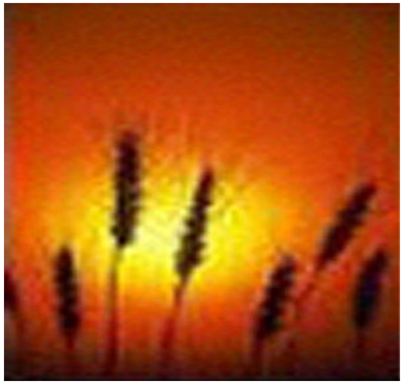
Lessons from Food, Land and Water Research at IIASA

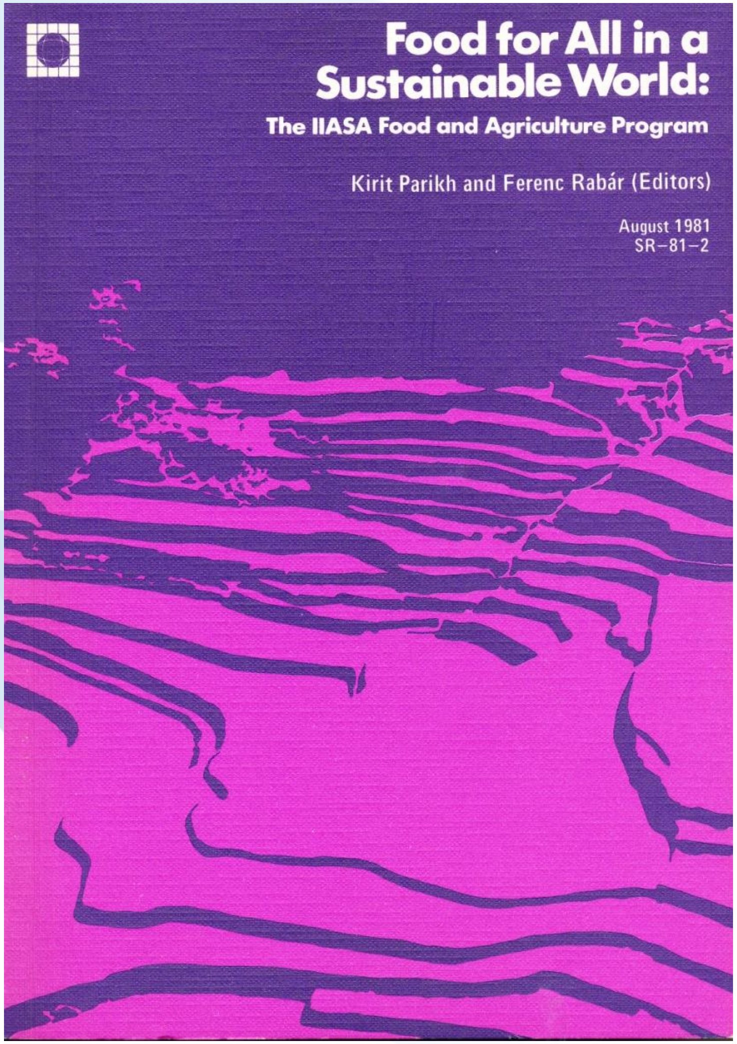
Honorary Symposium

30 January 2020, IIASA, Laxenburg

Günther Fischer, Senior Researcher, Food and Water, WAT Program
International Institute for Applied Systems Analysis, Laxenburg, Austria

IIASA's Food, Land and Water Research

1980‘s–IIASA’s Food and Agriculture Program



What were the key questions?

- What can a study at the IIASA do to help reduce hunger?
- Why do hunger and large food surpluses exist concurrently?
- What prevents the distribution of food surplus to the hungry?
- Can we identify policies to eradicate hunger in our time?

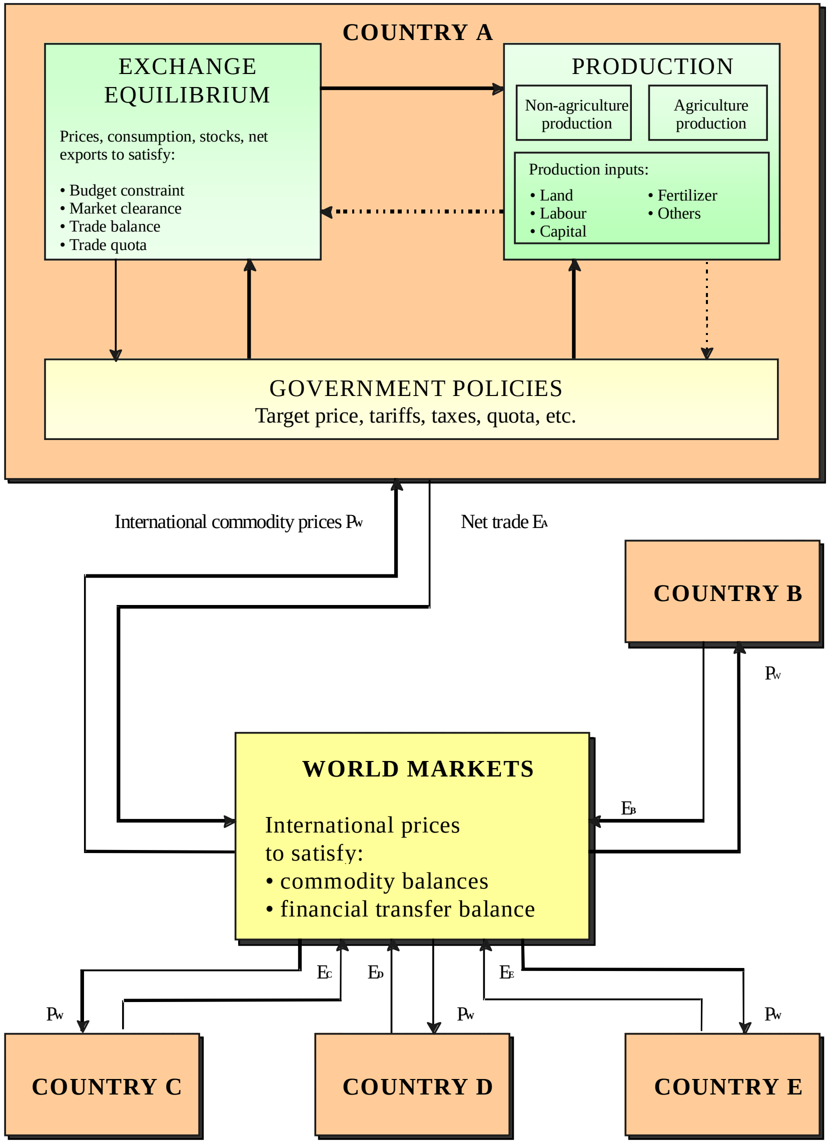
Why was it undertaken at IIASA?

