

Reshaping EIA for Human Sustainability

重塑以人類持續為本的環評

Kin-Che LAM 林健枝

Adjunct Professor, The Chinese University of Hong Kong

Fellow, Hong Kong Institute of EIA

Environmental Consultant, The World Bank

Regional Award Winner, IAIA 2016

6th SEA Forum 第六届中国战略环境影响评价学术论坛

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Haikou, PR China, August 21-23, 2019



“Moais” on Easter Island



*"The **real mystery** of Easter Island is not how the strange statues go there..... but why Rapanui **did not react in time.**"*

UNEP "Home", 2012

Reacting “In Time”

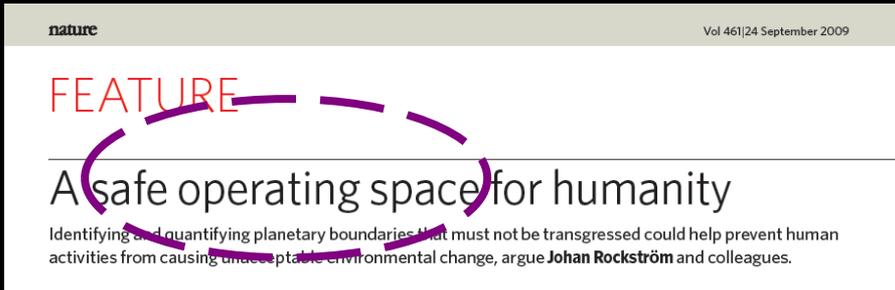
- Ability to anticipate and manage crisis
- Is EIA the appropriate tool?
 - Whether or not?
 - If not, how to shape/reshape it to be.

Nowadays ... Reacting to “What”

- Threats undermining human sustainability
 - Climate change
 - Biodiversity loss
 - Nutrient cycling

“Loss of species and climate change are the two great challenges facing humanity this century. The Red List addresses both, by letting us know the extinction risk faced by all species, including climate change, in that assessment. The results are clear, we must act now both on biodiversity loss and climate change,”

Are We in Danger? 人類正面對危險嗎？



- Earth system has been stable in last 10K yrs
- Earth is resilient
- Can withstand impacts only to a certain limit
- In danger if the threshold is exceeded

A safe operating space for humanity

Identifying and quantifying planetary boundaries that must not be transgressed could help prevent human activities from causing unacceptable environmental change, argue **Johan Rockström** and colleagues.

Although Earth has undergone many periods of significant environmental change, the planet's environment has been unusually stable for the past 10,000 years¹⁻³. This period of stability — known to geologists as the Holocene — has seen human civilizations arise, develop and thrive. Such stability may now be under threat. Since the Industrial Revolution, a new era has arisen, the Anthropocene⁴, in which human actions have become the main driver of global environmental change⁵. This could see human activities push the Earth system outside the stable environmental state of the Holocene, with consequences that are detrimental or even catastrophic for large parts of the world.

During the Holocene, environmental change occurred naturally and Earth's regulatory capacity maintained the conditions that enabled human development. Regular temperatures, freshwater availability and biogeochemical flows all stayed within a relatively narrow range. Now, largely because of a rapidly growing reliance on fossil fuels and



SUMMARY

- New approach proposed for defining preconditions for human development
- Crossing certain biophysical thresholds could have disastrous consequences for humanity
- Three of nine interlinked planetary boundaries have already been overstepped

industrialized forms of agriculture, human activities have reached a level that could damage the systems that keep Earth in the desirable Holocene state. The result could be irreversible and, in some cases, abrupt environmental change, leading to a state less conducive to human development⁶. Without pressure from humans, the Holocene is expected to continue for at least several thousands of years⁷.

Planetary boundaries

To meet the challenge of maintaining the Holocene state, we propose a framework based on 'planetary boundaries'. These

boundaries define the safe operating space for humanity with respect to the Earth system and are associated with the planet's biophysical subsystems or processes. Although Earth's complex systems sometimes respond smoothly to changing pressures, it seems that this will prove to be the exception rather than the rule. Many subsystems of Earth react in a nonlinear, often abrupt, way, and are particularly sensitive around threshold levels of certain key variables. If these thresholds are crossed, then important subsystems, such as a monsoon system, could shift into a new state, often with deleterious or potentially even disastrous consequences for humans^{8,9}.

Most of these thresholds can be defined by a critical value for one or more control variables, such as carbon dioxide concentration. Not all processes or subsystems on Earth have well-defined thresholds, although human actions that undermine the resilience of such processes or subsystems — for example, land and water degradation — can increase the risk that thresholds will also be crossed in other processes, such as the climate system.

We have tried to identify the Earth-system processes and associated thresholds which, if crossed, could generate unacceptable environmental change. We have found nine such processes for which we believe it is necessary to define planetary boundaries: climate change; rate of biodiversity loss (terrestrial and marine); interference with the nitrogen and phosphorus cycles; stratospheric ozone depletion; ocean acidification; global freshwater use; change in land use; chemical pollution; and atmospheric aerosol loading (see Fig. 1 and Table).

In general, planetary boundaries are values for control variables that are either at a 'safe' distance from thresholds — for processes with evidence of threshold behaviour — or at dangerous levels — for processes without

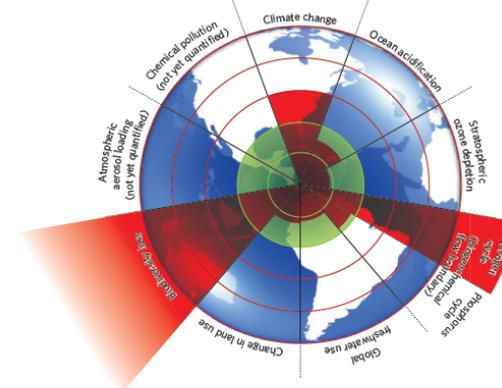


Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

已超越安全 界線的範疇

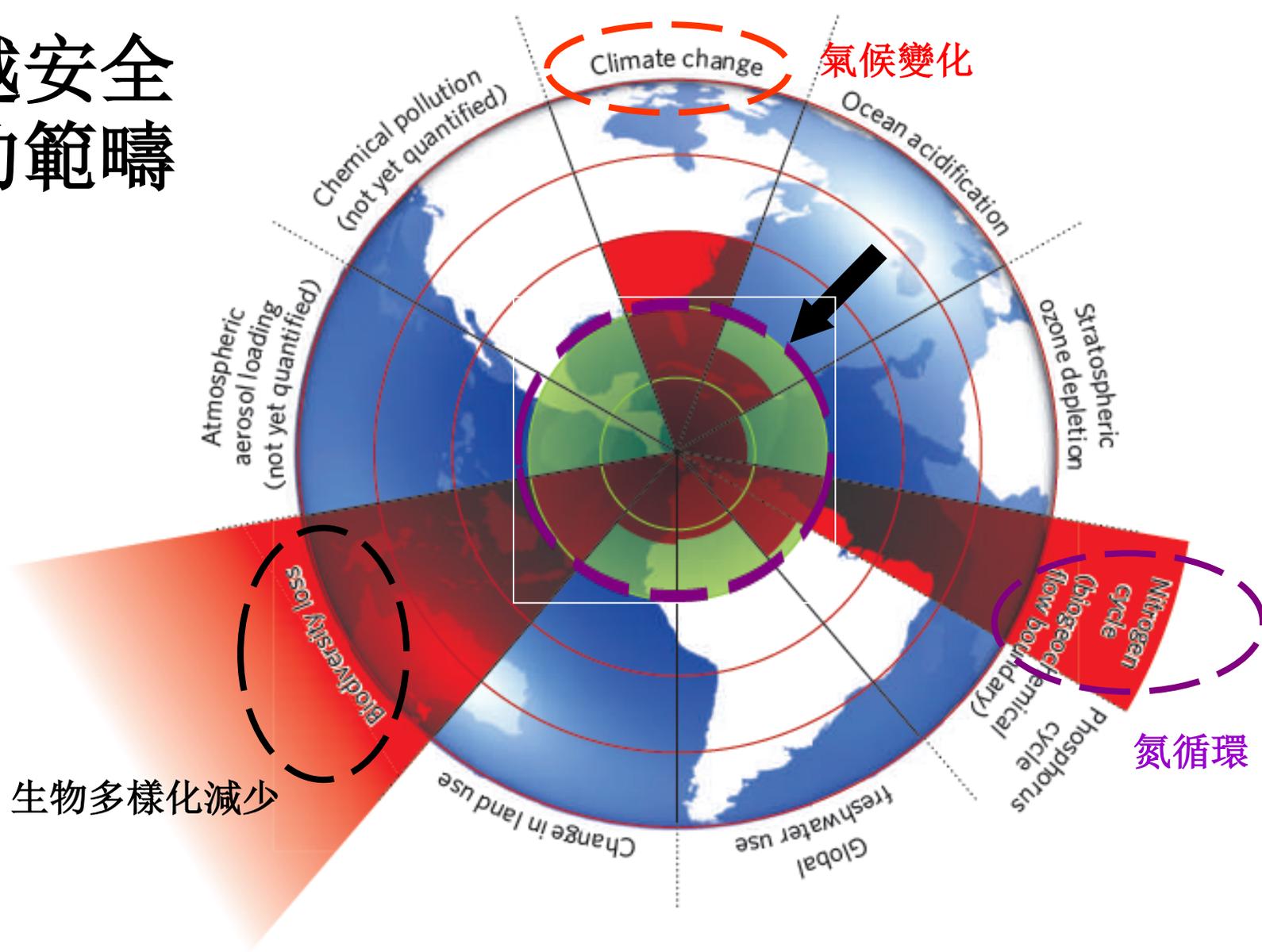


Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

Source: Rockstrom et.al. Nature, 2009

已跨越安全界限的地球過程

PLANETARY BOUNDARIES				
Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Climate change	(i) Atmospheric carbon dioxide concentration (parts per million by volume)	350	387	280
	(ii) Change in radiative forcing (watts per metre squared)	1	1.5	0
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10	>100	0.1-1
Nitrogen cycle (part of a boundary with the phosphorus cycle)	Amount of N ₂ removed from the atmosphere for human use (millions of tonnes per year)	35	121	0

