Desertification and development: some broader contexts

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Slides

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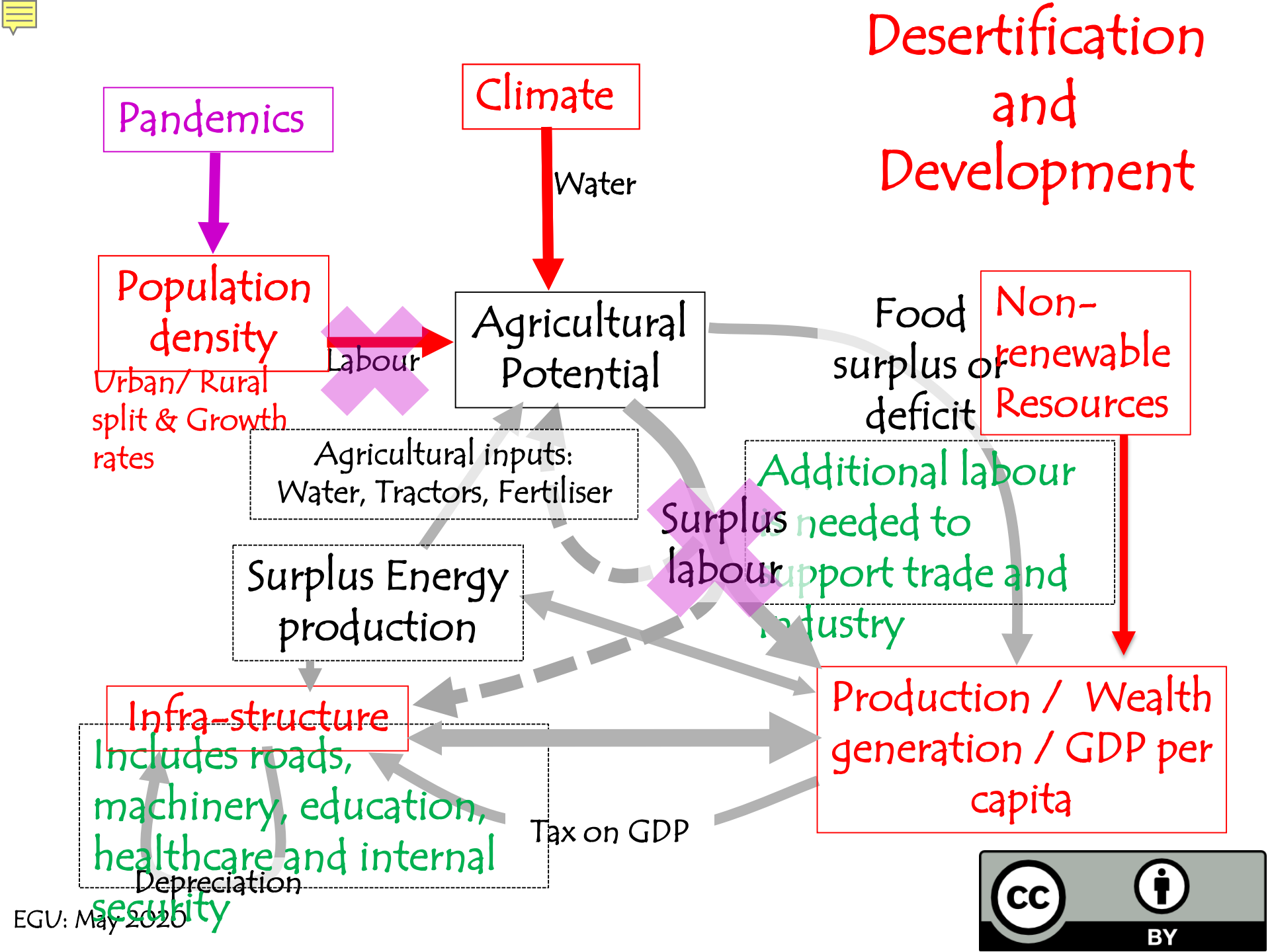
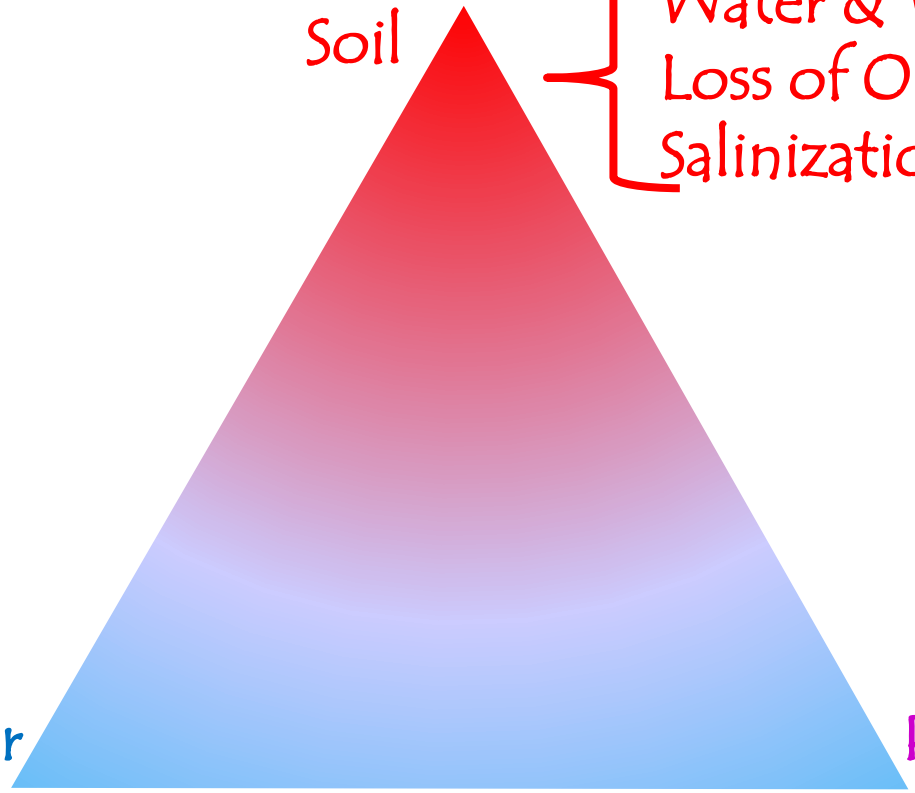
Desertification and Development