- Although hunger is regionally confined, the growing interdependence of the global food system requires an international approach.
- Economic relations and policies are complex and require the development of new analytical tools.
- The problem requires a multidisciplinary approach as it covers a number of different fields and sectors.

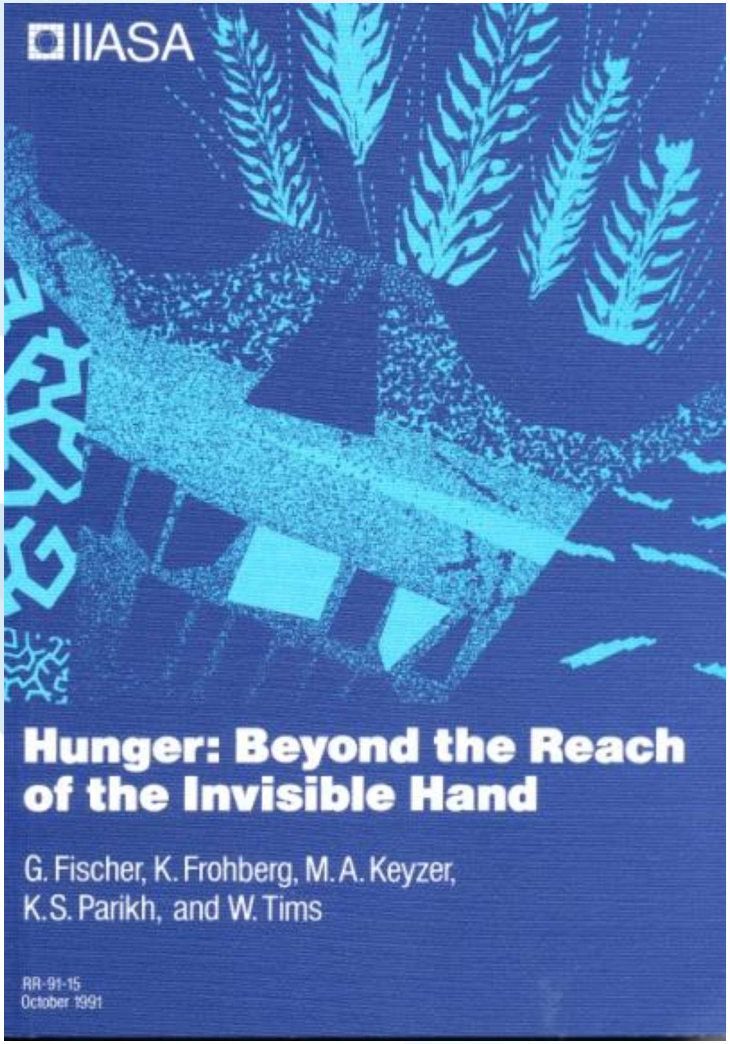
1980's – IIASA's Food and Agriculture Program

The analytical tool

- Formulation and operational implementation of an applied general equilibrium approach.
- A set of national agricultural systems embedded in national economies affected by national governments and interacting through trade, aid and capital flows.
- Empirically estimated demand and production systems.
- In the process of exchange all markets are cleared within each country's balance of trade constraint and the income and resource constraints faced by the actors.
- Population and its growth are exogenous (e.g. taken from UN or SSP projections).
- Land available for cultivation is exogenous (e.g. taken from FAO/IIASA GAEZ data).
- Dynamically recursive simulation model solved in yearly time steps.



1980's – IIASA's Food and Agriculture Program



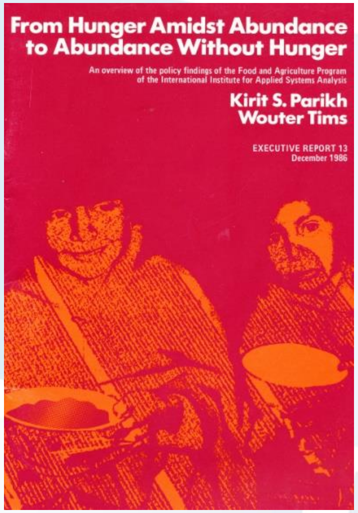
Main characterization of the hunger problem:

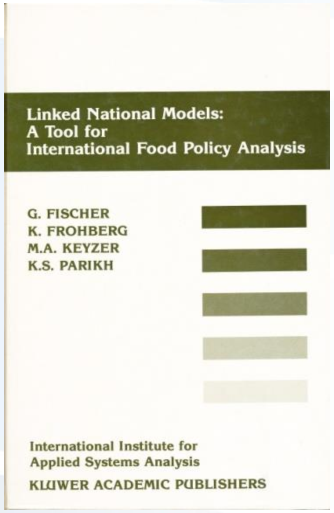
- Hunger is closely related to poverty.
- The majority of the poor earn their incomes by offering unskilled labor in markets with abundant supply of such labor.
- No safety net exists to maintain minimum levels of income to people not employable.
- The daily concerns of the poor with survival and their lack of resources severely limit their influence on national development priorities.
- The existing world food system is resilient for the rich and stubborn for the poor.