- **Biodiversity Loss – 100 to 1000 times natural rate**
- **Nitrogen & phosphorus cycle – “Extracting” N & P from atmosphere & rock -> lakes & seas**

Source: Rockstrom et.al. 2009, Nature

地球 - 我們的家

著名电影制作人吕克·贝松 高空摄影家扬·阿尔蒂斯-贝特朗
 LUC BESSON YANN ARTHUS BERTRAND
 走访50个国家 俯瞰生态光影 美不胜收搬上了大银幕
 ZHOUXUN
 联合国开发计划署(UNDP)中国亲善大使 周迅中文配音
 联合国环境规划署(UNEP)“地球卫士”
 “OUR PART 我们的贡献”项目诚意推荐

OUR PART 我们的贡献

HOME

拯救地球

HOME 家园

你有能力改变，还等什么？

家园 HOME

DZL-GD-Z20

广东弘艺文化传播有限公司



学懂爱惜我们仍然保有的50%雨林
而非只着眼那失去的一半

当你在看封底文字的这一分钟 地球就有四个人死于水污染……

导演扬·阿尔蒂斯-贝特朗花了15年时间筹备，走访50多个国家拍摄，由澳洲海底的大堡礁到非洲肯尼亚高原的乞力马扎罗山；亚马逊热带雨林到戈壁沙漠；美国德克萨斯州连绵不断的棉花田到中国上海的工业城镇。如诗如画的美景唤醒世人：珍惜现存的一切自然资源，继续呵护我们的家园——地球，这才是60亿人的责任所在……

吕克·贝松监制，国际著名摄影师扬·阿尔蒂斯-贝特朗执导的纪录片。以客观的角度阐述地球的诞生、演变及地球现今所面临的种种问题！以一幕幕自然漂亮的画面带领观众认识美丽的地球，并借此宣扬环保的重要以及迫切性。

英文解说：格伦·克洛斯 中文解说：周迅



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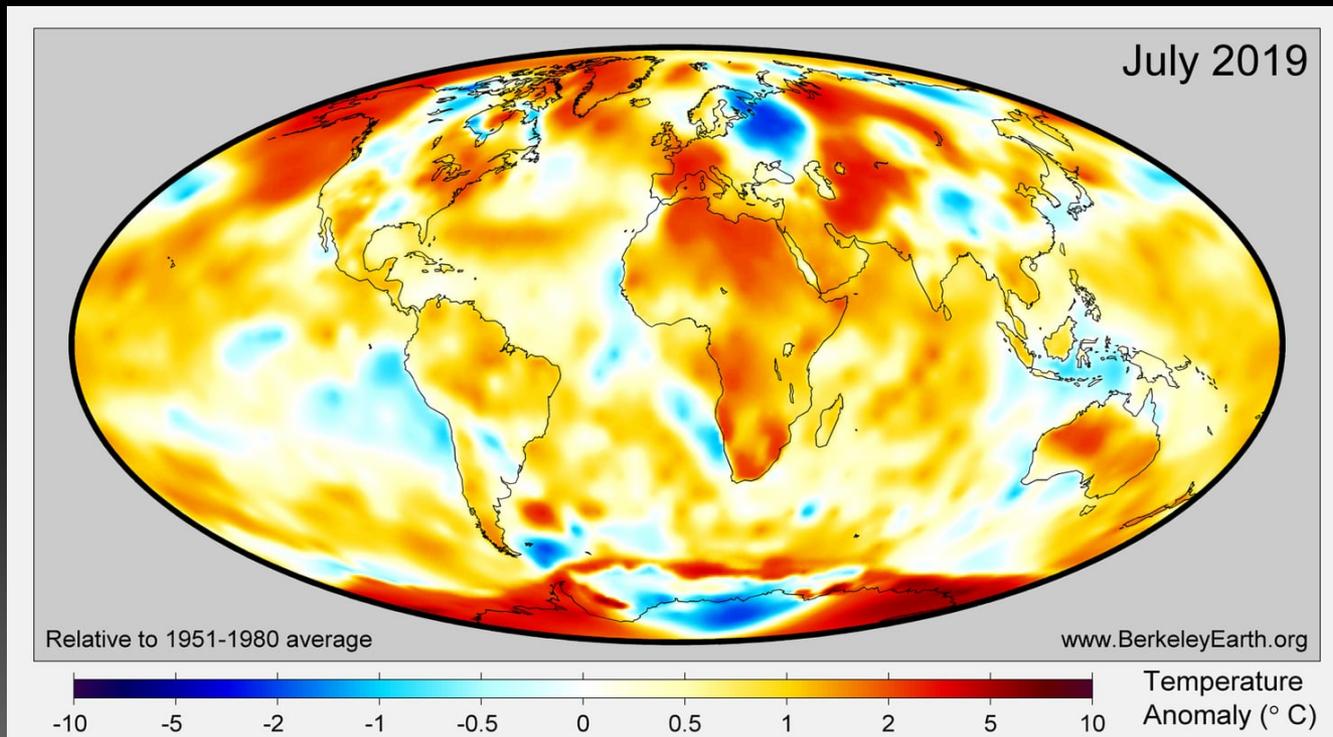
*“The most unique feature of Earth is the **existence of life**, and the most extraordinary feature of life is its **diversity**.”*

Approximately 9 million types of plants, animals, protists and fungi inhabit the Earth. So, too, do 7 billion people.”

Bradley J. Cardinale et al. 2012. Nature

News Headline – Washington Post 15 August 2019

“July was Earth’s hottest month since records began, with the globe missing 1 million square miles of sea ice.”



Global average surface temperatures during July 2019 compared to the 1951-1980 average.

Credit: Berkeley Earth

Breaking and Melting Ice Caps



Source: US Geological Survey



Photograph by Jim Brandenburg

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National Geographic 100 Best Pictures
Collector's Edition Vol. 1

Area to be Inundated 海水上升可能淹沒的地方

Fort Lauderdale, Florida with 1.2 metre sea-level rise
More than 150 million people live within 1 metre of high tide level



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Flooding Everywhere

Thailand
2011



Tonle Sap Lake,
Cambodia 2013



Vietnam
2008



“The significance of biodiversity for human wellbeing was recognized 20 years ago with the formation of the Convention on Biological Diversity – an intergovernmental agreement among 193 countries.”

Bradley J. Cardinale et al. 2012. Nature

IUCN Red List Report

18 July 2019

國際自然保護聯盟 IUCN 報告 2019

Humankind accounts for the loss of 30000 species, **none of which we can afford to lose.**

近三萬物種即將因人類而滅絕，而我們無法承受任一物種的消失



國際自然保護聯盟 IUCN 報告 2019

“The loss of these species would deprive billions of people of a critical source of food and income, and could have knock-on effects on entire ecosystems. To halt these declines, we urgently need policies on the human use of freshwaters that allow for the needs of the many other species sharing these ecosystems.”

「人類存續關鍵，也就是食物、淡水、飲用水和乾淨空氣，全都仰賴生活周遭生態多樣性的平衡。我們沒辦法承受任一物種的消失。」



「最新的紅皮書名錄證實了IPBES全球生態多樣性評估的調查結果：大自然正以有史以來從未見過的速度快速凋零。若想阻止這樣的衰退，就必須採取更有決斷性的手段。」

“There is mounting evidence that biodiversity increases the stability of ecosystem functions through time.”

Bradley J. Cardinale et.al. 2012, Nature

*“The majority of models indicate alarming consequences for biodiversity, with the worst case scenarios leading to extinction rates that would qualify as the **sixth mass extinction in the history of the earth.**”*

Celine Bellard et.al., 2012, Ecology Letters

Plastic Pollution – National Geographic Images



Plastic bottles choke the Cibeles fountain, in central Madrid.