Components of desertification



Soil

- Water & Wind Erosion
- Loss of Organic Matter
- Salinization

Water

- Scarcity & Flooding
- Water Harvesting
- Sanitation

People

- Sustainable Population
- In/Out-Migration
- External Support

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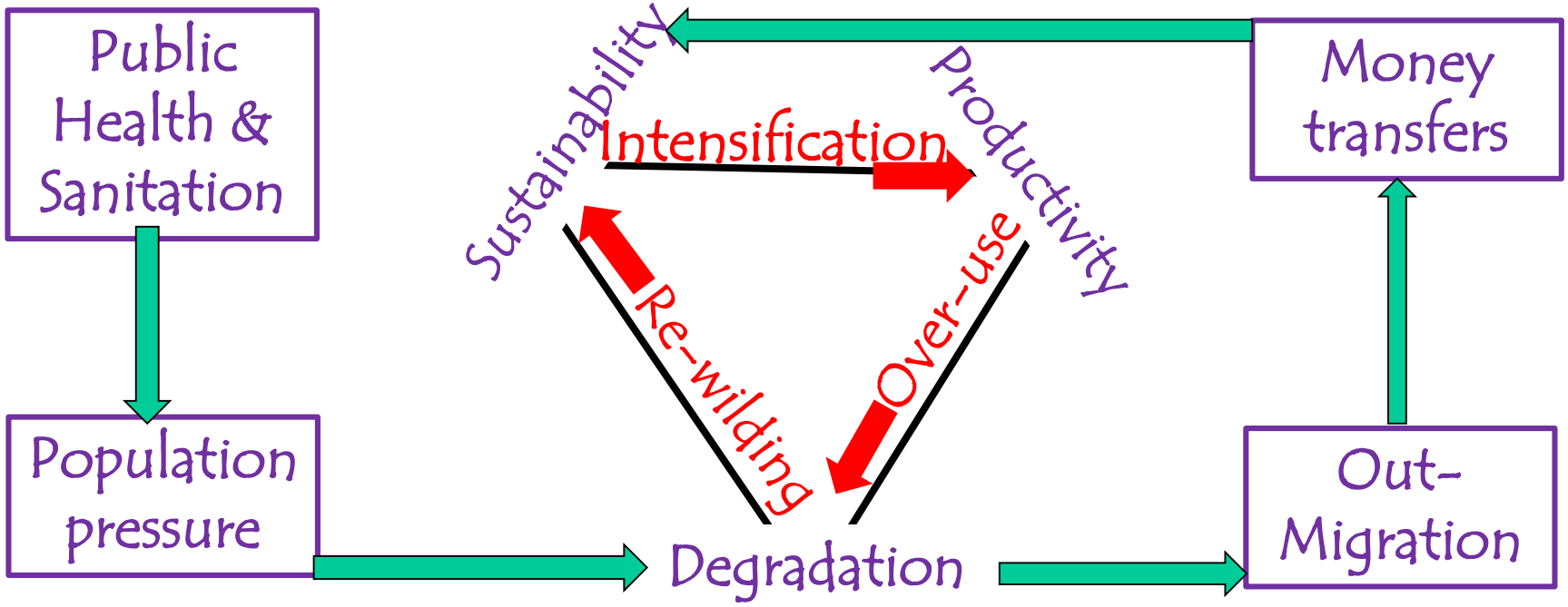
Why should we care about desertification?

Desertification is seen as one component in a broader view of managing our environment for the benefit of both the ecosystem and people in it.

- Maintaining global soil and food resources
  - Soil conservation
  - Efficient agriculture
  - Food security
  - Fostering biodiversity at all levels
- Supporting sustainable rural life
  - Slowing urban growth
  - Maintaining national identities
- Making best use of scarce water
  - Constraining intensive irrigation
  - Resolving trans-national competition

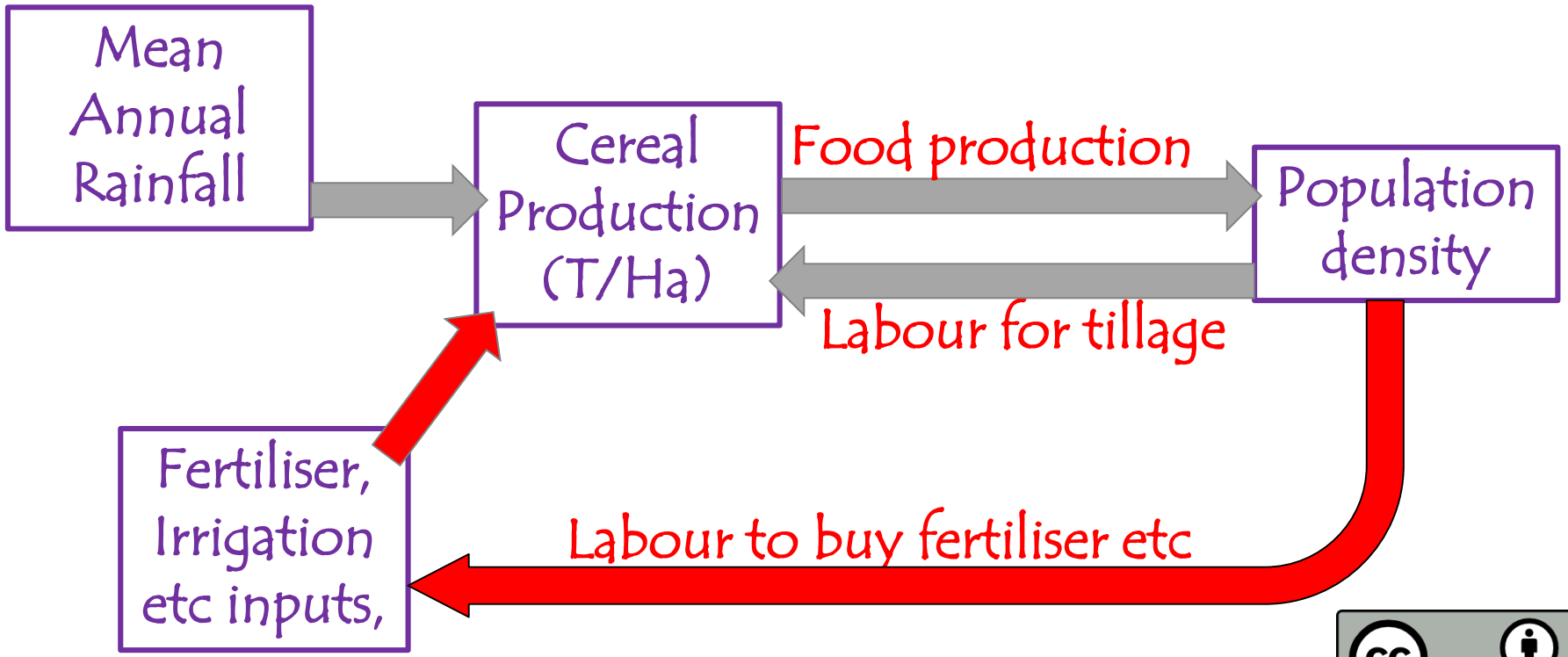
Balance between physical components of desertification



