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Experiencing the Water-Food-Energy Nexus

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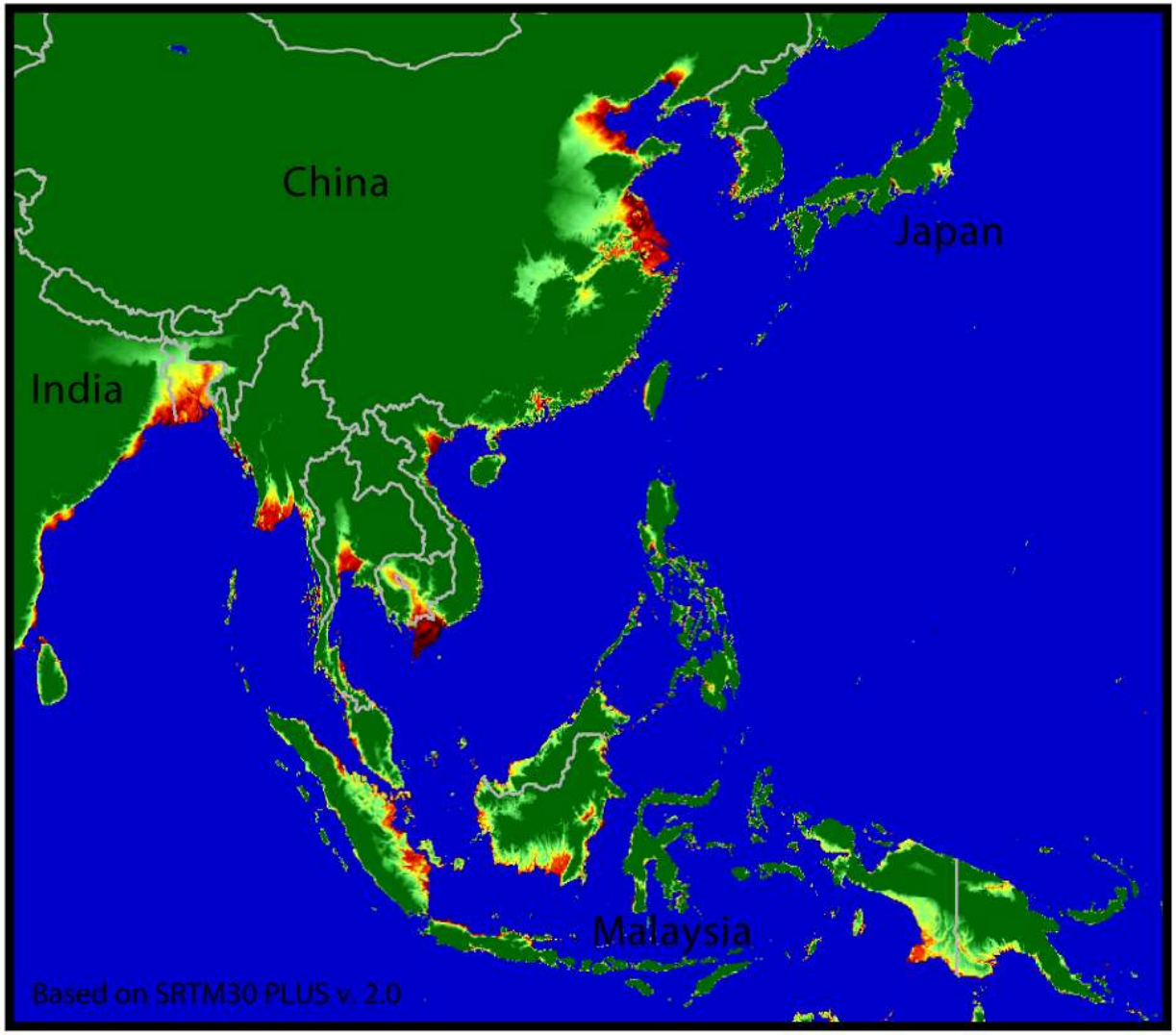
Sea Level Risks - Southeast Asia



