oC reduce glacier-supplied river water	Potential impact on water supplies for human consumption	Spread of waterborne diseases	Reduce potable water for La Paz and El Alto (population 2.3 million)
	Increased rainfall in the South Altiplano of Cochabamba cause floods and landslides	Local communities depend on products ecosystems for fuels, animal food, building material, food and medicines for their livelihoods	Low-income peasants with limited human resources to cope with these events	Damage of roads, bridges and irrigation channels
Land	Intensive overgrazing and slash and burn in the North Altiplano of La Paz (NALP)	Reduce land's productivity	Increased poverty in rural areas	Reduction of agricultural production capacity
	Longer dry seasons due to more ENSO conditions	Land erosion impact at the NALP	There is no institutional coordination to tackle causes of land erosion	Lost of arable land

(a) By order of appearance of each climate hazard, the sources are : (see Parry et al., 2007, pp 285) (see Vuille et al., 2008, pp 79) (see Aparicio et al., 2006, pp 36,92) (see Parry et al., 2007, pp 285) (see Aparicio et al., 2006, pp 91).

Questions to face in modelling extreme events

- **Difficult to predict the occurrence of extreme weather events (Lack of past-data, uncertainty in climate change projections).**
- **Subjectivity in the estimation of climate-related risk indicator (e.g. selection of variables , measurement technique).**

!!Thank you for your attention!!

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