Over-use leads to physical degradation of the soil
Abandonment & re-wilding may return the land to more sustainable use (e.g. grazing)
Intensification/Mechanisation of agriculture increases productivity.
Improved public health & water supply reduces mortality, and increase populations, increasing pressure on the land and desertification
Partial abandonment and out-migration may bring in money transfers for crop improvement and intensification (seed, fertiliser, machinery)

Simple Interactive productivity model

- PRINCIPLES IN THE MODEL
- Response to annual rainfall is very limited below about 100 mm, rising more steeply thereafter, and reaching an upper limit of around 10 tonnes/ Ha above annual values of 1000 mm.
- Nitrogen fertilizer further reduces yields at low annual rainfall, but strongly and progressively increases yields at higher rainfalls, and needs labour input to purchase.
- It is assumed that soils contain a low background level of available nitrogen that may be supplemented by fertilizer additions



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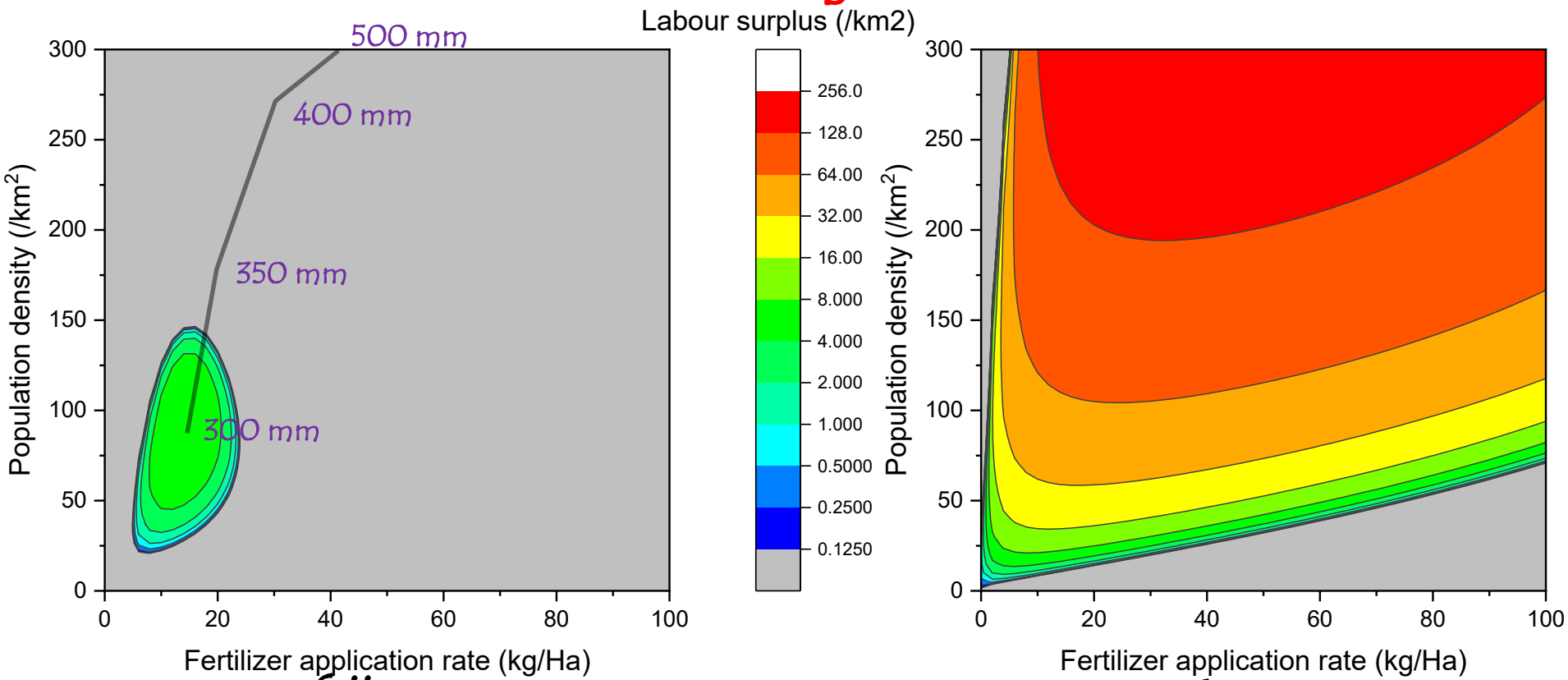
Optimum cultivation strategies under different rainfall regimes