http://www.globalwarmingart.com/images/4/49/SE_Asia_Sea_Level_Risks.png

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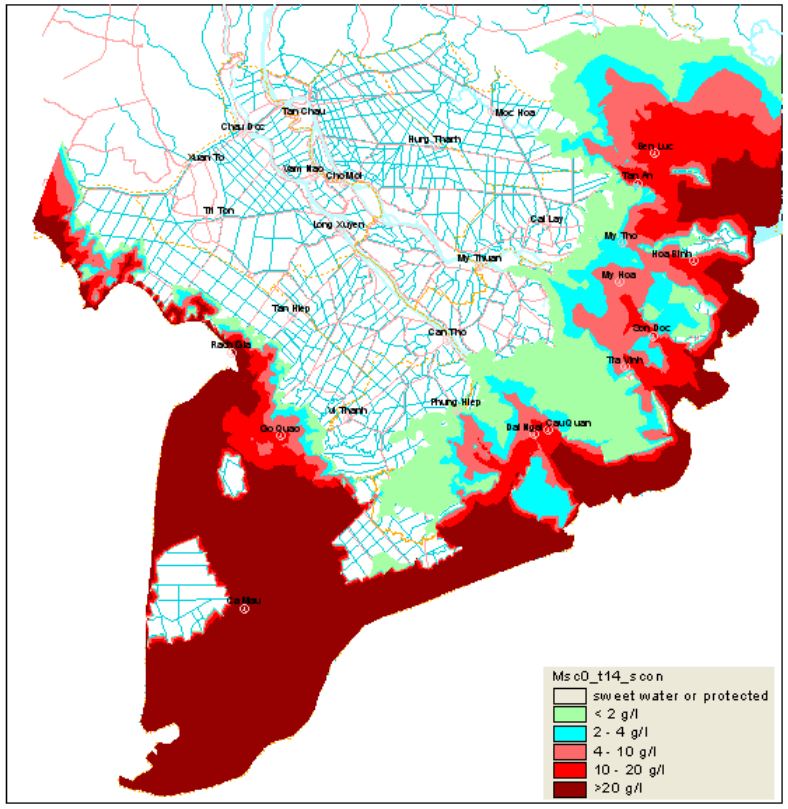
Principle adaptation options

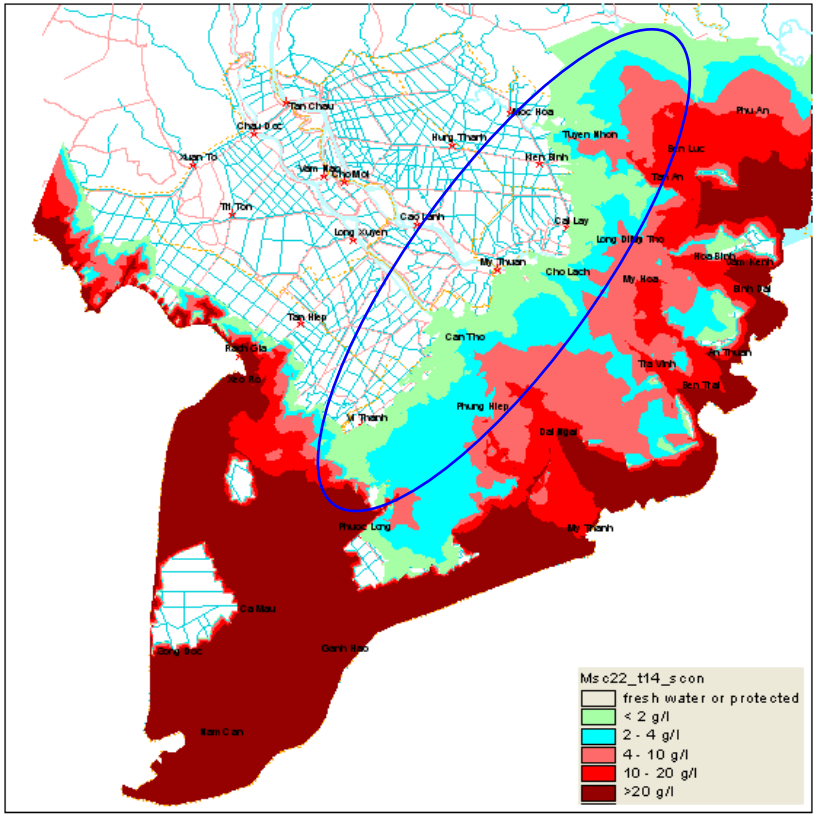
- Large-scale sluice gates and dikes
  - $25b-$38b investment required
  - Some land-use change has to be reversed
  - Annual maintenance costs of about $500m
  - Main risk: damage/loss to storm surge and erosion
- Land-use change
  - Incentive schemes for re-optimised land use
  - Re-organisation of farm systems and market access
  - Main risk: livelihoods in extreme years/events

Debate

Make a short statement
for or against an option
and explain why

Salinity intrusion + Dams More saline land and less rice production (282,000 households)





SLR by 30 cm:

- *50,000 ha affected (of 1.8m ha)*
- *120,000 tonnes less rice (23m tonnes)*

SLR 30 cm + dams + drought (85%)

- *500,000 ha affected*
- *1,000,000 tonnes less rice*

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Large scale infrastructure

Major benefits

- 13,000 ha require land use change
- Rice production unchanged
- National Food security and export objectives
- Aligns with household's motivation and behavior

Major costs

- Costs of sea dikes and sluices: $5,329m to $8,176m
- Soil and water acidification and water pollution by agro-chemical residues
- Decline of bio-diversity and aquatic resources
- Existing rice-shrimp farmers severely affected (>100,000 households)
- 2 and 3 crop rice based income ≈ 50 % less than other farming systems
- Reduced sediment loads, land subsidence, SLR, storm surge may effect long term operational efficacy of sea dikes