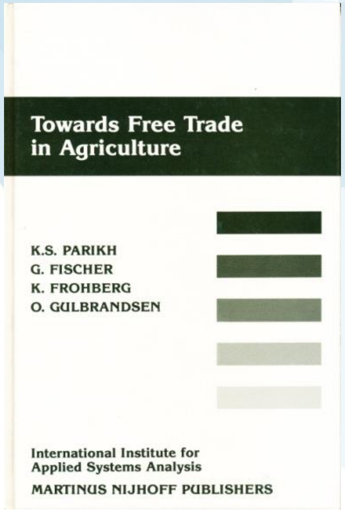
Policy suggestions for alleviating hunger:

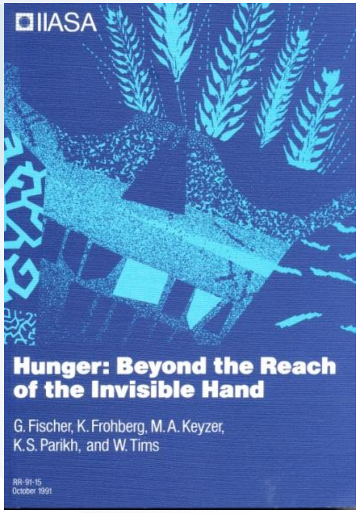
- Through trickle down over time.
- Increase food supplies on the world market.
- Increase food production in developing countries.
- Increase productivity of the assets of the poor.
- Increase real incomes of the poor

1980‘s – IIASA’s Food and Agriculture Program









Major achievements:

- Advanced systems analysis: First global study of this nature, depth and complexity.
- Methodological breakthrough: First global multi-region and multi-commodity applied general equilibrium model of the world food system.
- An in-depth analysis of who are the winners and losers of trade liberalization in agriculture.
- Hunger: Beyond the Reach of the Invisible Hand

Policy relevant findings:

- Current national and international policies will not lead to significant alleviation of hunger.
- Agricultural trade liberalization will have only marginal effects on hunger and produces mixed effects for developing countries.
- Trade liberalization combined with liberalized international movement of production factors and additional aid to finance redistributive programs in poor developing countries could eradicate hunger.

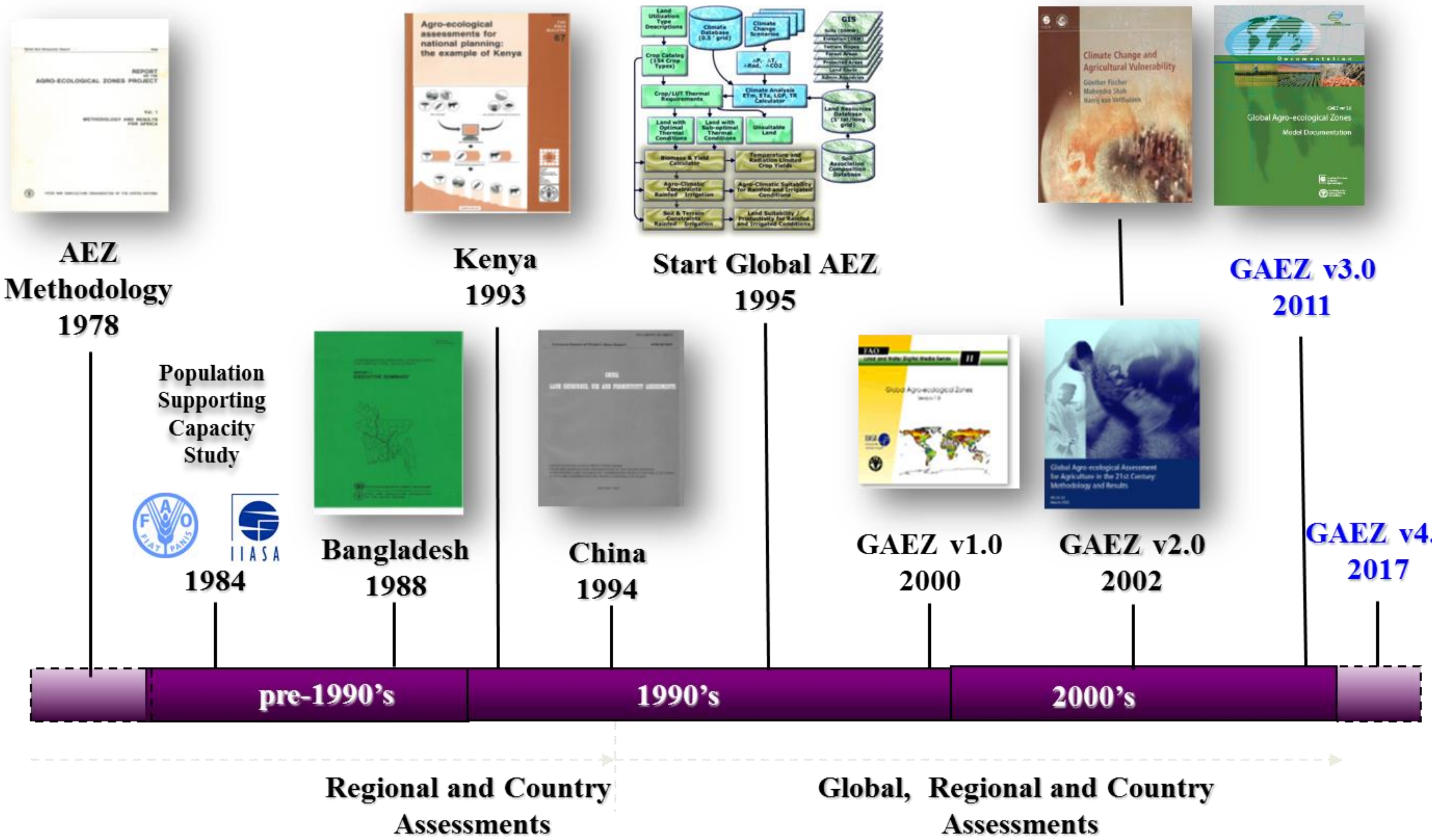
Land Resources & Agro-ecological Zoning:

- FAO and IIASA have developed a spatial analysis system that enables rational land-use planning on the basis of an inventory of land resources and evaluation of biophysical limitations and production potentials of land.
- The AEZ methodology provides a standardized framework for analyzing synergies and trade-offs of alternative uses of agro-resources (land, water, technology) for producing food and energy, while preserving environmental quality.

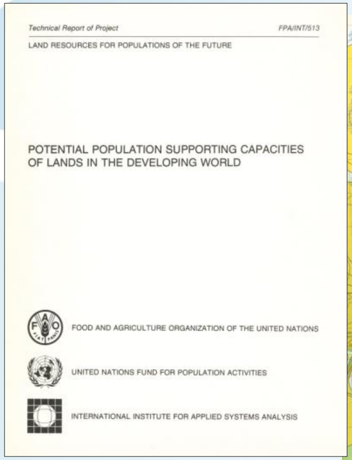
- The AEZ analysis yields knowledge about current and future production potentials of land, helps identify land and water limitations and provides insight into current yield and production gaps and their causes.

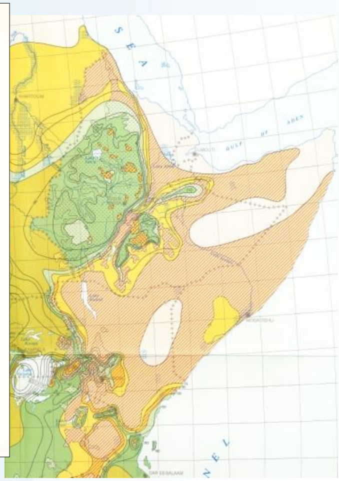
Food and Agriculture Organization of the United Nations

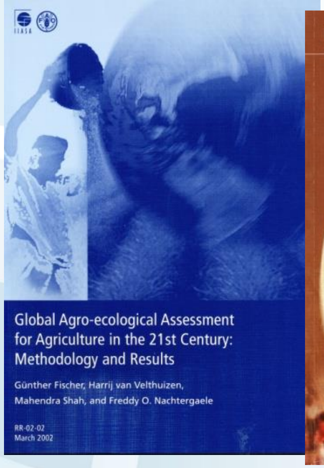
AEZ development

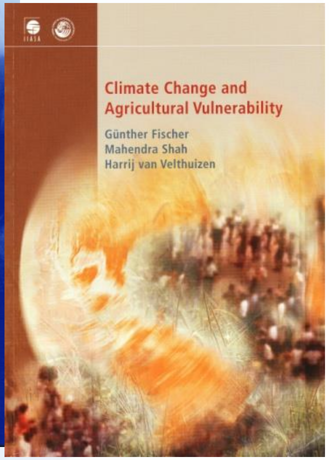


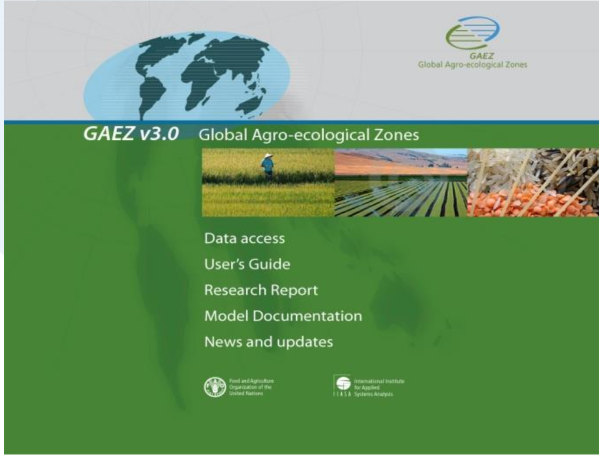
Major Highlights of Global AEZ Assessments











1984 – FAO/UNFPA/IIASA: Population Supporting Capacities of Lands in the Developing World.

2000 – IIASA/FAO: First global AEZ assessment (GAEZ v1.0) released.

2002 – IIASA/FAO: GAEZ v2.0 released.

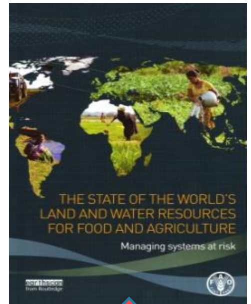
2011 – IIASA/FAO: GAEZ v3.0 released, including downscaling of actual production and yield gaps.