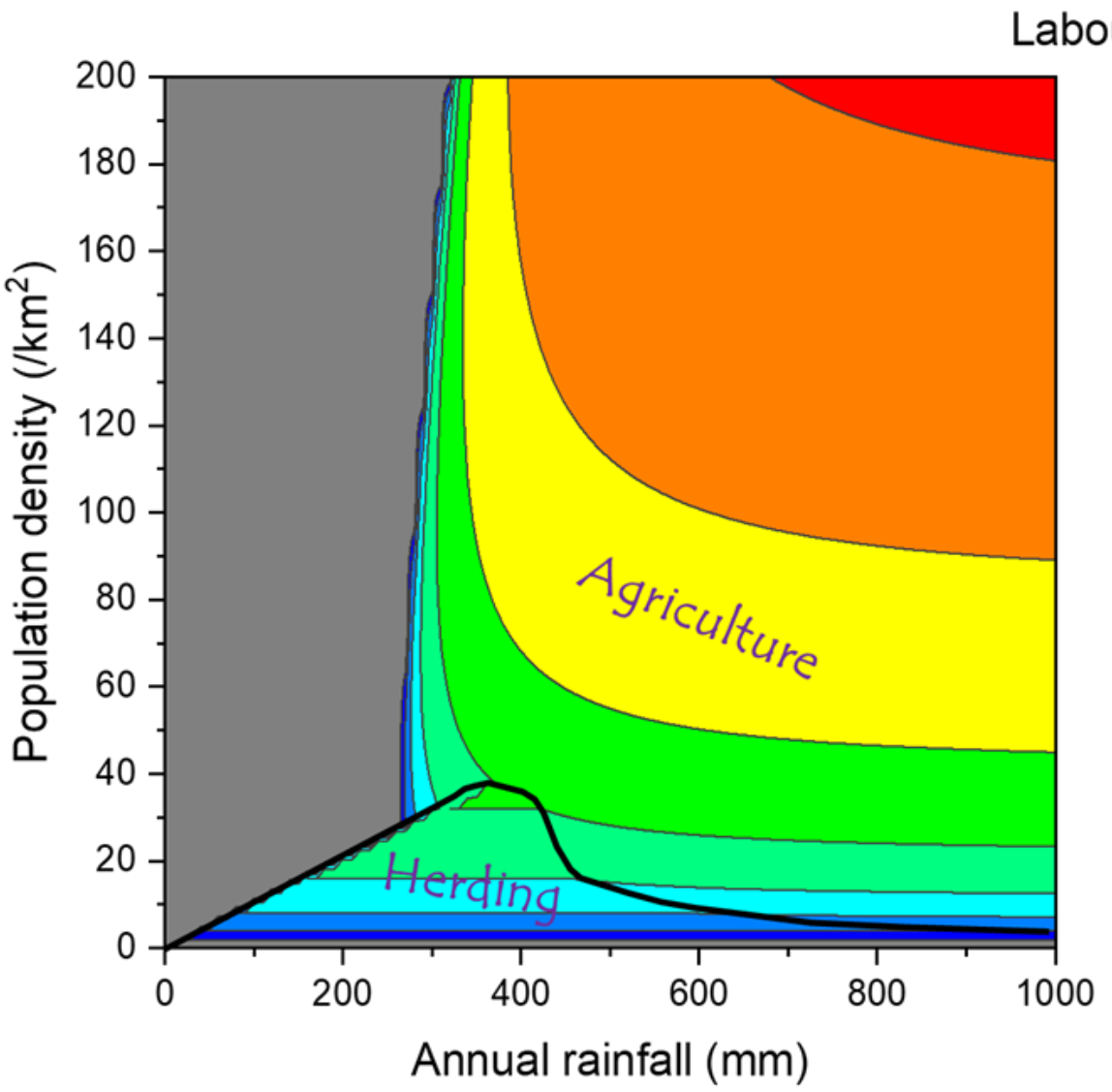


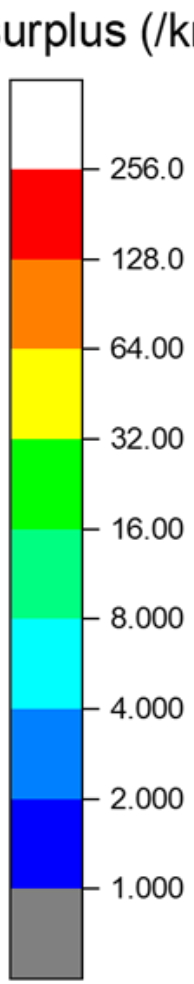
Rainfall=300 mm

Rainfall=600 mm

Lines and colours show(on same scale) the net surplus generated
Right: In a wet environment, it is worth investing in additional labour (to work fields or earn to buy fertiliser, seed etc) and improve quality of inputs, since it will then pay off
Left: A dry environment will support smaller populations, and so it is less worth-while investing in improving yields. Curve shows change in optimum with rainfall