Trade-offs for hard adaptation

Water-Food

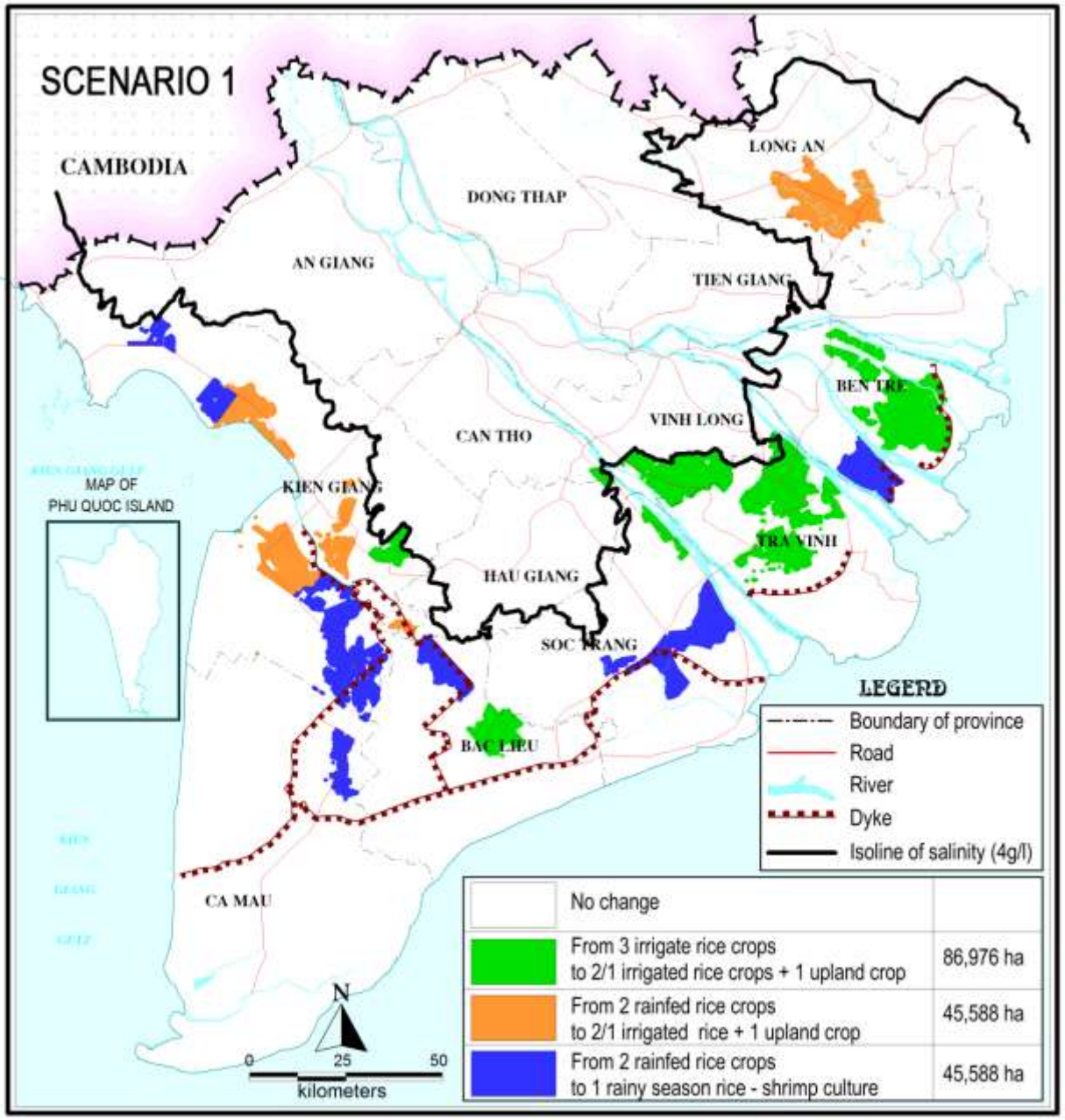
- Increase rice production (low income)
- Reduce aquaculture production (high income)
- Accelerated soil acidification
- Substantial loss in fisheries
- Food vulnerability maintained due to land subsidence and sediment reduction

Energy-Food

- Short term avoided migration lowers energy incline
-Biofuel scenario postponed (Sugarcane scenario)
- potentially higher pumping requirements to maintain aquaculture

Water-Energy

- Energy input for construction and maintenance high
- Higher urban energy needs due to income gap
- Short term avoided desalinisation for urban water needs
- Mechanisation of rice farming accelerated increasing energy needs



Recommended Policy: land use change:

