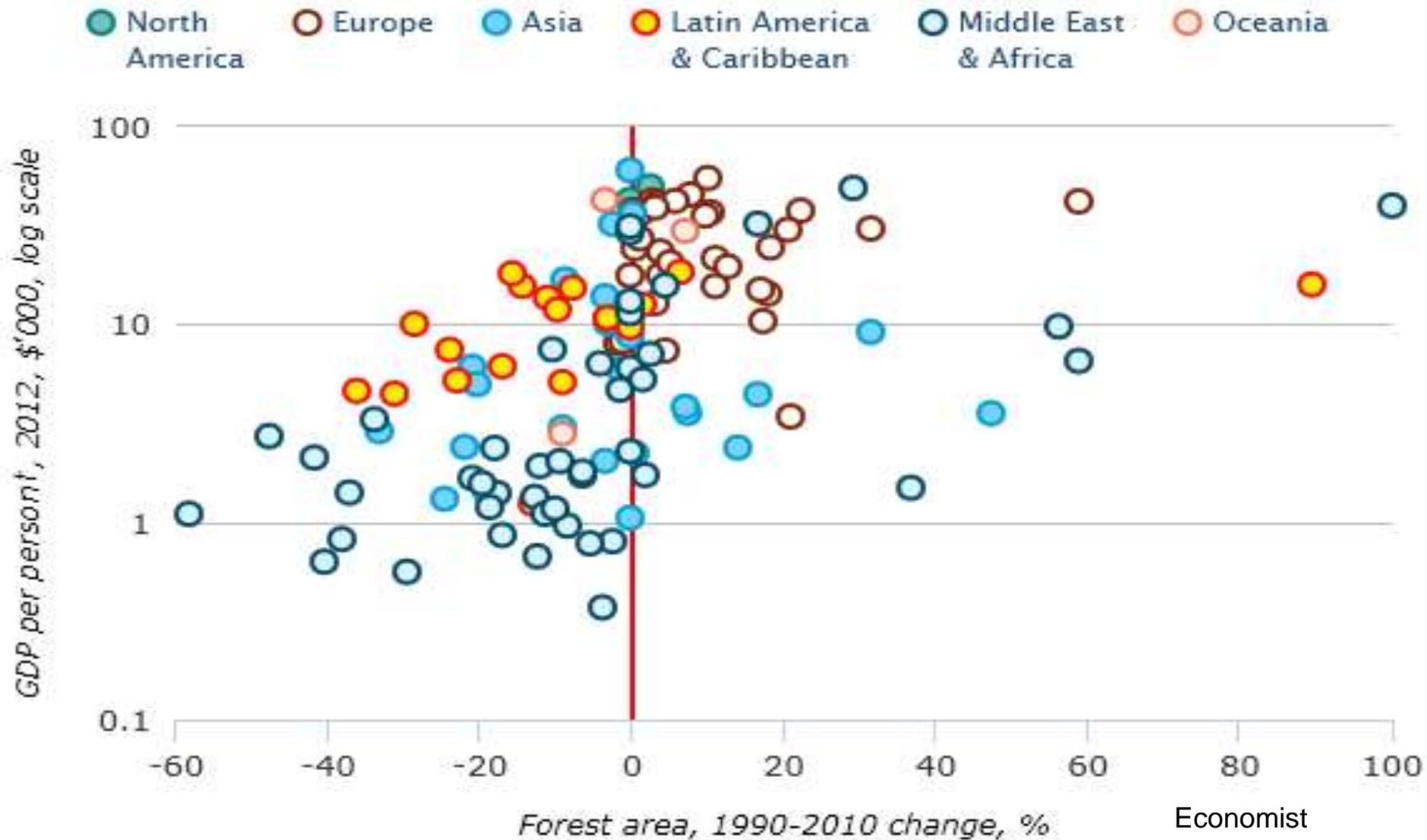


Shifting from forest  
rehabilitation to forest and  
landscape level restoration:  
why, how and what?