Modelled optimum farming strategies as population and rainfall are varied

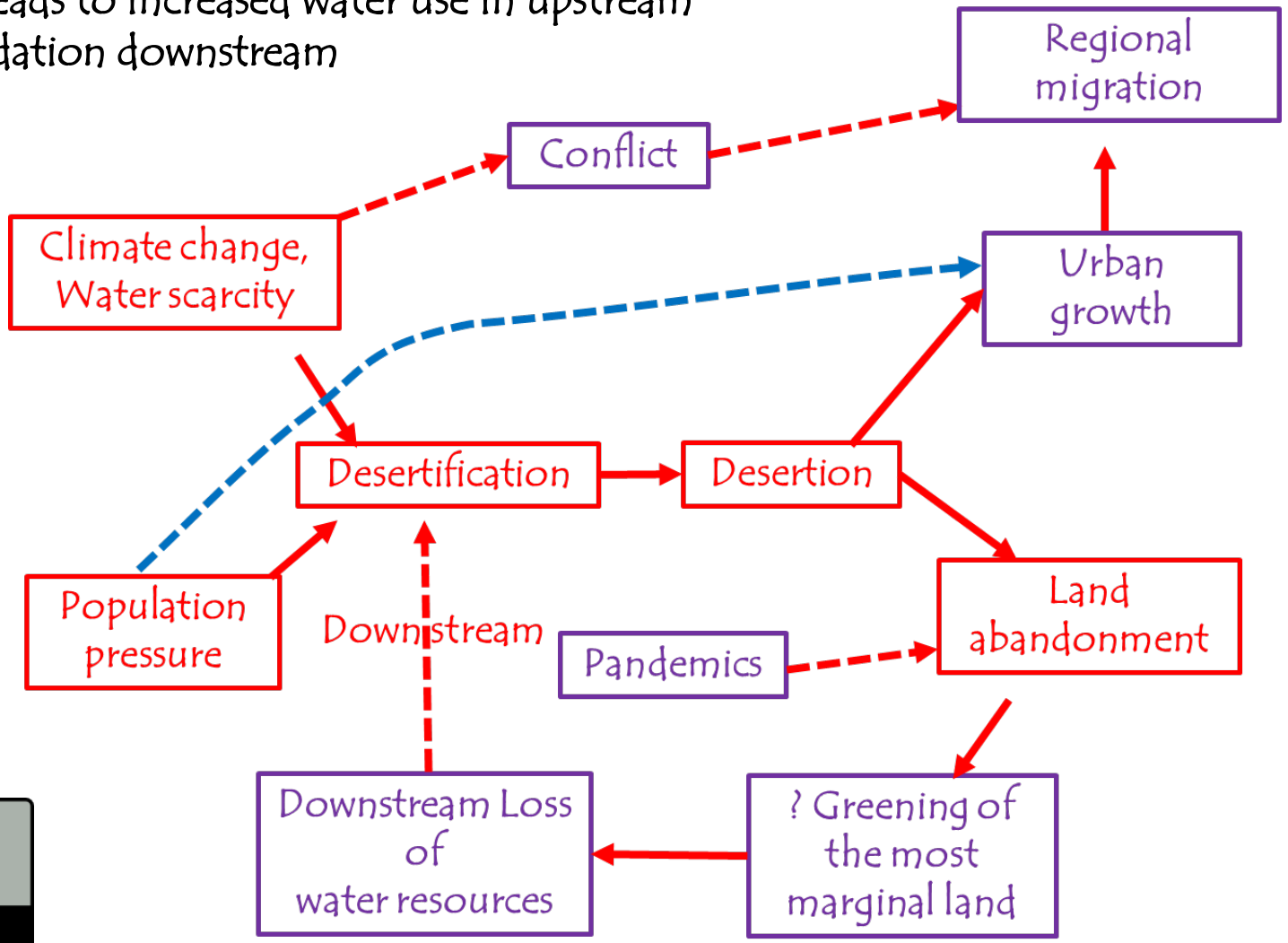




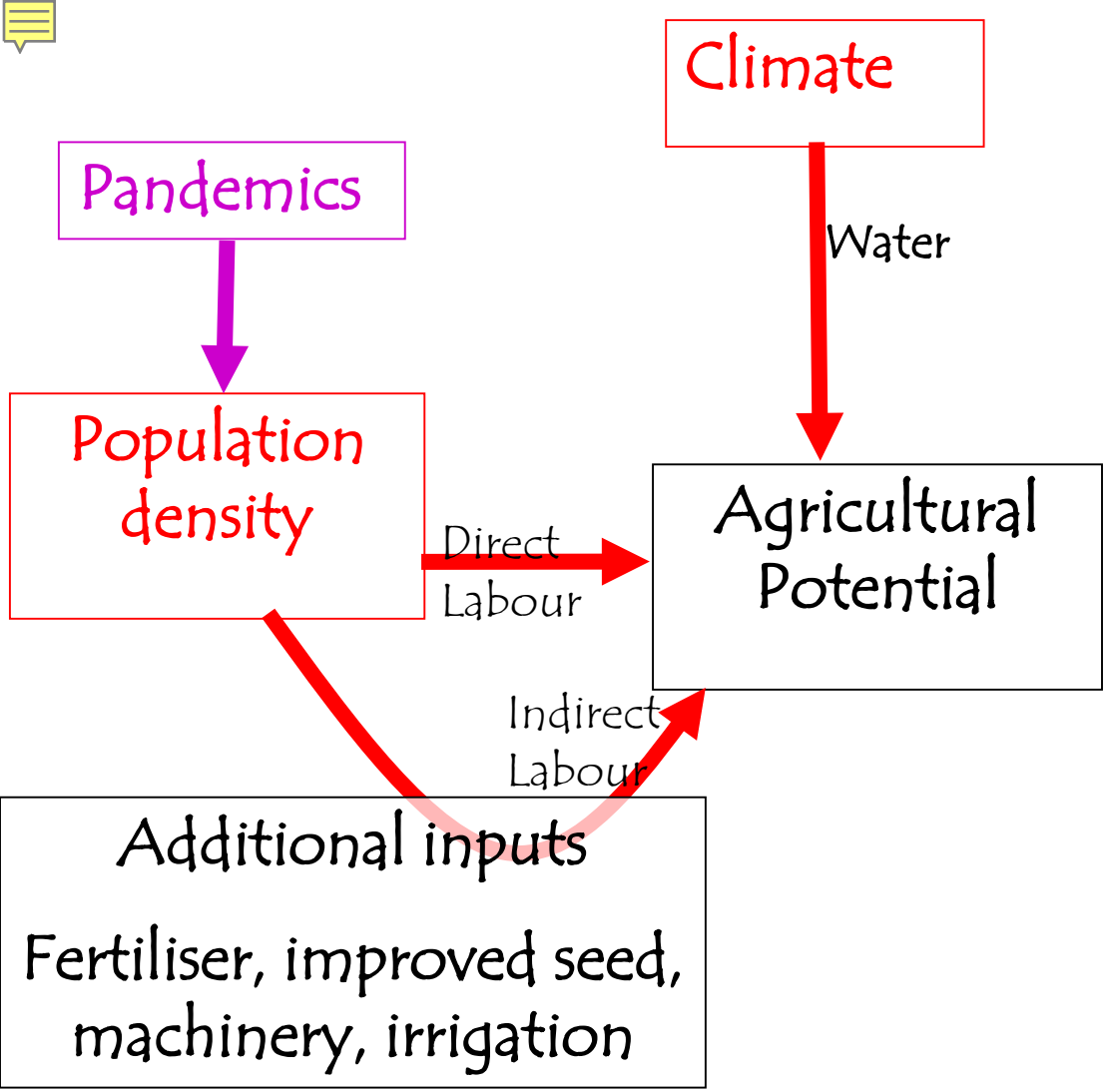
Combining with comparable model for optimal nomadic herding, identify population and rainfall conditions favouring agriculture and herding.