180,000 ha land use change

up to 8 farming systems

existing rice shrimp retained

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Land use changes	Major benefits
Upland crop production	• Improved farm incomes • Increased employment opportunities • Increased crop and potential ecological diversity • Improved nutritional security
Land use changes	**Major costs**
Upland crop production	• 1 million tonnes LESS rice produced • Heavy use of pesticides
Shrimp intensification	• Soil and water salinization • Mangrove losses • Water pollution from shrimp field effluents • Increased risk of failed production

Trade-offs for soft adaptation

Water-Food

-Decrease rice (low income)
- Increase aquaculture (high income)
- Diversified farming reduces vulnerability
- Lower agricultural water needs
- Off-shore fisheries less vulnerable
- Declining water quality
  due to agro-chemicals

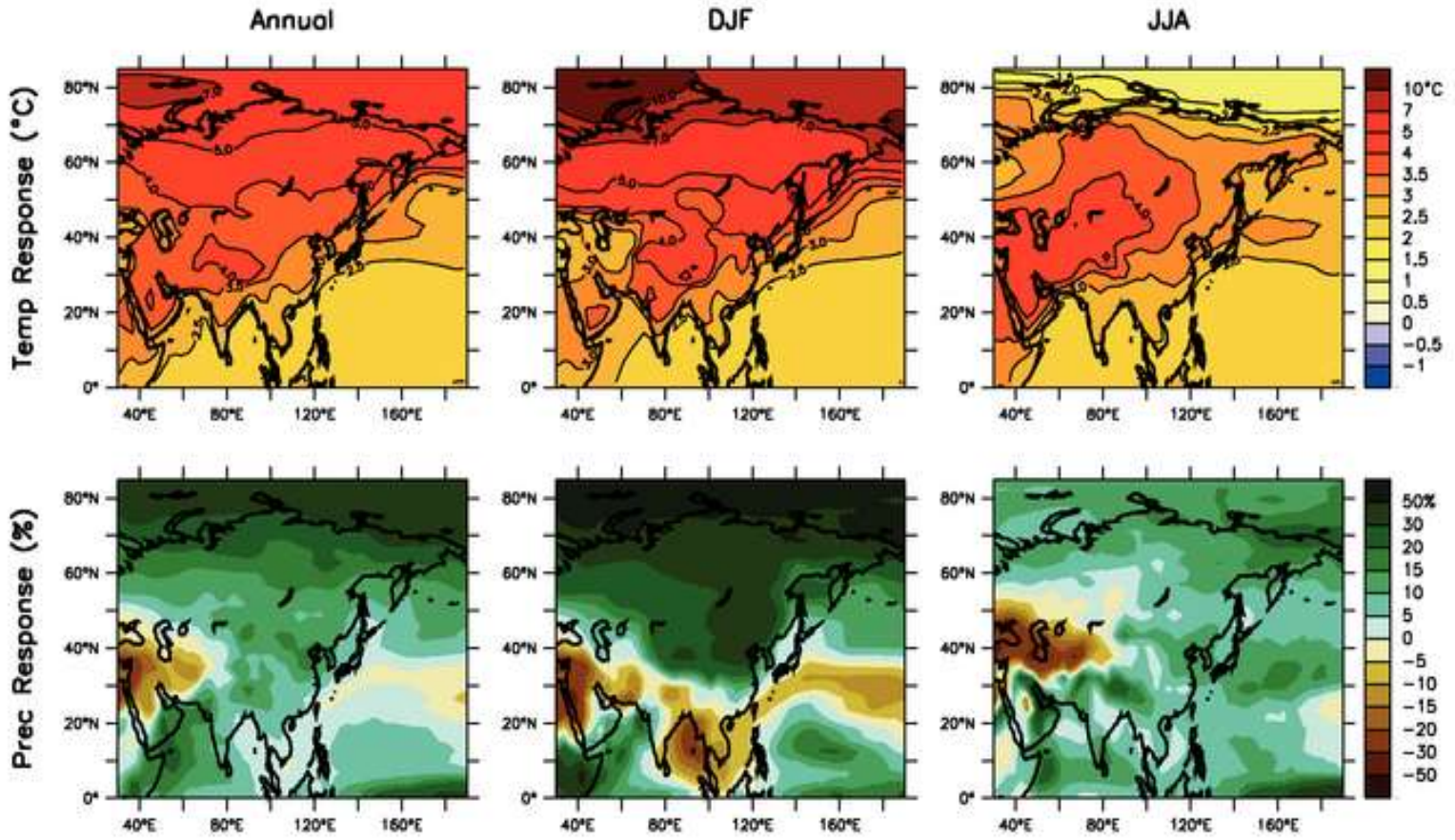
Energy-Food

- Long term migration scenario paths
  lower and energy projection declines
- Bio-fuel scenario enabled
  (Sugarcane scenario)
- lower pumping to maintain aquaculture

Water energy

- Growing need to think about urban water needs
- Urbanisation path lowers and with that energy projections lower
-Avoided energy input for large-scale construction