Plastic Pollution - National Geographic Images

Trapped in a plastic bag at a landfill in Spain, this stork has a lucky escape - the photographer later freed it.

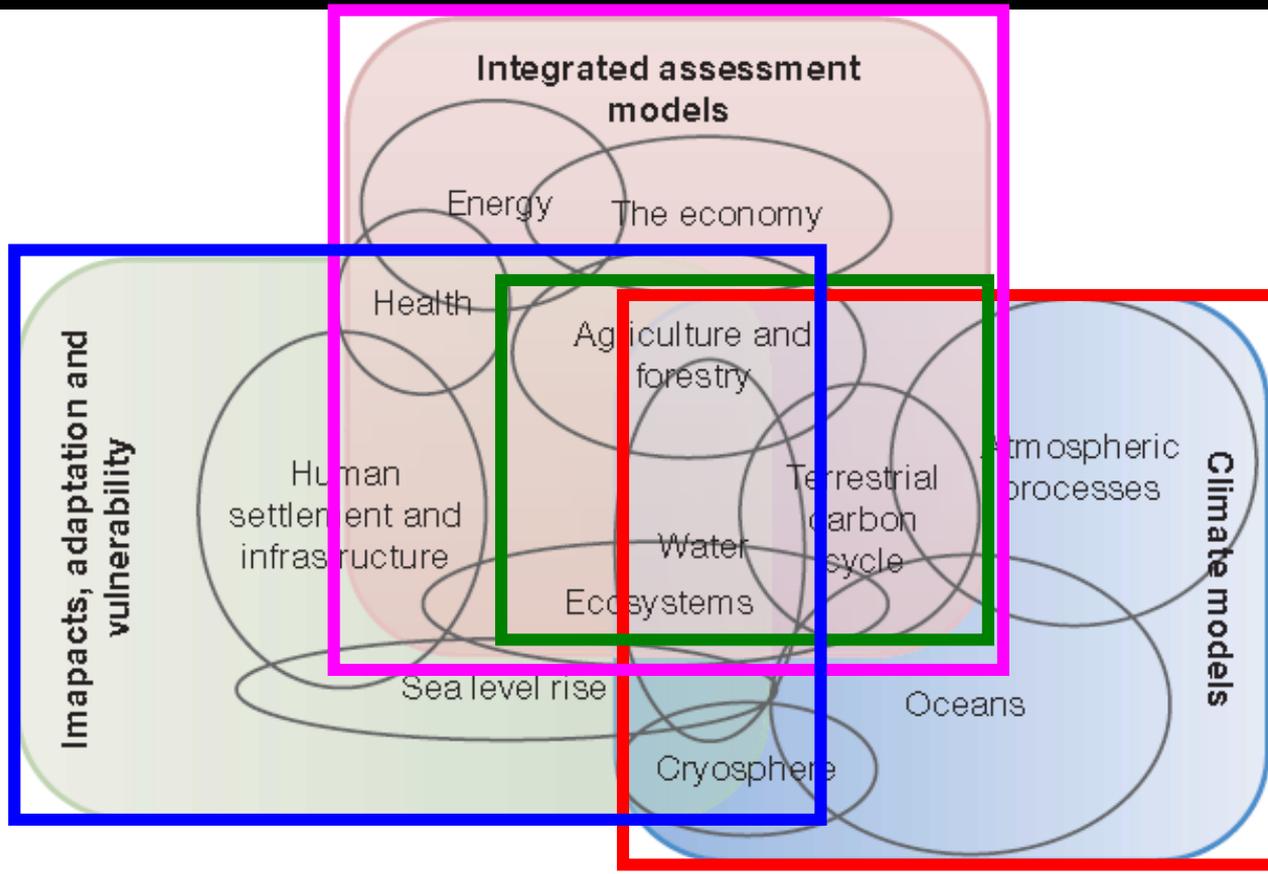


Plastics In Rainwater, Plastics In Snow, Plastics In Our Food, Plastics Everywhere



Source: Steve Hanley, 15 August, Facebook

The Interlocking Physical, Biological & Human Systems



Source: Richard H. Moss et.al. 2010, Nature

It is About Human Survival

“As biodiversity is degraded, human society becomes more vulnerable, because options for change are diminished.”

UNEP and UN-Habitat,
The Role of Cities, 2005

Hexi Corridor: 祁连山与河西走廊: 水资源短缺、沙漠扩张、绿洲萎缩

温家宝: 决不能让民勤成为第二个罗布泊 (多次批示)

从植被等生态系统的生存极限来看, 未来的14-20年内, 甘肃石羊河流域民勤绿洲将不复存在

巴丹吉林沙漠

民勤绿洲萎缩

腾格里沙漠

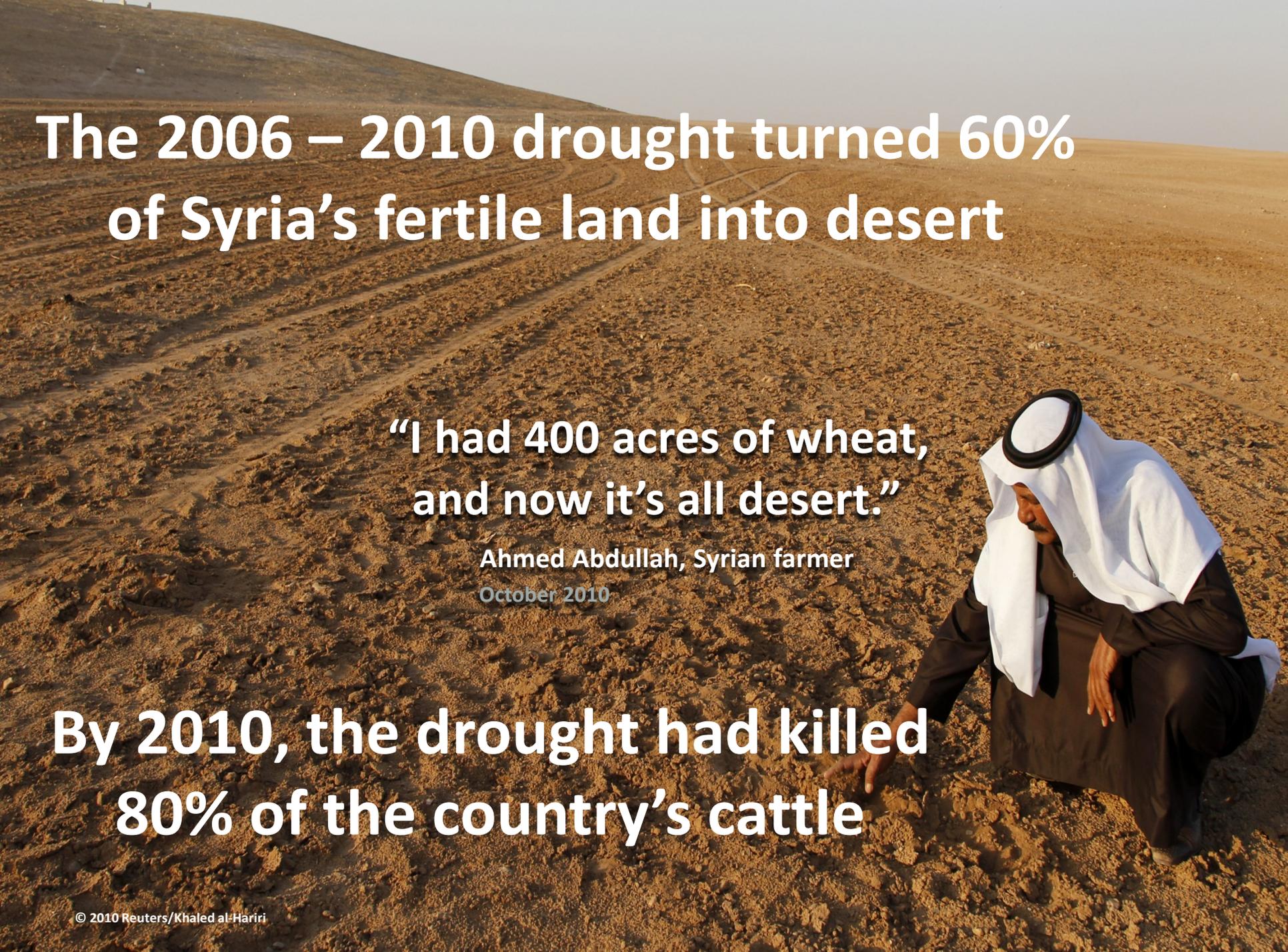
祁连山





Uneven Impacts of Climate Change

- “Africa - the continent **most vulnerable** to the impacts of projected changes because poverty limits adaptation capabilities.” (*IPCC 2001*)
- “The high sensitivity of **food crop systems** in Africa to climate is exacerbated by additional constraints such as heavy **disease burden, conflicts and political instability, debt burden** and unfair international trade system.” (*Andrew Challinor et.al., 2007, Climatic Change*)



**The 2006 – 2010 drought turned 60%
of Syria's fertile land into desert**

**"I had 400 acres of wheat,
and now it's all desert."**

Ahmed Abdullah, Syrian farmer
October 2010

**By 2010, the drought had killed
80% of the country's cattle**



A million people fled their homes and farms due to drought

How Effective is EIA in Addressing The “Double Jeopardy”?