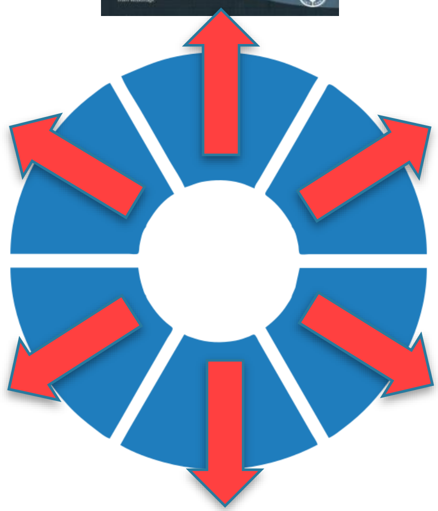
2012 – IIASA/FAO: Launch of GAEZ v3.0 Data Portal at FAO CO-AG providing public access to spatial planning information.

2017 – IIASA/FAO: GAEZ v4.0 completed, including assessment of CMIP5 climate model outputs by 4 RCPs.

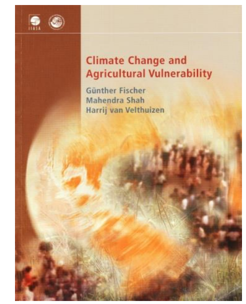
Global and National Applications supported by AEZ databases

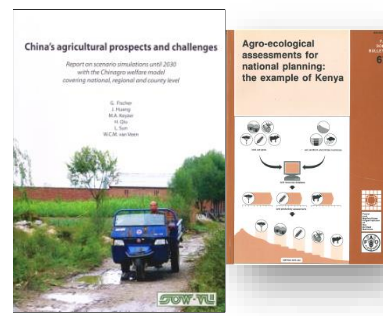
1. Land resources appraisal under current and future climate conditions





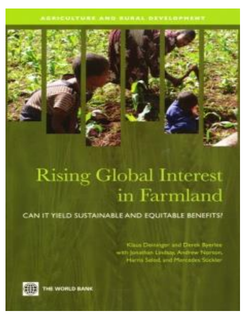
2. Climate change vulnerability and adaptation





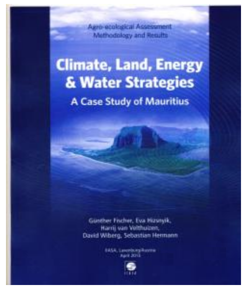
3. National food security and development planning

4. Biofuels and food security



5. Farmland value and fair investments

6. Food–Energy–Water Nexus



Land & Water Days 2015

Food and Agriculture Organization of the United Nations

IFAD Investing in rural people

WFP World Food Programme

Major Highlights of Global AEZ/WFS Applications

2002 – WSSD/IIASA: Johannesburg Special Report on Climate Change and Agricultural Vulnerability.

2005 – IIASA: Socio-economic and climate change impacts on agriculture: An integrated assessment, 1990–2080.

2007 – IIASA: Reducing climate change impacts on agriculture: Global and regional effects of mitigation.

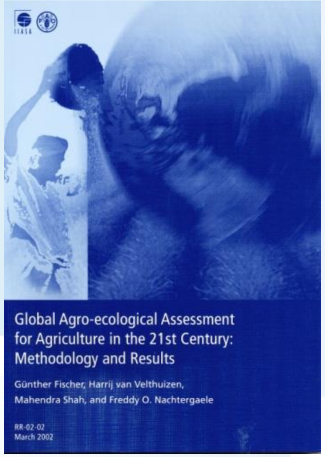
2009 – OFID/IIASA: Biofuels and Food Security.

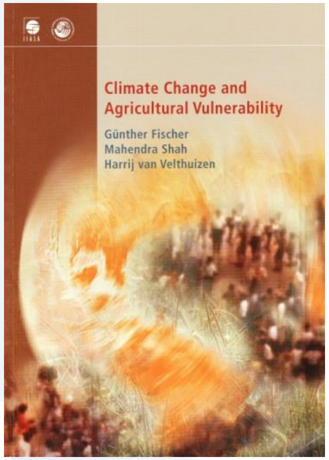
2011 – FAO/IIASA: Looking Ahead in World Food and Agriculture: Perspectives to 2050.

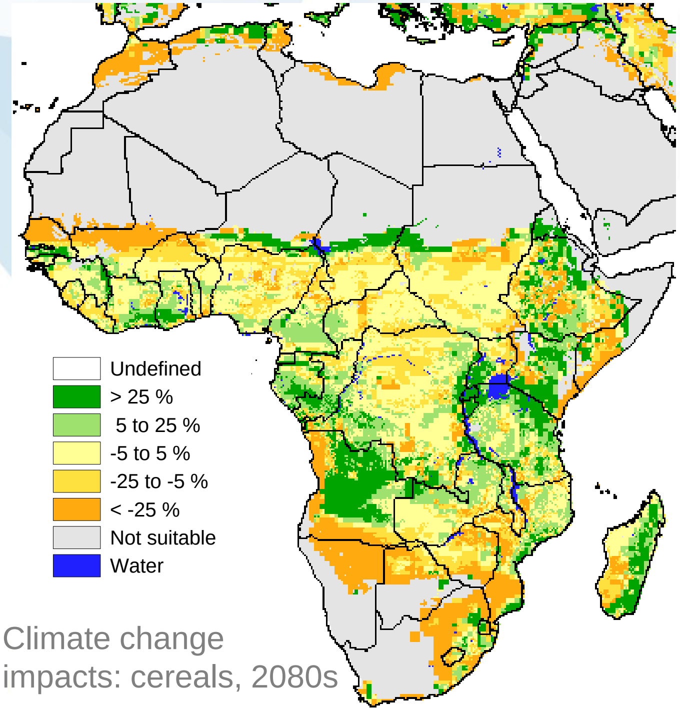
2017 – WFaS: Multi-model and multi-scenario assessment of Asian water futures.