Drought management strategies



Principe adaptation options

- Large-scale infrastructure investments
  - $10b-$12b investment required
  - Annual maintenance costs of about $800m
  - Main risk: soil salinisation, low uptake, reduced in stream flows
- Land-use change
  - Incentive schemes for re-optimised land use
  - Re-organisation and re-location of farm systems and market access
  - Main risk: livelihoods in extreme years/events
  - Peri-urban poverty

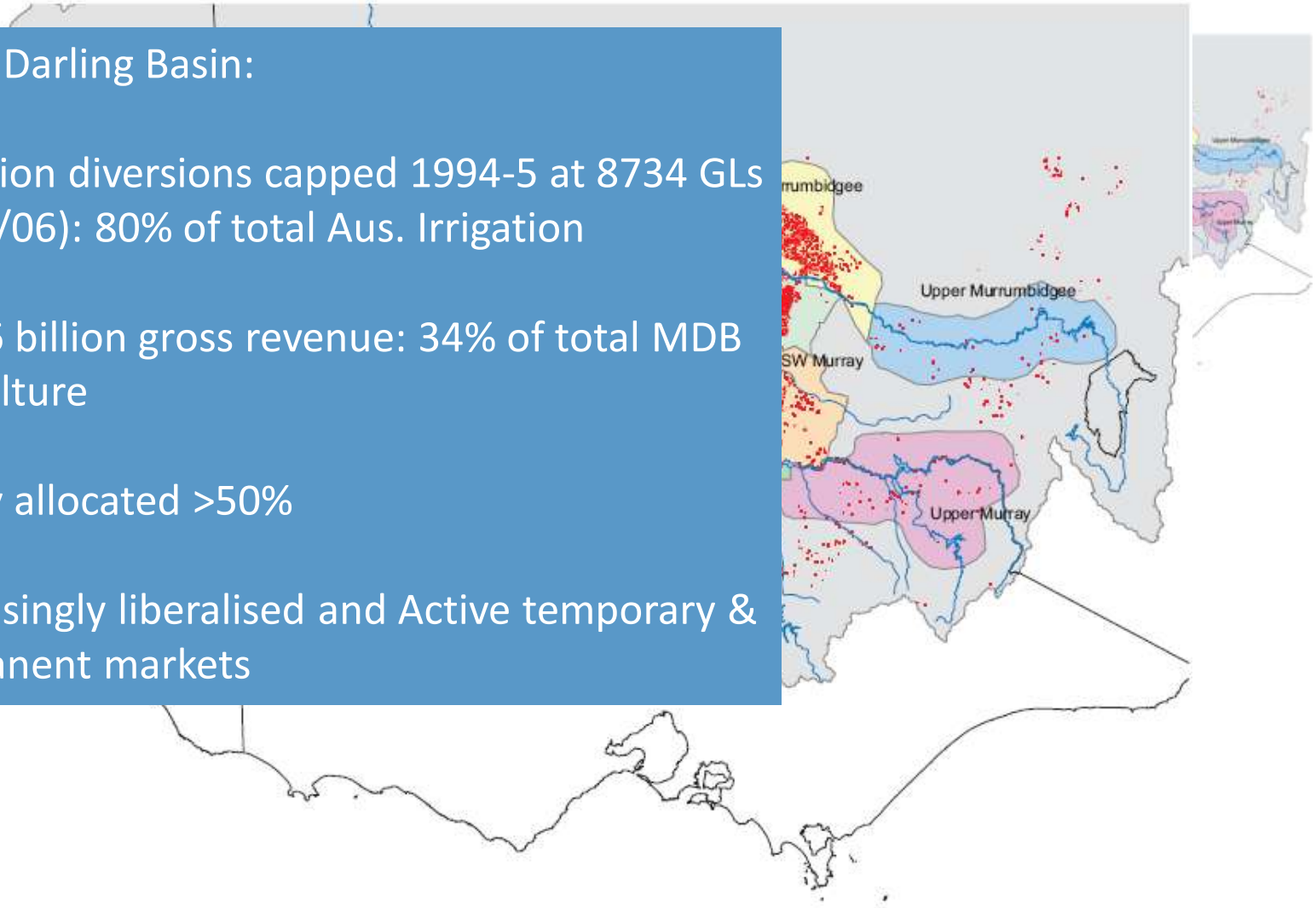
Debate

Make a short statement
for or against an option
and explain why

Murray Darling Basin

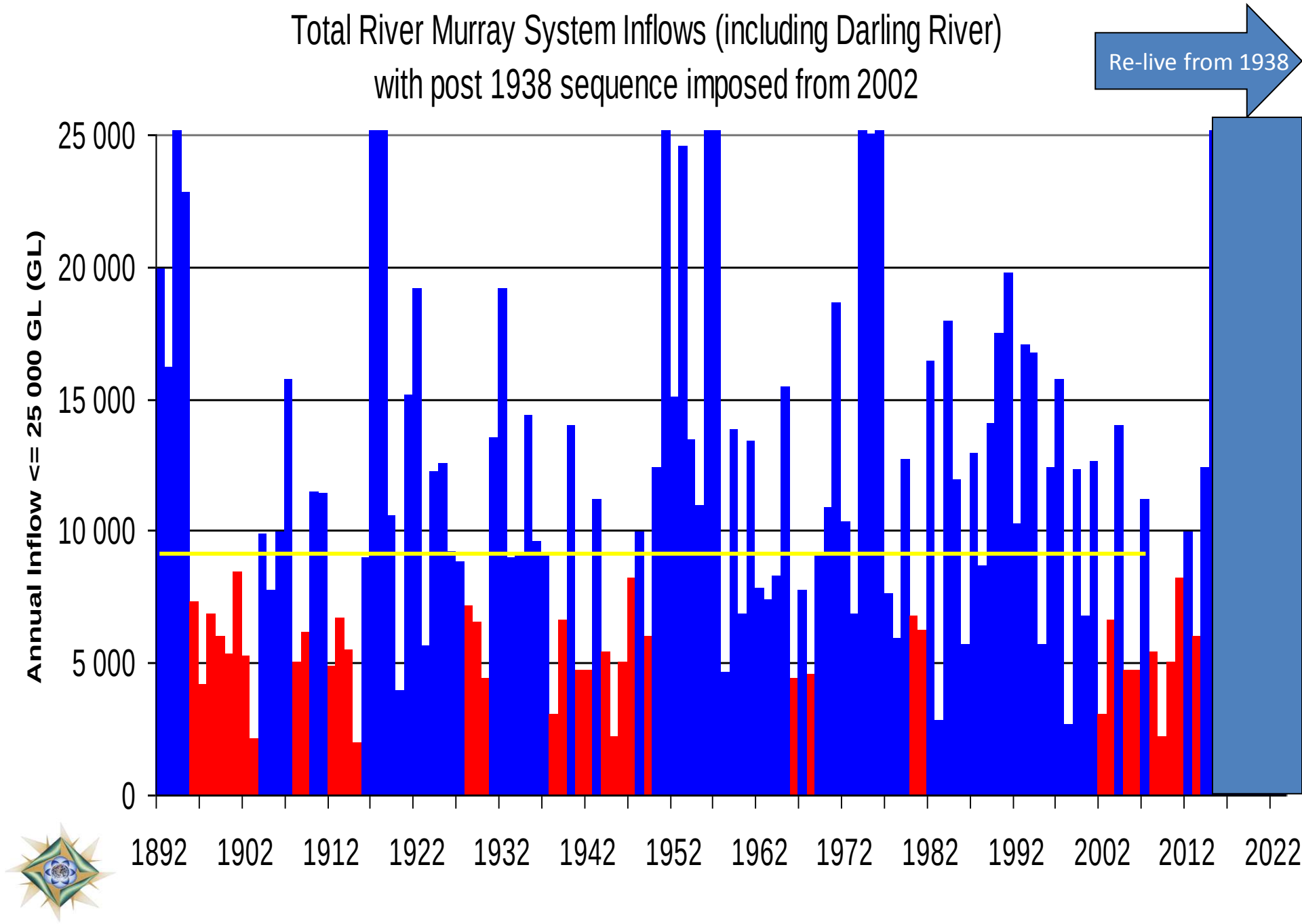
Murray Darling Basin:

- Irrigation diversions capped 1994-5 at 8734 GLs (2005/06): 80% of total Aus. Irrigation
- ~ $4.6 billion gross revenue: 34% of total MDB agriculture
- Highly allocated >50%
- Increasingly liberalised and Active temporary & Permanent markets



Climate change predictions

1. Nearly 40% reduction in water runoff by 2030
2. 10- to 20-fold increase in exceptionally hot years; 2- to 3-fold increase in exceptionally dry years by 2040
3. 50% reduction in agricultural output by 2050


Total River Murray System Inflows (including Darling River)
with post 1938 sequence imposed from 2002
Re-live from 1938
Annual Inflow <= 25 000 GL (GL)
25 000
20 000
15 000
10 000
5 000
0
1892
1902
1912
1922
1932
1942
1952
1962
1972
1982
1992
2002
2012
2022

- 20% decreased rainfall = 67% reduced inflow= Dams empty
- 17% ↓ Diversions: 83% ↓ in-stream flows. Fish loss, hyper saline estuary, wetland loss, acid sulphate mobilised
- $12b= infrastructure and water buy back for the environment. Reduced diversions by 25%
- Agricultural value only ↓ 1% GDP
- Water trading meant water moved to high value cash crops= secure water rights independent of land
- Cities: water treatment, desalinisation and recycling= energy intensive
- Hydro scheme had to trade in water= less food production
- regional urban centres: population and businesses increased by 16-28%