- **Ability** to anticipate, prevent and suggest measures to manage the impending crises
- **Is EIA the appropriate tool?**
 - **Whether** or not?
 - **How** to shape/reshape it to be.

How Effective is EIA in Addressing These Threats?

- How many IA practitioners are involved directly in:
 - Climate change: UN - IPCC?
 - Biodiversity: UN – Biodiversity Convention?
- How many of our publications have been cited in their reports?

EIA Has Been Evolving: From Project EIA to SEA

- There are **three** turning points:
 - Focus: from “**projects**” to “**programs, plans & policies**”
 - Consideration of **alternatives**
 - **Capacity and institutional analysis**

1ST Turning Point: Changing Focus - PPPs

- **Policy:** guiding intent, defining goals, objectives and priorities, setting directions
- **Plan:** strategy or design to carry out a general or particular course of action, incorporating policy ends, options and ways and means to implement them
- **Programme:** schedule of proposed commitments, activities or instruments to be implemented within or by a particular sector or area of policy
(UNEP 2002:499)

The 2nd Turning Point – Alternatives

‘Thérivel and colleagues (1992:19-20), for example, defined SEA as:

*The formalized, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan or programme **and its alternatives**, including the preparation of a written report of the findings of that evaluation (emphasis added)’*

2nd Turning Point: Alternatives

The EU Directive asks for:

“Reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme.”

Alternative Options

- *WHY?* Is there a genuine need?
- *WHAT?* What can be done to meet the need?
- *WHERE?* Where should the proposed developments be located?
- *HOW?* In what form and design should the development be carried out?

3rd Turning Point: Capacity and Institutional Analysis

Assessing institutional governance

Review of a country's environmental management and governance systems, legislative framework and analytical capacities

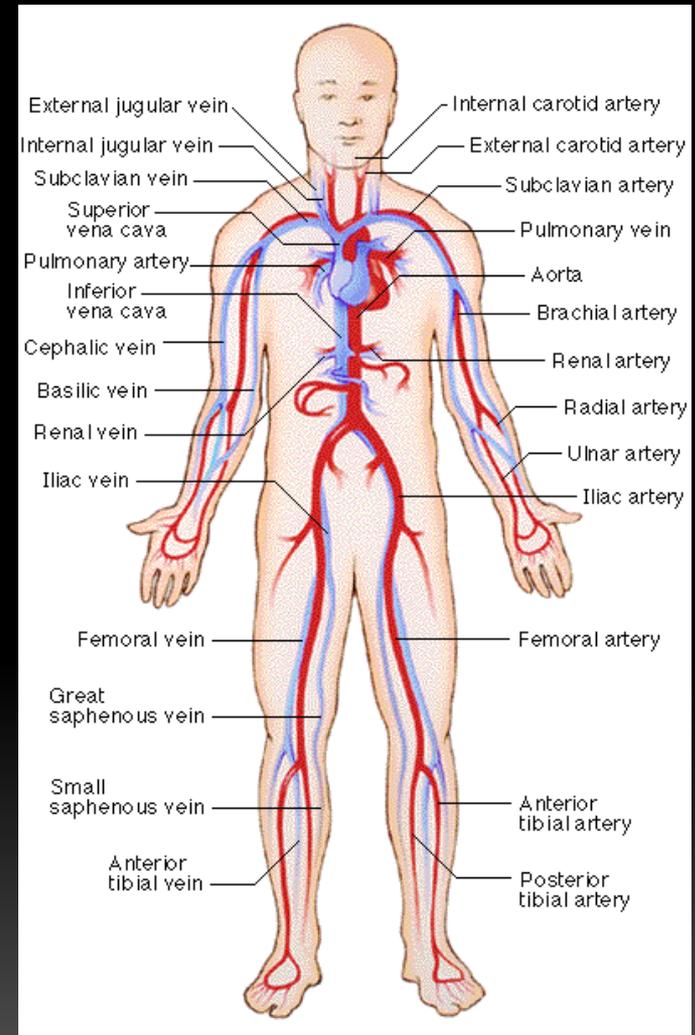
Strengthening institutional governance

Support to increase social accountability and governance
Adaptive learning – ensuring continuity in SEA processes
Policy alignment and integration

Capacity and Institutional Analysis

The Chinese Medicine Analogy:

- Building up the body
- Understanding the context
- Enhancing circulation
- Identifying the critical points



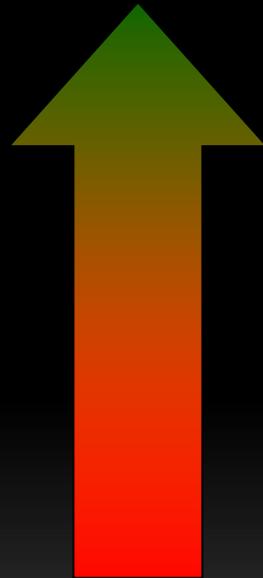
How is Impact Assessment Usually Done with Respect To ...



- **氣候變化 Climate Change**
- **生物多樣性流失
Biodiversity Loss**

EIA Mitigation Hierarchy

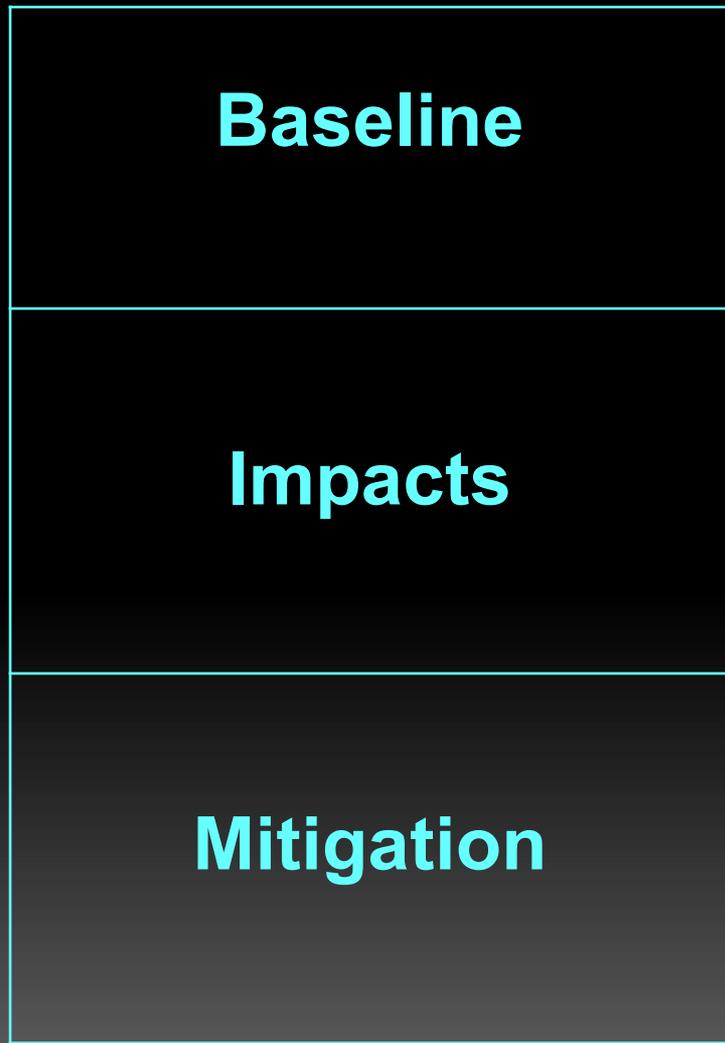
More Preferred



Less Preferred

- Avoidance – need?
alternatives alignment &
design
- Minimization of impacts
- Mitigation of residual impacts
- Compensation