David Lamb  
University of Queensland  
Australia

# Net change in Forest Area and GDP per capita



# But a change in focus is underway

- Most reforestation in 20<sup>th</sup> Century done for production of goods
- Current emphasis now on production AND ecosystem services - or just ES  
(watershed protection, carbon storage, wildlife habitats, pollination, recreational opportunities etc.)
- Some former 'production' forests being converted to supplying ES
  - E.g. UK, Japan, South Korea

# Recent international policy developments

## 1. Calls for governments to adopt policies to increase reforestation

- UN Framework Convention on Climate Change
- UN Convention to Combat Desertification
- UN Forum on Forests
- UN Environment Program

## 2. Convention on Biological Diversity

- Call to **restore** 15% of degraded ecosystems by 2020

## 3. Rio+20

- 'Outcomes' document calls for increased afforestation and reforestation

## 4. IUCN Bonn Challenge

- to **restore** 150 million ha by 2020

# Examples of governments promoting new forms of reforestation

Country	Scale (m ha)	Date and Purpose
Korea	2	1950s; originally production, but later <i>ecosystem services</i>
Australia	4-5?	1997; treble plantation area (1.6m) by 2020; mainly goods but some services
Vietnam	5	1998; 3 m ha production, 2 m ha for <i>protection</i>
China	50+	2001; <i>protection</i> forests (32 mill ha in Sloping Land Conversion Program)
Brazil	15	2009; <i>Ecosystem services</i> ; Atlantic Forest Restoration Pact; >80 <i>species</i>
India	5	2010; <i>Ecosystem services</i>
Philippines	1.5	2011; National Greening Program; <i>protection</i> (and some production?)

# The context in which future reforestation will be done

## Reforestation more difficult?

- **Poverty**: Large numbers of poor people living in many degraded lands
- **Climate change**: uncertain future environmental conditions
- **Populations** increasing
- **Food needs**: Need more agricultural land

## Reforestation easier?

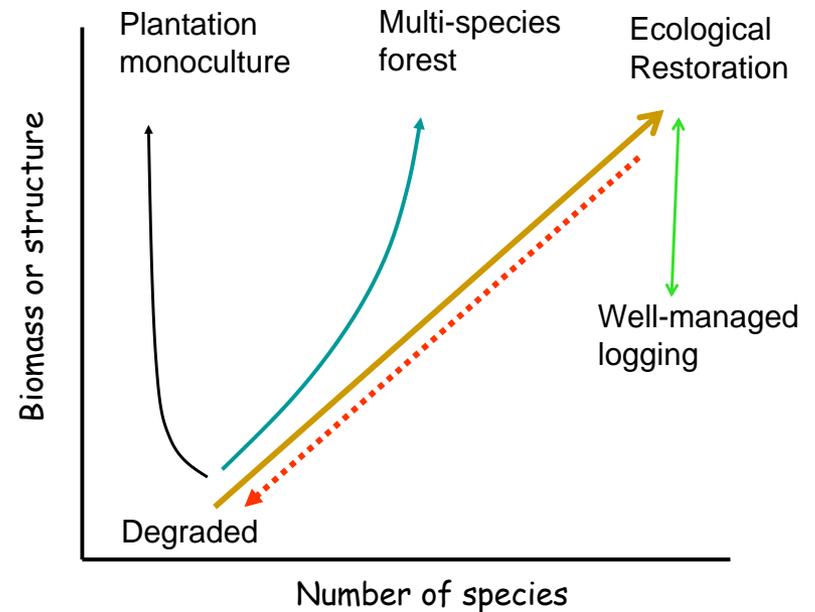
- **Increased awareness** of scale of degradation
- **Increased interest** in environmental protection
- **Development of markets for ecosystem services as well as goods** (but difficult to predict future markets?)
- **Urbanisation** (agricultural land being abandoned?)

# Implications for reforestation

Issue	Implication
Poverty	<i>Wider variety of species</i> New plantations for multiple purposes
Climate change	<i>Wider variety of adaptable species,</i> Develop tolerant polycultures
Food security	Identify marginal lands, Silvicultural methods for on-farm use
Environmental concerns	<i>Wider variety of species</i> New plantations supplying multiple ES
Markets for ES	<i>Wider variety of species</i> New plantations supplying preferred ES
Urbanisation	Silvicultural methods to manage natural regrowth