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- Nexus-type analysis
- Participatory processes to establish efficient science-policy interfaces
- Integrated modelling and analysis
- Household level analysis
- Training center

Nexus analysis

1. Sector-specific impact assessment
2. Identify ripple effects
3. Qualify and quantify trade-offs
4. Dynamic projection of trade-offs

Water specific impact assessment

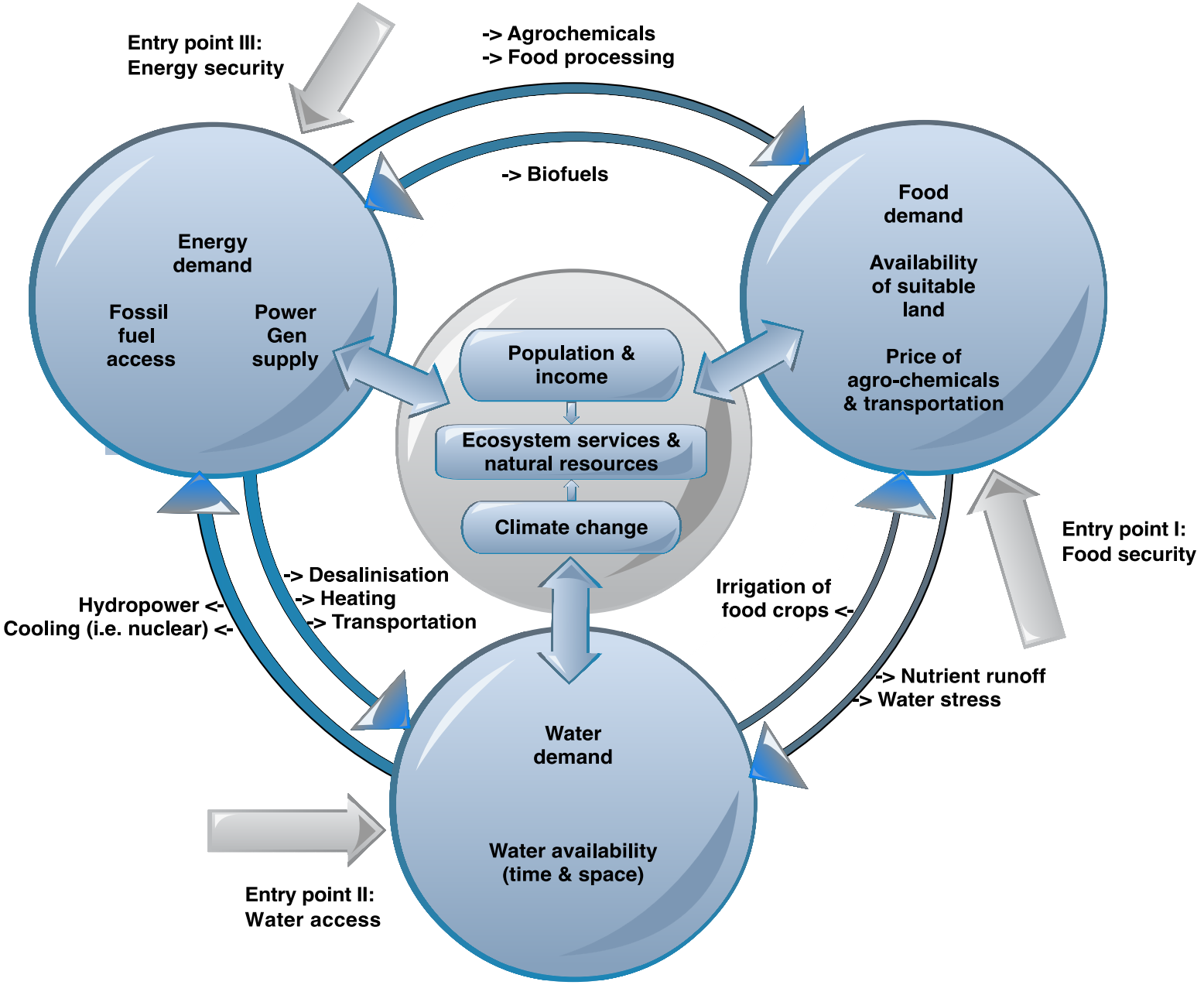
1. Flood Risks change from natural to operational (3-6 meters of daily flow fluctuations 40-50km downstream reservoirs)
2. Up to 70% increase in dry season flow in North Laos and Thailand, but only 10% in Delta
3. 200 Mt sediment loads drop to 90Mt to 20Mt/year causing erosion of riverbanks and the Delta