2019 – WWF/IIASA: Sustainable Aviation Biofuel Feedstock Potential in sub-Saharan Africa.

Climate Change Impacts on Agriculture: An Integrated Assessment, 1990-2080







Climate change impacts: cereals, 2080s

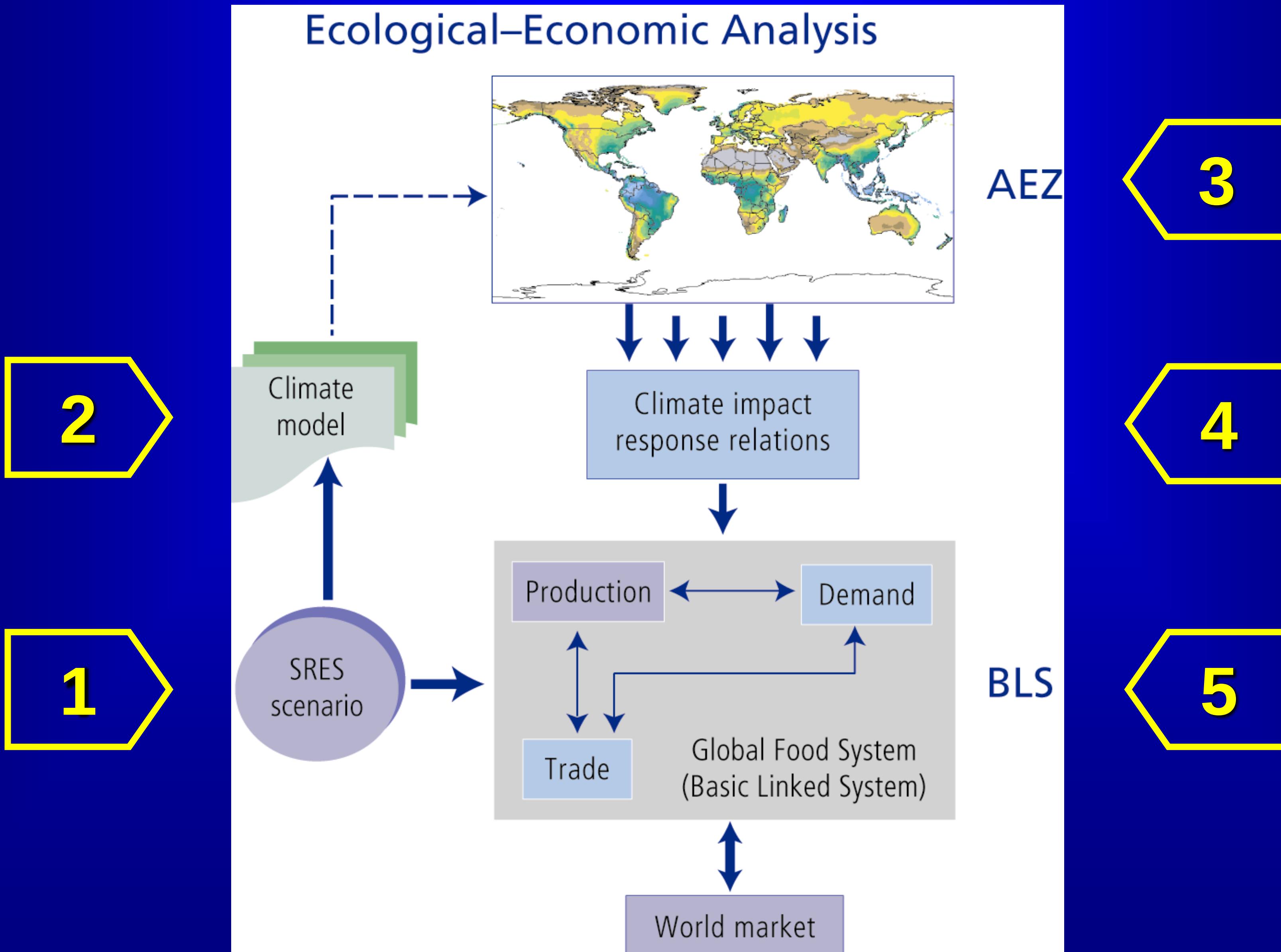
Major achievement:

- Advanced systems analysis: Integrated multi-scale, multi-region and multi-commodity assessment framework of the climate change – agriculture – food security nexus, combining agronomic bottom-up analysis and spatially detailed data with an economic applied general equilibrium analysis.

Policy relevant findings:

- Aggregate impacts of projected climate change on the global food system are relatively small. The global balance of food demand and supply is not likely to be challenged until middle of the century.
- The impacts of climate change on crop production are geographically very unevenly distributed and aggregate global figures reveal little.
- Climate change, if not halted, will have a clearly negative impact in the second half of this century.
- Climate change effects will likely further widen the gap between developed and developing countries.