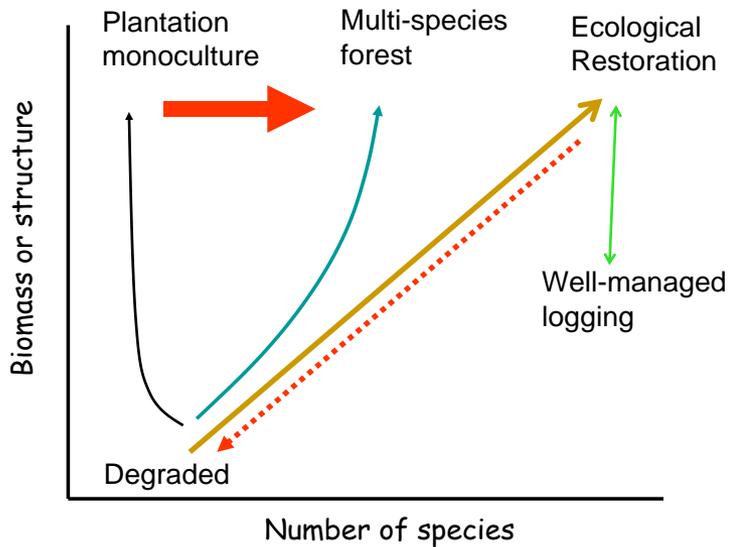
# Types of reforestation

- Many types and not just industrial model
- By natural regrowth
- Through various types of mixture
- Through ecological restoration





Monocultures may diversify if natural forest nearby

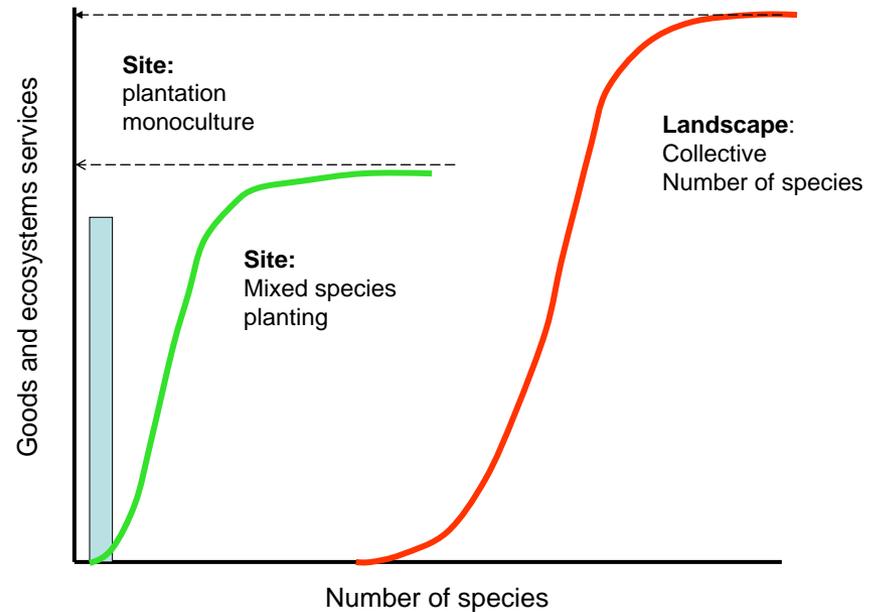


# Why the emphasis on 'landscape scale'?

- Site-based reforestation can generate some ecosystem services but not others
- Many ecological processes operate at a large spatial scale
  - Hydrological flows
  - Species reproduction
- Need large scale reforestation to
  - maintain these processes
  - generate Ecosystem Services

# Site and landscape diversity

- Mixtures often generate more **ES** than monocultures
- Landscapes contain many site-types
- Must match species to site
- Hence should have greater overall number of species

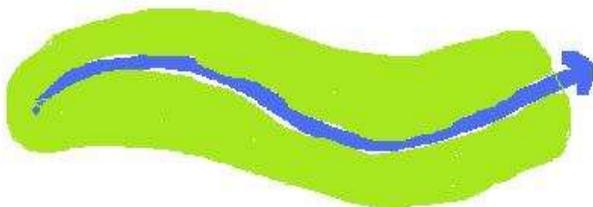


# How to do this?

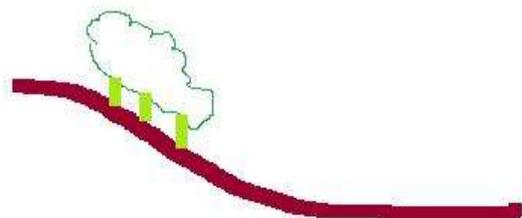
- Random or *ad hoc* plantings of cleared land by individual landholders may be ineffective (*'tyranny of small decisions'*)
- Need coordinated plantings
  - of appropriate **type**
    - Need option of more than just one type of reforestation
  - in strategic **locations**
    - Where they will generate required ecosystem service?
  - of sufficient spatial **extent**
    - One large area or many small areas?