Upscaling: Desertification & Desertion

At coarser scales, socio-economic factors become increasingly important.
Cycle of desertification leads to desertion of rural areas and land abandonment.
Knock-on effects on urban growth – one of policy reasons to combat desertification
Climate change is already fostering conflict – water wars
Land abandonment leads to increased water use in upstream
– may increase degradation downstream

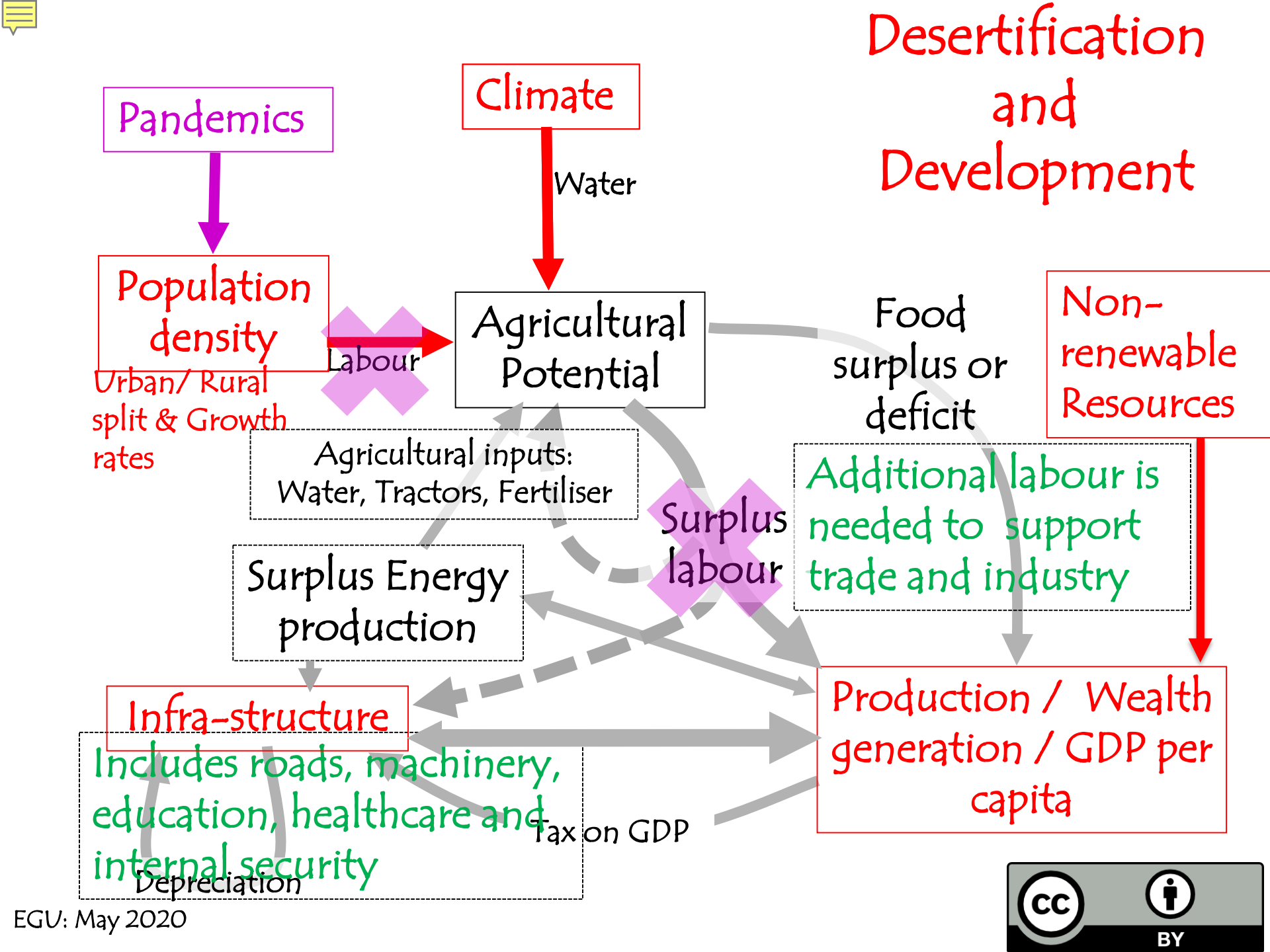


Desertification and development



- Agriculture & desertification are also strongly linked to development & economic circumstances.
- How much you can grow is limited by water, nutrients and available labour, and also depends partly on other inputs – better seed, fertiliser, additional labour/ machinery.
- Model shows how 'surplus' labour depends on climate and population.
- 'Indirect labour' implies earning the money to pay for these inputs