Integrated ecological-economic Analysis of the Impact of Climate Change on Agriculture and Food Systems



Informal Meeting of EU Agriculture and Environment Ministers:

London, 11 September, 2005

Climate Change Impacts on Agriculture: An Integrated Assessment

Günther Fischer

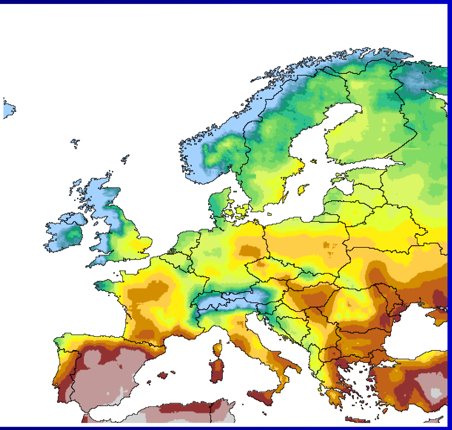
International Institute for Applied Systems Analysis, Laxenburg, Austria

Conclusions 1:

- Aggregate impacts of projected climate change on the global food system are relatively small.
- *Heterogeneity* of climate change impacts, *imbalance* of adaptive capacity, *disconnection* of causes and impacts are intrinsic characteristics of GHG debate.
- The impacts of climate change on crop production are geographically very unevenly distributed and aggregate global figures reveal little.
- While there is *uncertainty* regarding
  - magnitude and geographical detail of impacts
  - response mechanisms of terrestrial ecosystems
  - effectiveness of adaptation and mitigation measures
  - future capacities to respond (technologies, wealth)

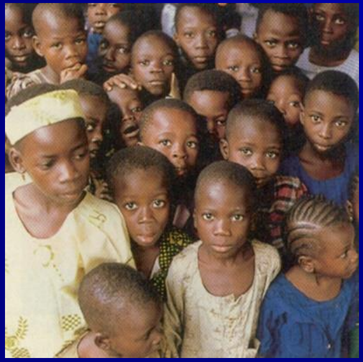
  model calculations indicate that *developed* countries overall will experience an increase in agricultural productivity. In contrast, *developing* regions as a whole suffer a loss in all estimates.

Conclusions 2:



- Climate change will have substantial impacts on Europe’s ecosystems and agriculture. Notably, rain-fed agriculture in many areas will be less viable. In Europe, positive climate change impacts are limited mostly to higher latitudes.

- Among developed regions, simulations indicate that North America gains in all GCM scenarios; agricultural GDP increases in Russia; in contrast, Europe loses agricultural GDP in all scenarios.

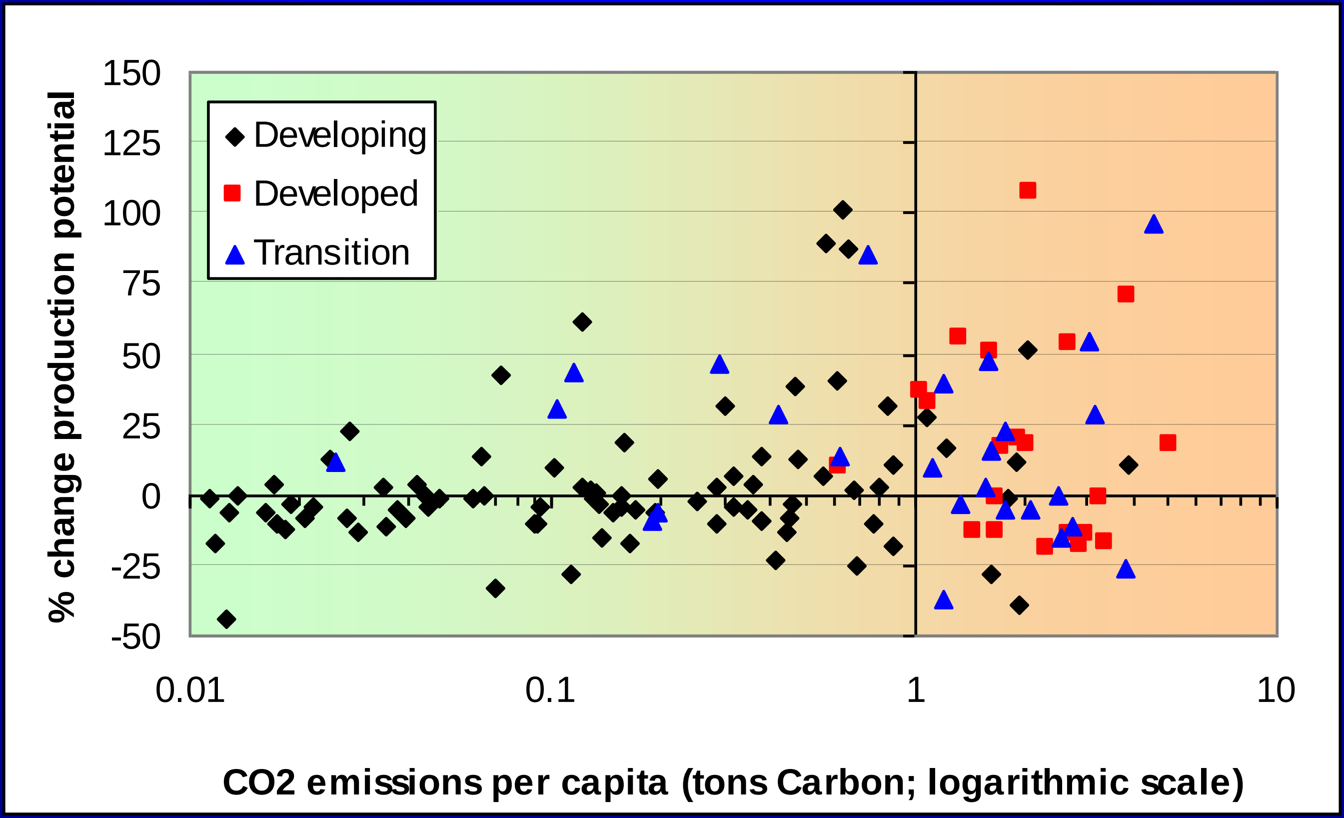


- Climate change effects will likely further widen the gap between developed and developing countries. Integrating mitigation, adaptation and sustainable development policies appears to improve prospects of achieving long-term environmental goals and of meeting LDC development needs.