# Better

1



2



2



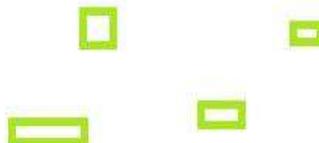
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5



# Worse



# Scaling-up to landscape scale generates questions

- How to balance reforestation with need for food security?
- How to balance production of goods with need to maintain water flows?
- How to increase biodiversity across the landscape?
- How to take advantage of natural regrowth?

# Query 1: How to balance reforestation with need for food security?

- A dilemma?
- Maybe not -
  - Use marginal and degraded land
  - Use steep land
  - Use land distant from food markets
- Reforestation may also benefit food production
  - Reduced wind and water erosion
  - A buffer in times of climatic stress (fodder)
  - A buffer in times of economic stress

# Query 2: How to balance production of goods with need to maintain water flows?

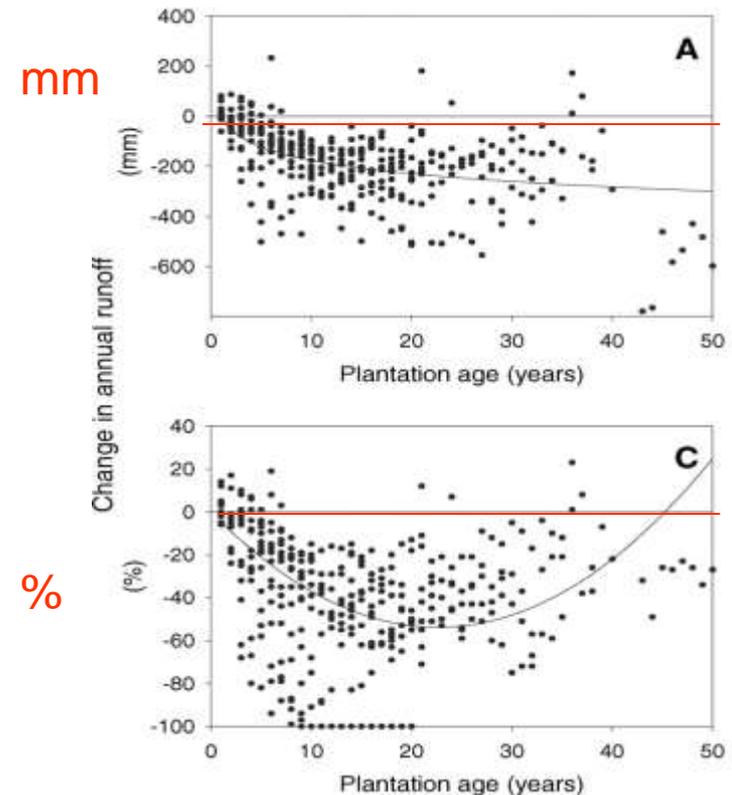
- Trees lose water through evapo-transpiration
- Water yield depends on
  - Proportion of area reforested
  - Tree density
  - Tree growth rates

- Water yield (Q)

$$Q = P - ET - \triangle S$$

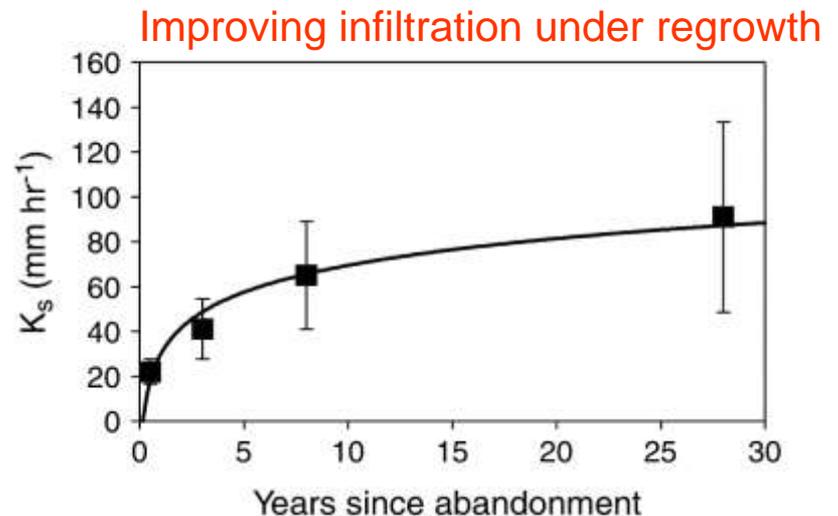
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change soil and groundwater storage