Desertification and Development



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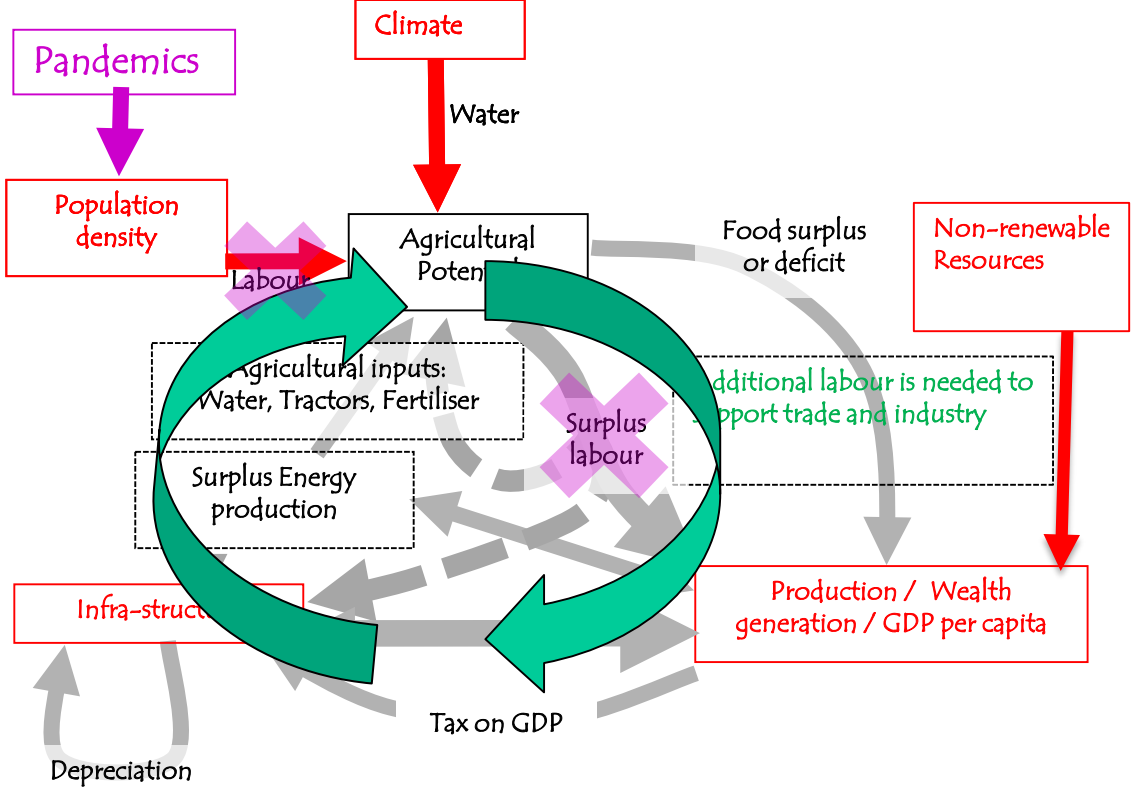

- Ideally a benign positive feedback, leading to exponential growth of GDP
- Small labour surplus supports trade, wealth supports more productive farming and so on.
- Kick-started by resource wealth or a coastal location
- Hindered by low rainfall and population, or a land-locked location

- Once started, feedback may be cut in various ways, e.g.
  - Conflicts or Pandemics that reduce production and useful labour.
  - Diversion of GDP from useful infrastructure (the Pyramids)
  - Over-dependence on rigid technical infrastructure (irrigation and salinity; US auto industry) without alternative investment
  - External exploitation without local investment

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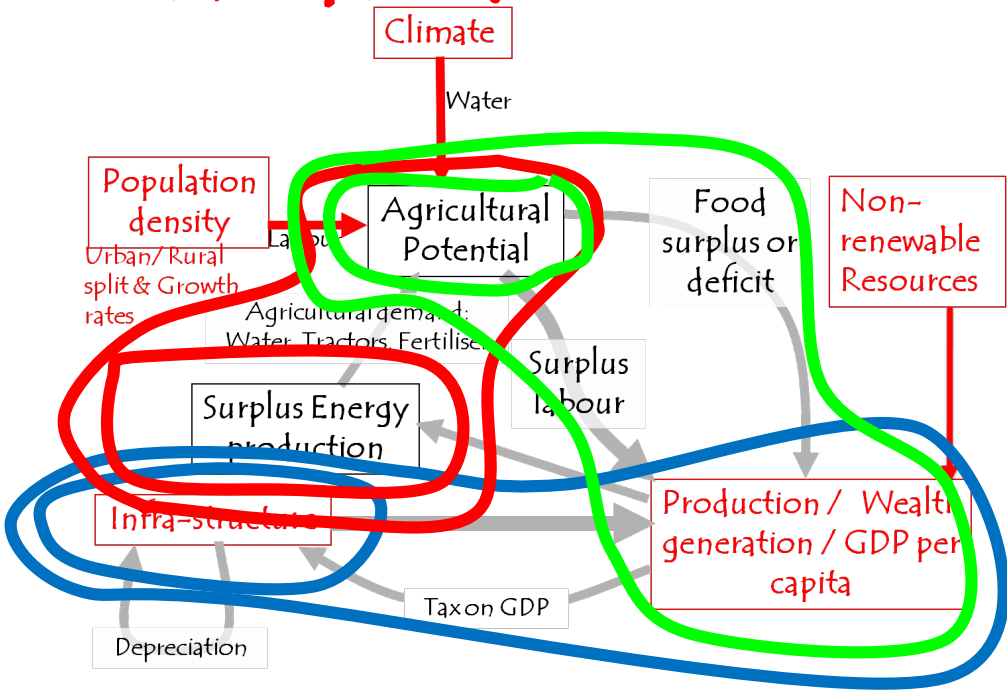
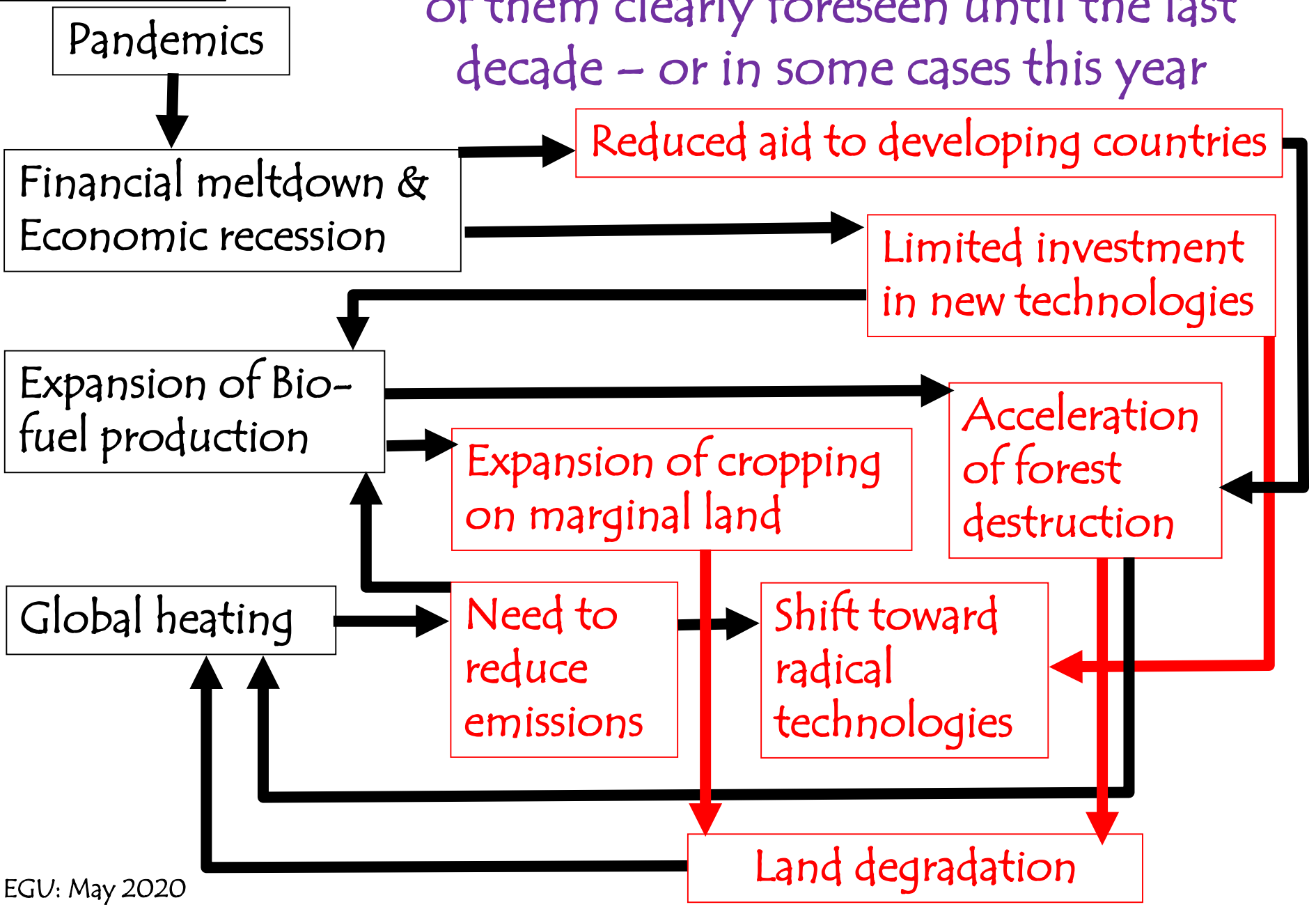
Mitigating desertification ?