Food specific impact assessment

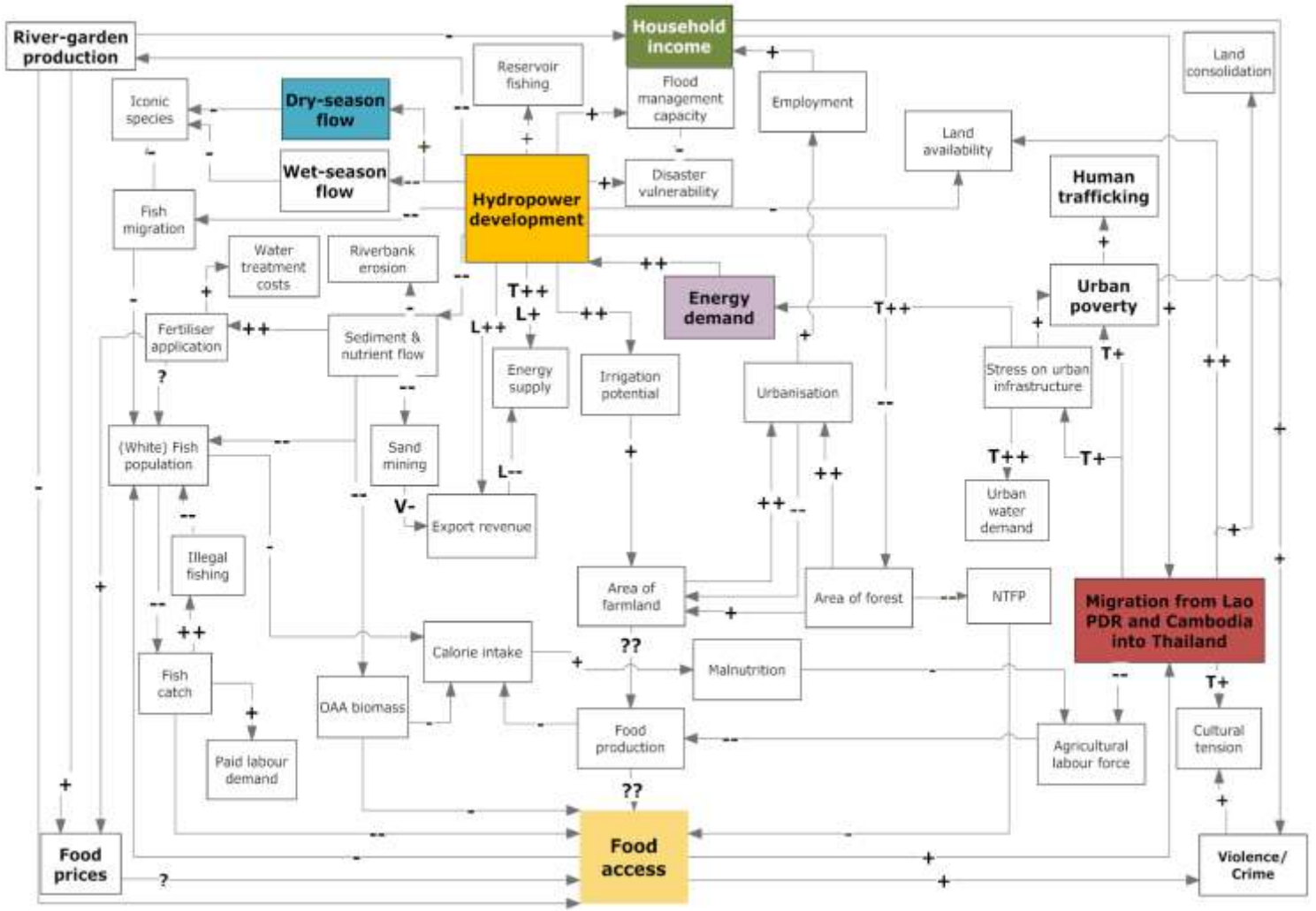
1. Sharp reduction in fisheries (including estuarine and off shore)
2. Dependence upon imported food and markets will increase
3. Food prices increase
4. Biodiversity will decline because of increased mono-crops

Energy specific impact assessment

1. Increased power generation capacity
2. Increase in national and regional GDP
3. Higher energy and materials prices


Entry point III:
Energy security
-> Agrochemicals
-> Food processing
-> Biofuels
Energy
demand
Fossil
fuel
access
Power
Gen
supply
Food
demand
Availability
of suitable
land
Price of
agro-chemicals
& transportation
Population &
income
Ecosystem services &
natural resources
Climate change
Entry point I:
Food security
-> Desalinisation
-> Heating
-> Transportation
Hydropower <-
Cooling (i.e. nuclear) <-
Irrigation of
food crops <-
-> Nutrient runoff
-> Water stress
Water
demand
Water availability
(time & space)
Entry point II:
Water access

Ripple effects



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Nexus-dynamics: System criticalities

- Transboundary fish stock management
- Instruments to manage risks from monocultures
- Strategies to avoid migration peaks due to change in access to natural resources
- Strategies for labour transition from primary to secondary sectors in the context of urban growth
- Explicit management of energy demand instead of sole focus on energy supply

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Thank You

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