Focus – Difference between Conventional and Climate Change IA



Common Approaches to Address Climate Change

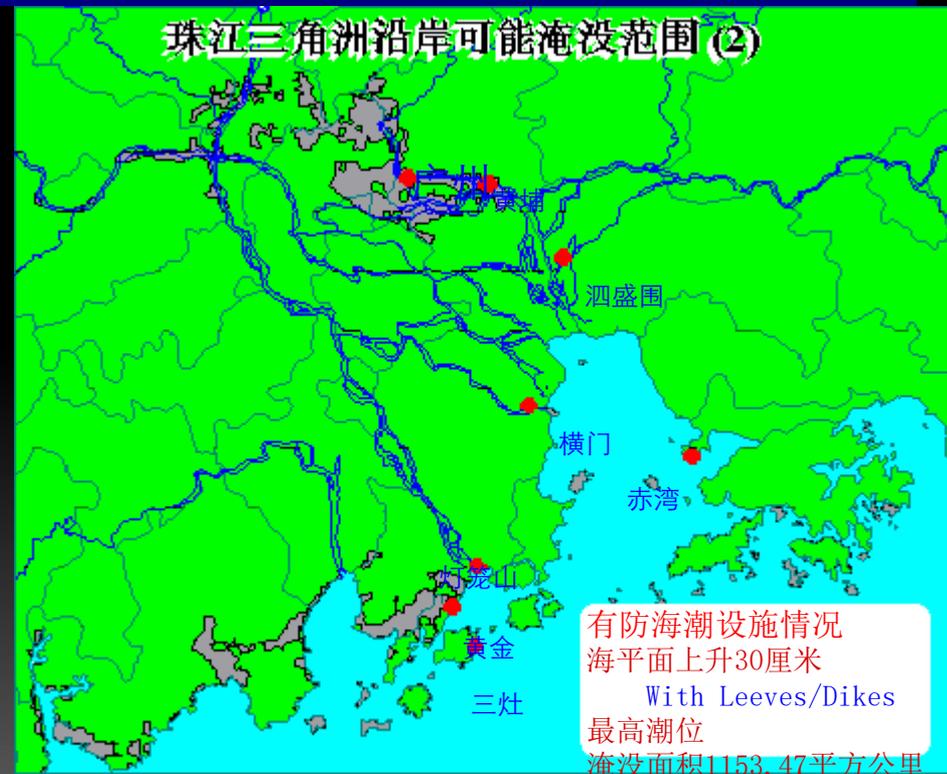
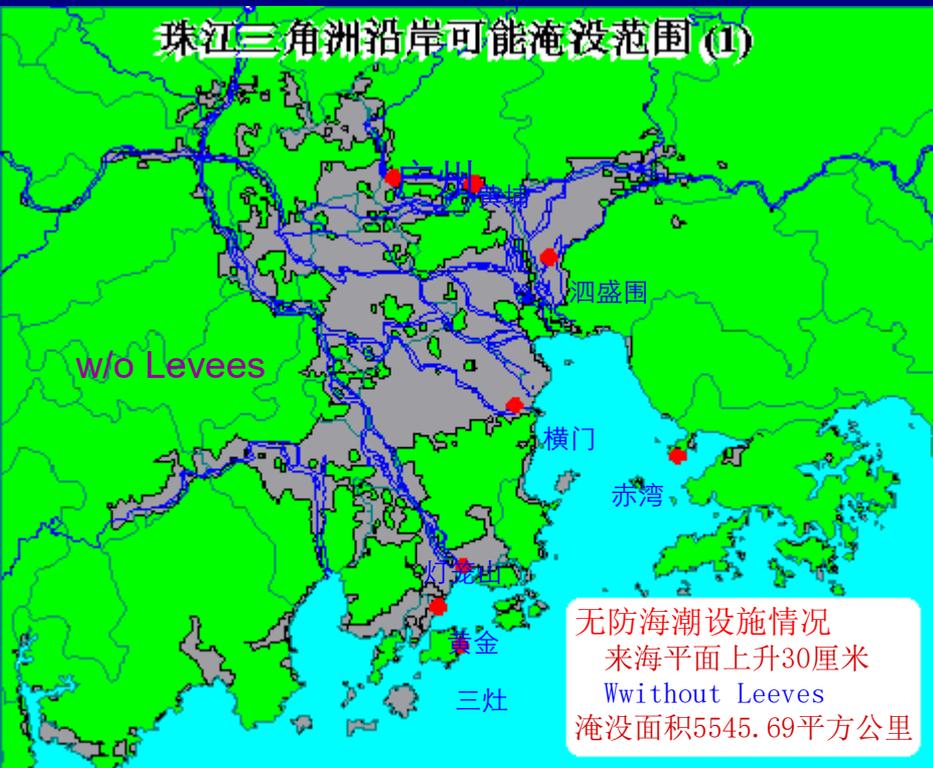
- **Mitigation:** limiting global climate change through reducing the emissions of greenhouse gases (GHGs) and enhancing their sinks
- **Adaptation:** moderating the adverse effects of unavoidable climate change through a wide range of actions

Climate Adaptive Capacity Enhanced by

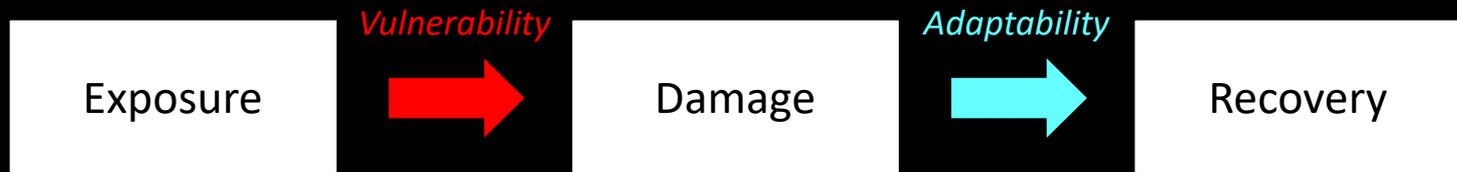
- Coping at the economy-wide level (economic restructuring)
- Adaptation through planning/engineering
- Adaptation through social protection
- Adaptation through ecosystem protection
 - In recognition of the linkages among livelihood, well-being of the poor, and the resilience of ecosystems

Adaptation: Areas to be Inundated in Pearl River Delta with/without Levees

中国珠江三角洲沿岸一些地区因海平面上升可能被淹没，
如采取适应措施可减轻损失



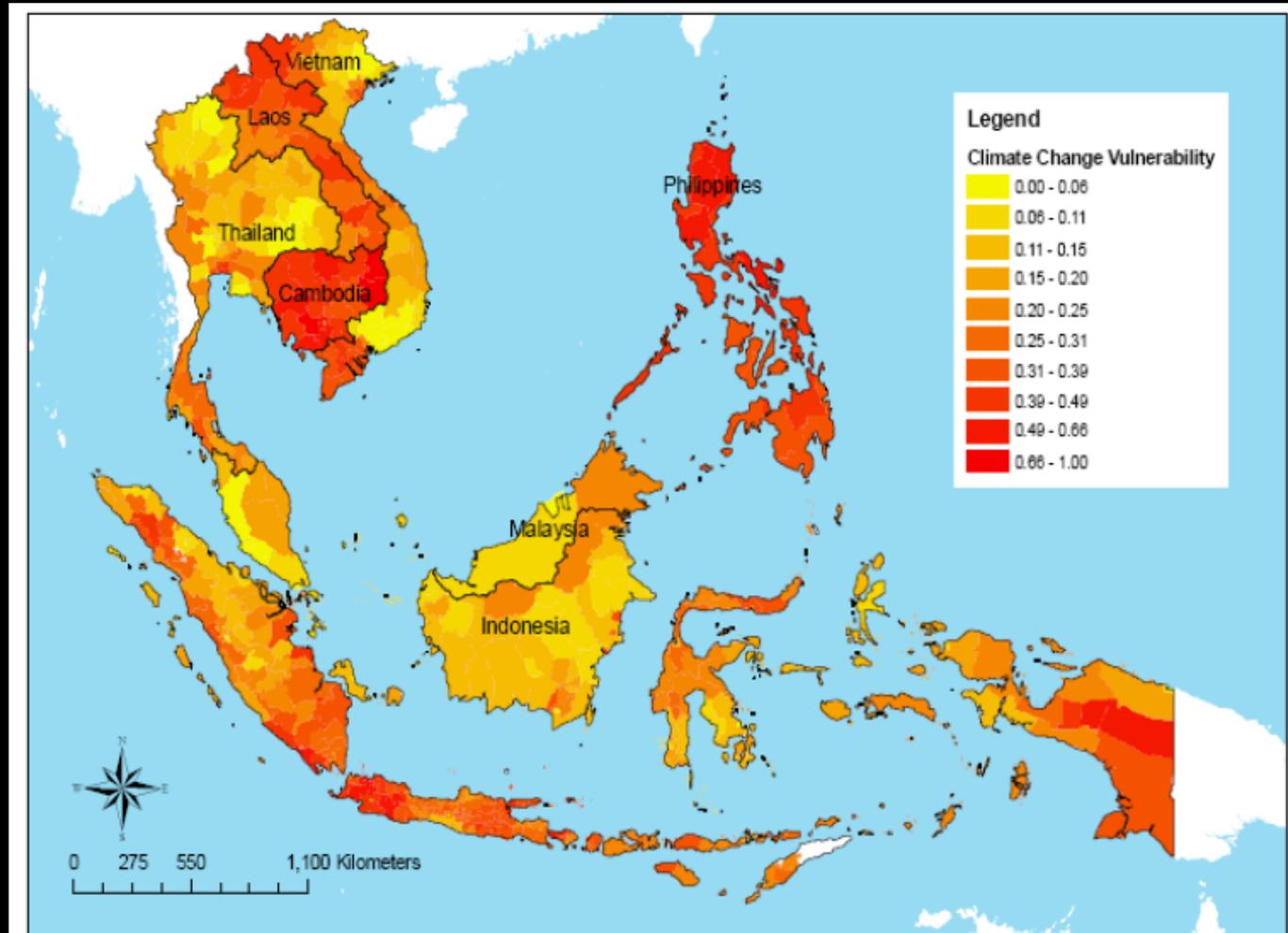
Model of Human Response to Climate Change