- Physical remedies that increase productivity
  - Terracing, mulching, inter-cropping….
- Investment in infrastructure
  - Roads, wells, machinery, healthcare, education
  - Supporting trade & improving agriculture
- Providing (cheap & renewable) energy
  - Increasing productivity and releasing labour
- Others, e.g.
  - Migration, Exploit resources



Possible responses to external shocks – none of them clearly foreseen until the last decade – or in some cases this year



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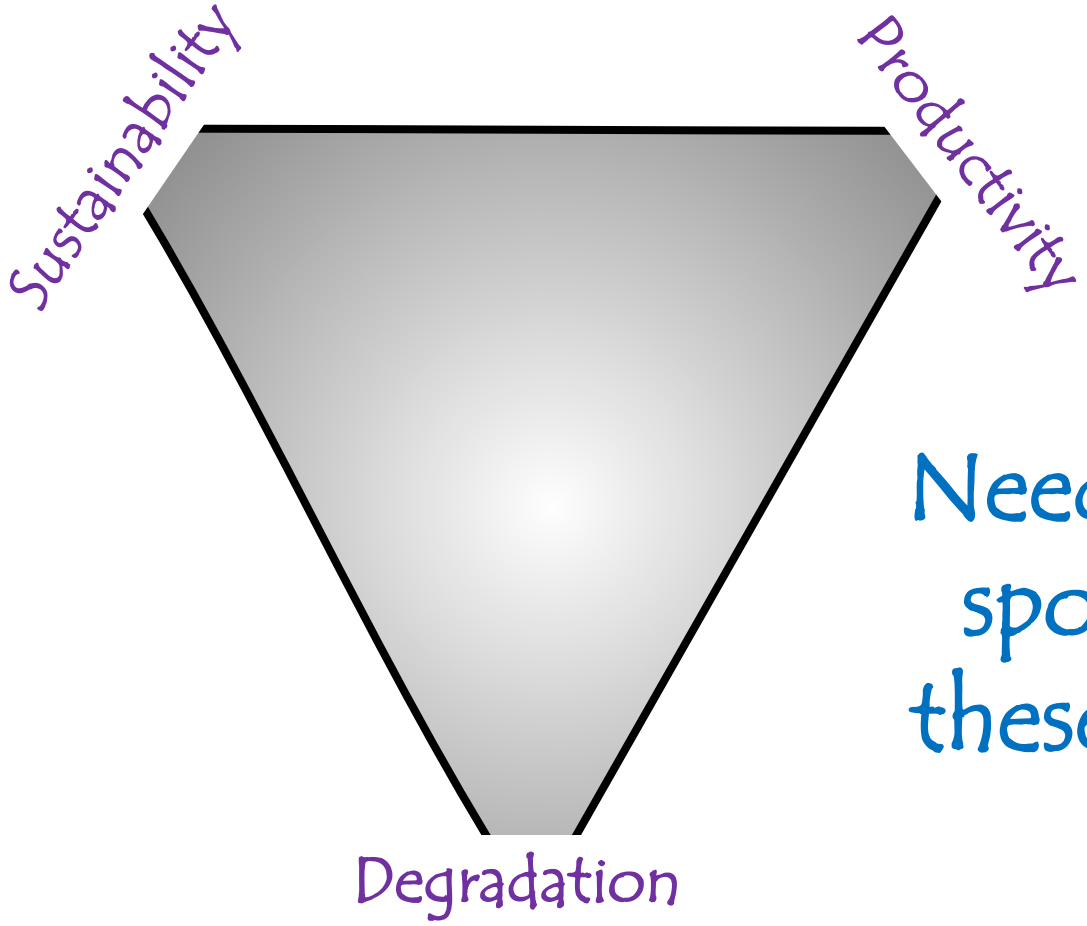
Conclusion?



Need to find a sweet spot that balances these components –

Depends on environment and culture

Thank you

Puerto Lumbreras 28 Sep 2012
$Q = 3400\ m^3\ s^{-1}$