# But sometimes reforestation can improve water flows

- Topsoil at **degraded sites** has low infiltration capacity
- Much rainfall lost quickly as overland flow
- BUT - if soil infiltration improved by reforestation
  - increased groundwater store
  - delayed release
- In this case benefit of reforestation > higher cost of ET from trees



# Query 3: How to increase biodiversity across the landscape?

Improve connectivity between patches of natural forest

1. Corridors - surrounding large monocultural plantations by regrowth or species-rich forests
2. Stepping stones - foster scattered small farm plantations



# Query 3: How to increase biodiversity across the landscape? [continued]

## 3. By diversifying the plantations themselves

- to match species to sites
- to diversify products (avoid one product for one market)
- to build resilience





## Hunan, China Reforestation of sites degraded by 2008 ice storm

Establish mixed-species forests over  
28,000 ha.

In learning phase use <5 species  
**per site** and 40 species **across  
Landscape**

Plan to increase over time



Enriching conifer monocultures  
with broad-leaved species

Mixing conifers and broad-leaved  
species



# Query 4: How to take advantage of natural regrowth?

- Natural regrowth can be extensive
- Is cheapest way of reforesting large landscape areas
- Depends on old roots, seed dispersers, wind
- But is it reliable? When to replant instead?



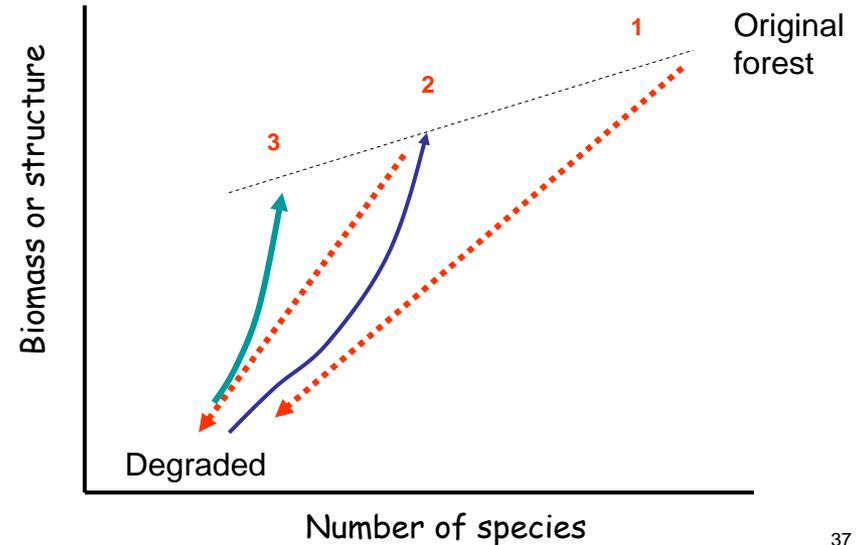
Sweden



Mexico

# Query 4: How to take advantage of natural regrowth?

- “Quality” varies with history →
- What is
  - Minimum seedling density?
  - Minimum seedling size?
- What if not uniform distribution?
- Managing
  - Protection
  - Enriching
  - Access rules



# Shifting from forest rehabilitation to forest and landscape level restoration: why, what and how?

## Why?

- Because things have changed; now require a wider range of goods and services

## What?

- Wider variety of reforestation methods at strategically chosen locations

# Shifting from forest rehabilitation to forest and landscape level restoration: why, how and what?

## How?

- New policies and institutions;
- Especially for designing new landscapes
  - Mosaic of environmental conditions
  - Mosaic of tenures
  - Variety of stakeholders