Vulnerability

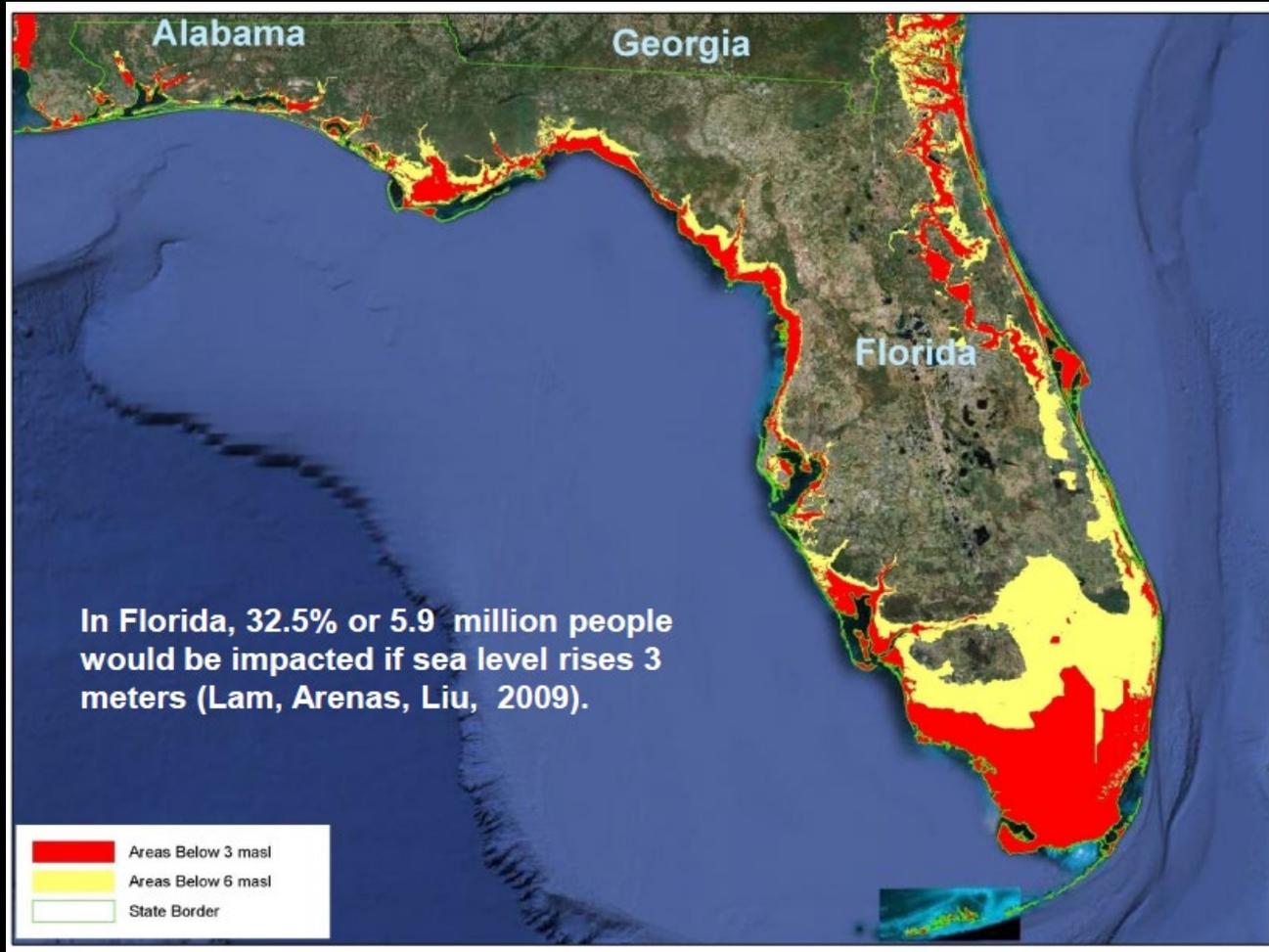
- The degree to which a society is **susceptible to, or unable to cope** with, adverse effects of climate change, including climate variability and extremes.
- Vulnerability is **a function** of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Vulnerability to Climate Change – South East Asia

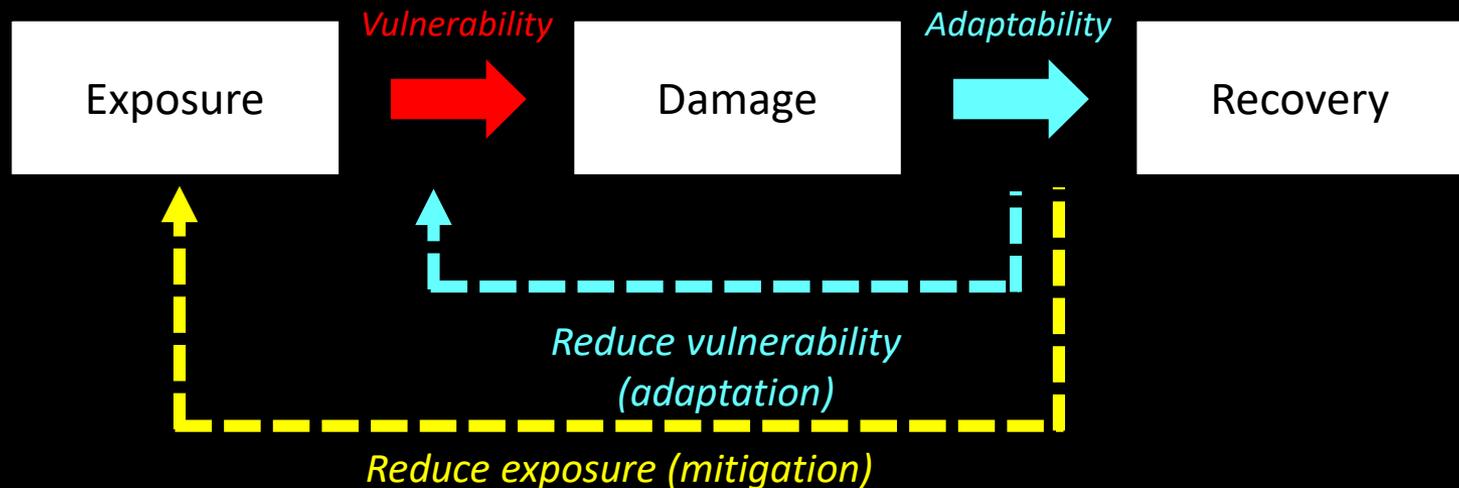


Climate change vulnerability of Southeast Asia
(Source: Yusuf and Francisco, 2009)

Vulnerability – Spatial Differences in Florida



Model of Human Response to Climate Change



Proposed Actions – Difference between Conventional and Climate Change IA

Minimize
Mitigate
Compensate

Reduce Exposure (Mitigation)
Adapt
Build up Resilience

China's Pledge at Paris 2015

- Peaking of CO2 emission on/before 2030
- Lower CO2 intensity per GDP by 60-65% from 2005
- Increase RE in primary energy consumption by 20%
- Increase forest stock by around 4.5 billion m3 from 2005 level

China's Policies and Actions on Climate Change (2015)

The National Development and Reform Commission

November 2015

Conventional Approach

Impact assessment

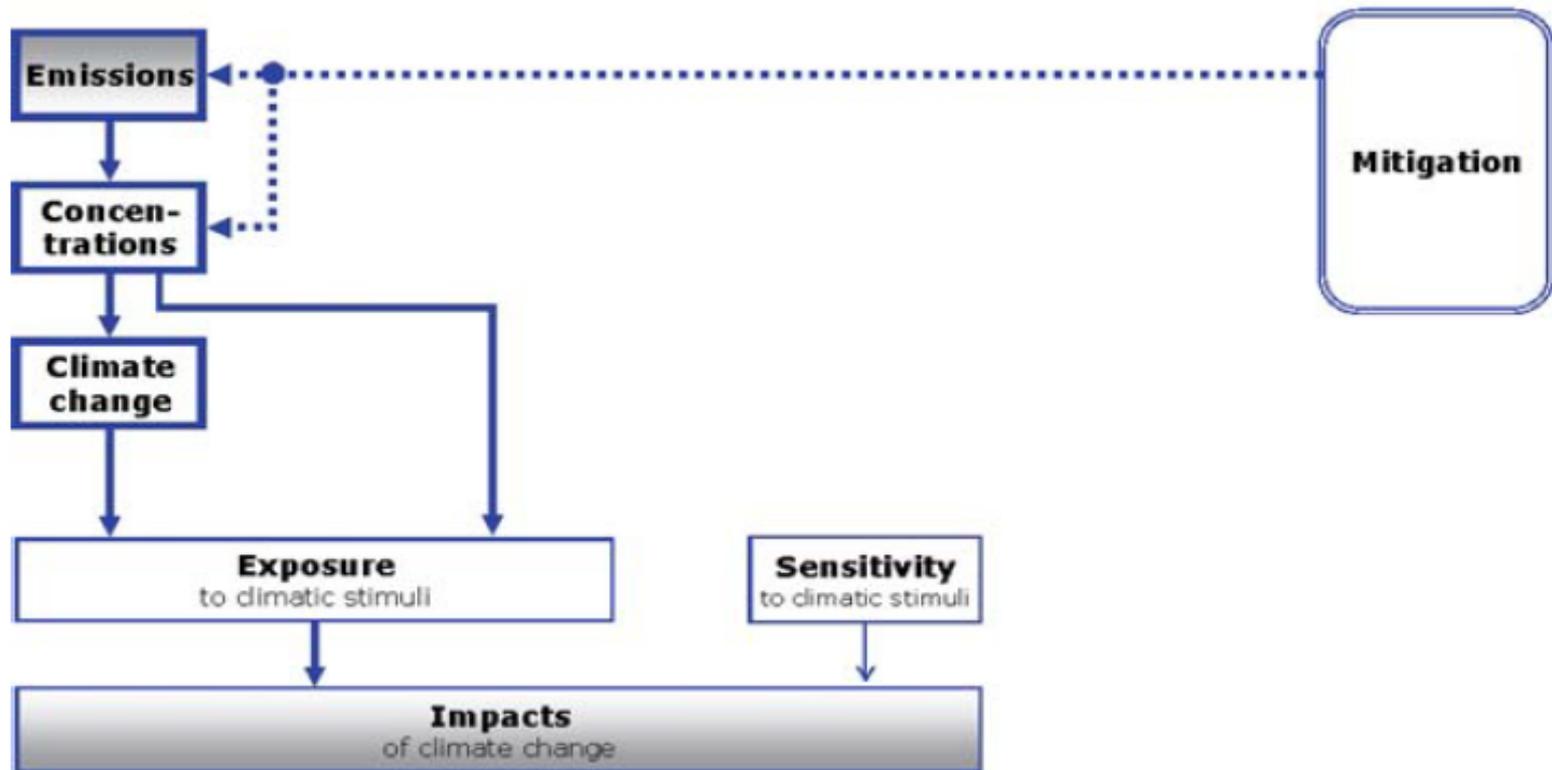


Figure 3. Conceptual framework for a (climate) impact assessment.

From Impact Assessment to Capacity Analysis

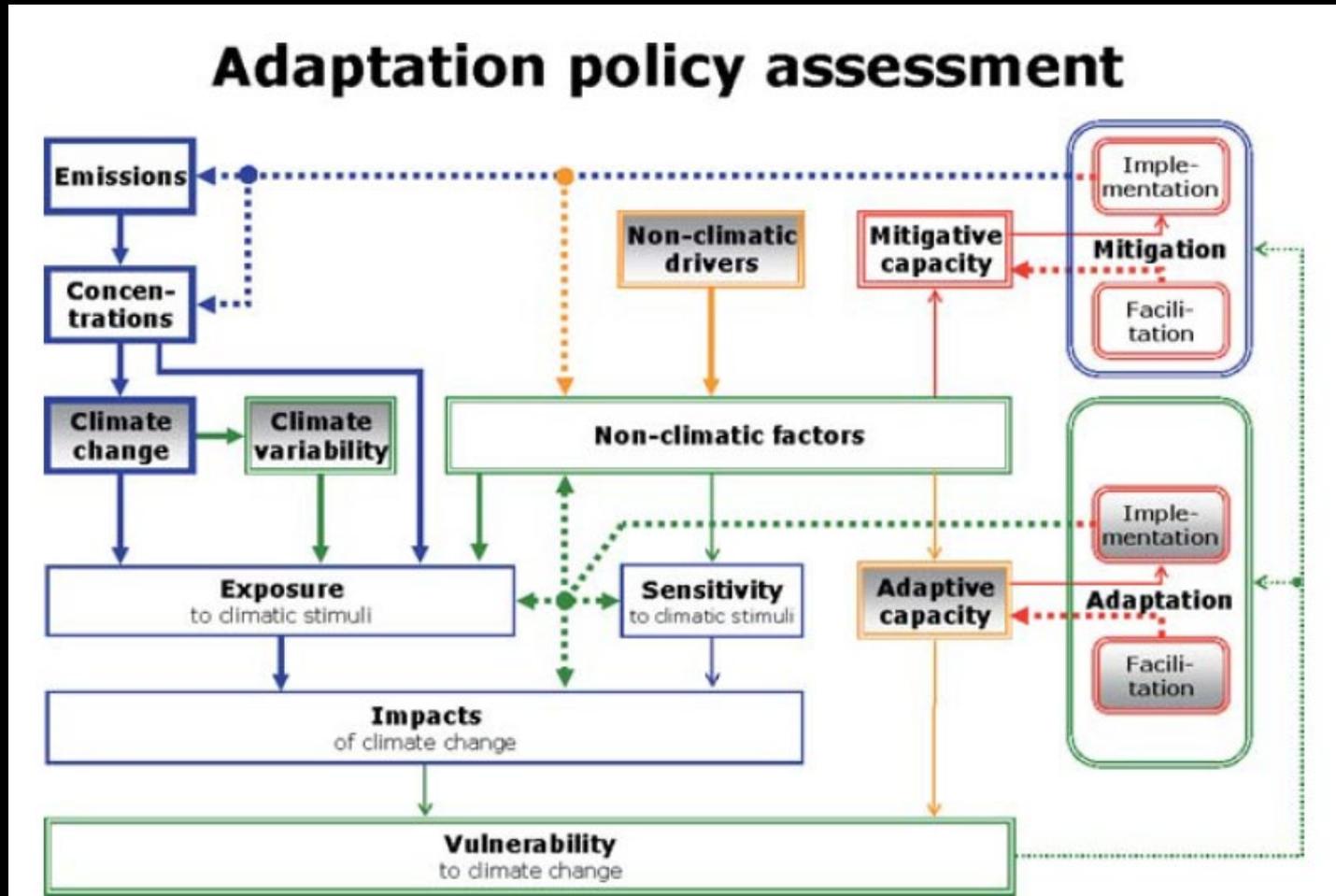


Figure 6. Conceptual framework for an adaptation policy assessment.

Tasks New to IA Profession

- Adaptive capacity analysis
- Vulnerability analysis
- Recovery capacity analysis
- Based on understanding and analysis of
 - Context
 - Institution
 - Governance structure
 - Social structure

How is Impact Assessment Usually Done with Respect To ...



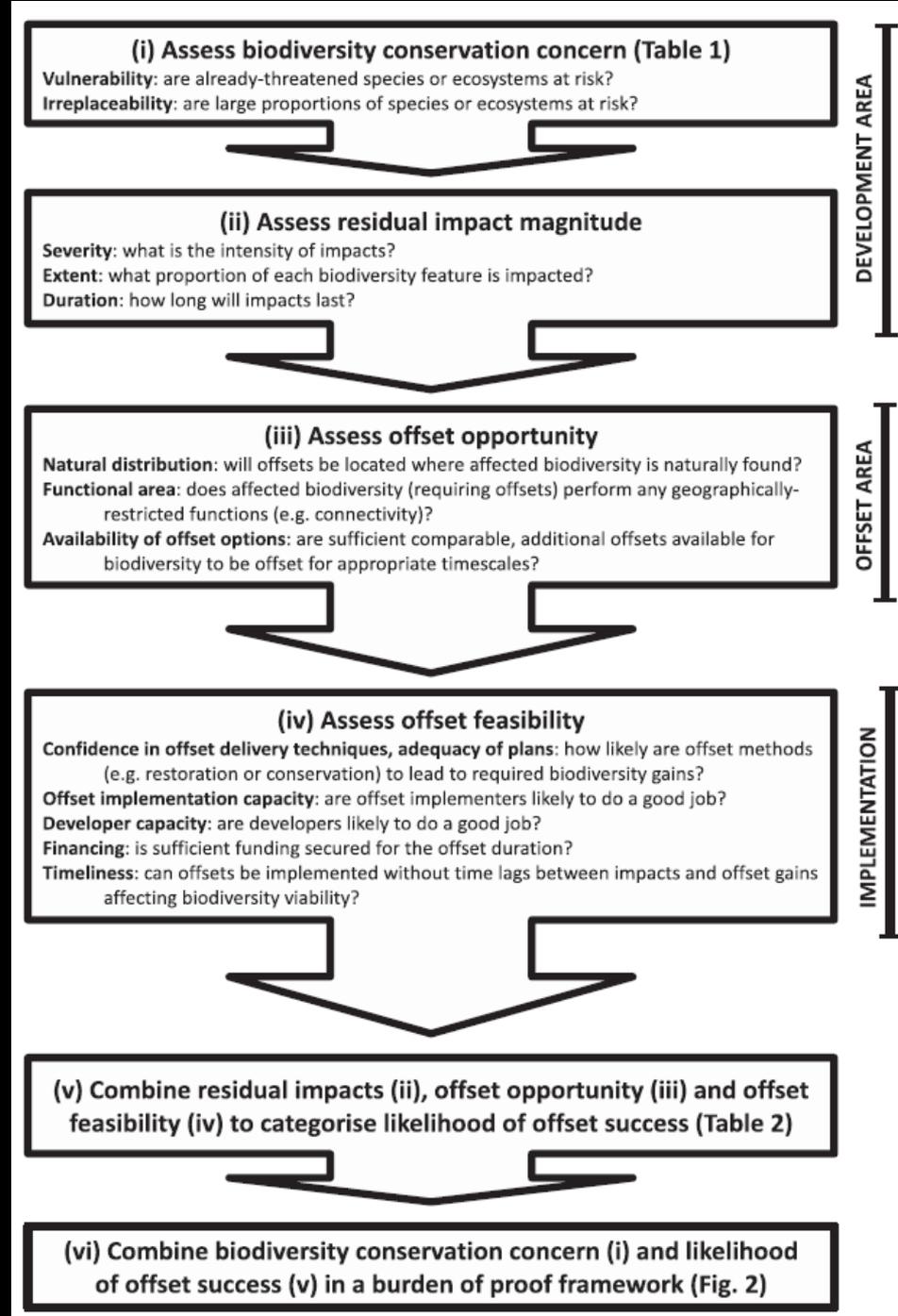
- 氣候變化 Climate Change
- 生物多樣性流失
Biodiversity Loss

“The study confirms the lack of a consistent quality in current biodiversity assessments, the term biodiversity is seldom used in today’s EIA practice, and its scope and meaning are not defined.”

Most EISs consider species and local habitats, they rarely consider the ecosystem level.”

M. Gontier et.al. 2006, EIA Review

Current Emphasis of Biodiversity Assessment



Source: John D. Pilgrim et.al. 2013,
Conservation Letters

Emphasis of Current Biodiversity Assessments

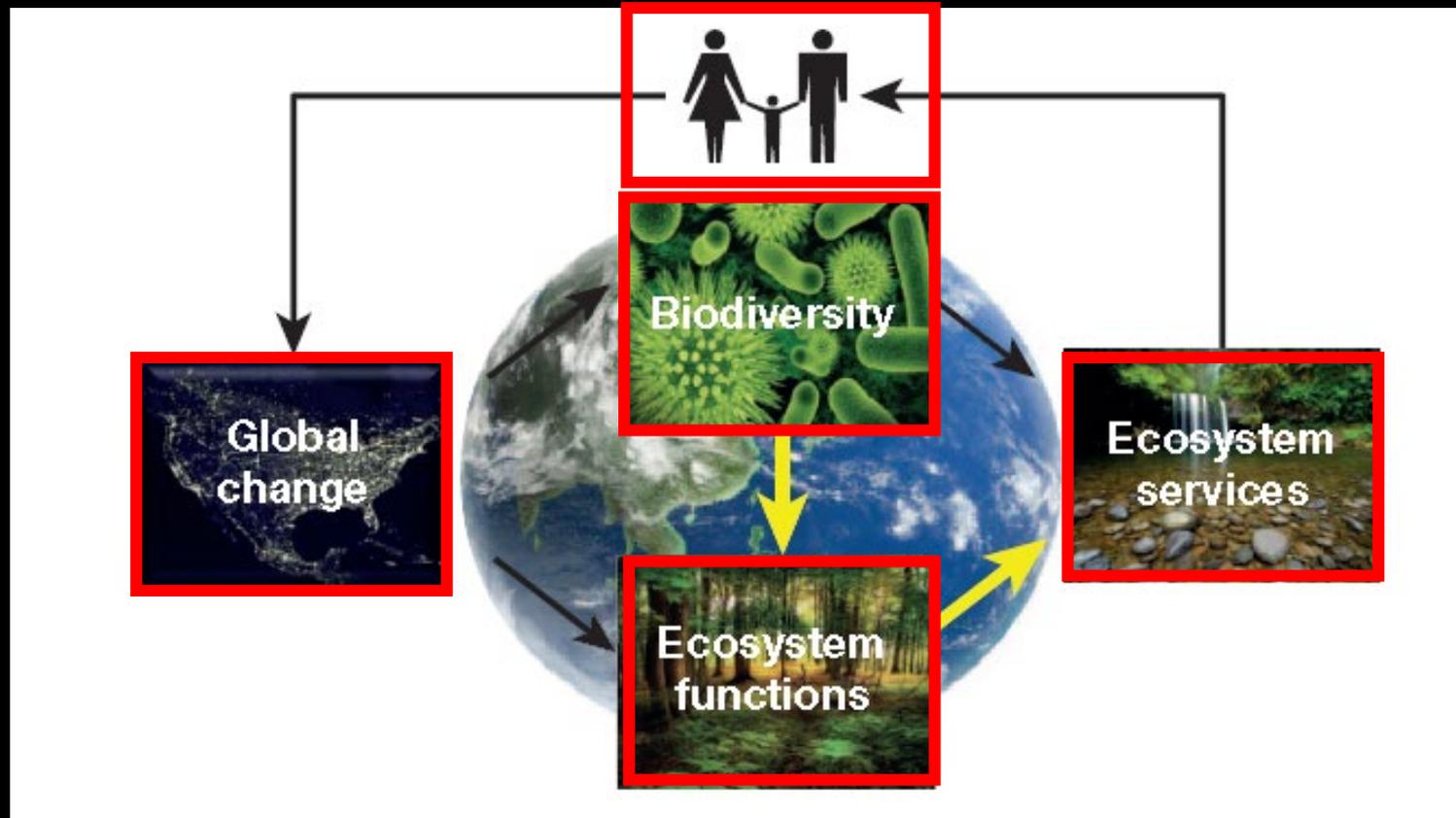
- *Impacts:* e.g. habitat loss, fragmentation
- *Mitigation:* e.g. road ecology
- *Compensation:* ecological equivalence, biological offset
- *Technical constraints:*
 - The impact of biodiversity on any single ecosystem process is nonlinear
 - Uncertainty in upscaling impact from habitat to ecosystem level

“Biodiversity increases the complexity and realism of experiments, not enough to move biodiversity research towards better forecasting.

We need sets of models and statistical tools that help us move from experiments that detail local biological processes to landscape-scale patterns where management and policy take place “

Bradley J. Cardinale et al. 2012. Nature

Interlinkage Between Biodiversity Loss, Ecosystem Function, Services and Global Change



Tasks New to IA Profession - Biodiversity

- Tasks already with some experience
 - Habitat disturbance and restoration
 - Offset
- Tasks with limited experience
 - Impacts on Ecosystem functions and Ecosystem services
 - International trade
 - Supply chain

Actions Called For

- Reversal of trend of biodiversity loss – trade and supply chain
- Restoration of damaged habitat and ecosystem
- Knowledge of effects of biodiversity loss on ecosystem functions and services

“Adaptation to human-induced change in climate has largely been envisioned as increments of these adaptations intended to avoid disruptions of systems at their current locations.

In some places, for some systems, however, vulnerabilities and risks may be so sizeable that they require transformational rather than incremental adaptations. “

Robert W. Kates et al. 2012, PNAS

“Moais” on Easter Island



Take – away Messages

- Earth under double jeopardy, some damage is done, need to avoid tipping
- Conventional EA approach is not well positioned to address challenges of Climate Change and Biodiversity Loss
- IA profession has to reshape our tool and be more pro-active and policy oriented
- New approach called for:
 - Climate change: **recovery, resilience**
 - Biodiversity: **trend reversal, restoration, ecosystem scale**

“By failing to prepare, you are preparing to fail.”

“不做好准备，就是准备失败”。

Benjamin Franklin
本杰明 富兰克林

An aerial photograph of a large, calm lake with a vibrant blue-green hue. The lake is surrounded by dense, lush green forest. In the center of the lake, a small white boat is moving, leaving a white wake behind it. The overall scene is serene and natural.

THANK YOU

Aspire to inspire, before we expire.

Lam Kin Che *HonFCIWEM, HonFHKIOA , FHKIEIA, FHKIQEP, SBS, JP*
kinchelan@cuhk.edu.hk