IIASA

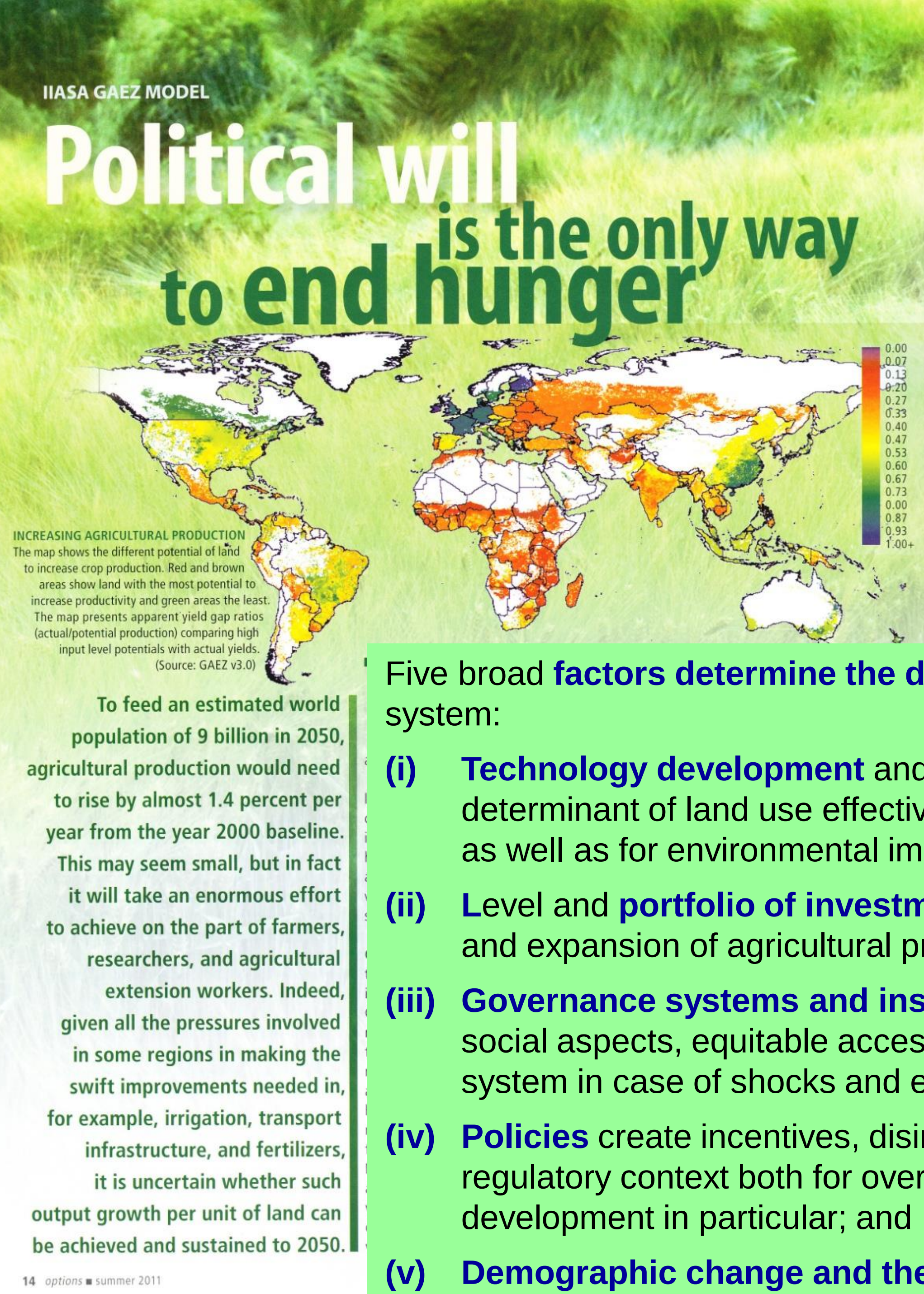
Climate Change Impacts and Past Carbon Dioxide Emissions

ECHAM4, 2080s



Fairness and Equity?

Greenhouse gas emissions since 1950:
75% from developed countries, 25% from developing countries



IIASA GAEZ MODEL

Political will is the only way to end hunger

INCREASING AGRICULTURAL PRODUCTION
The map shows the different potential of land to increase crop production. Red and brown areas show land with the most potential to increase productivity and green areas the least. The map presents apparent yield gap ratios (actual/potential production) comparing high input level potentials with actual yields. (Source: GAEZ v3.0)

To feed an estimated world population of 9 billion in 2050, agricultural production would need to rise by almost 1.4 percent per year from the year 2000 baseline. This may seem small, but in fact it will take an enormous effort to achieve on the part of farmers, researchers, and agricultural extension workers. Indeed, given all the pressures involved in some regions in making the swift improvements needed in, for example, irrigation, transport infrastructure, and fertilizers, it is uncertain whether such output growth per unit of land can be achieved and sustained to 2050.

14 *options* ■ summer 2011

Food and Water

- There is widespread poverty and inequity. Achieving food and water security can only be realized within the overall framework of poverty eradication.
- Food and water supply are key human sectors exposed to climate change. Climate-change impacts are already being felt in many countries; further global warming will be unavoidable.

Five broad **factors determine the dynamics** of an agricultural land use and production system:

(i) **Technology development** and availability, as in other economic sectors, is a key determinant of land use effectiveness, both in terms of input-output relationships as well as for environmental impacts;

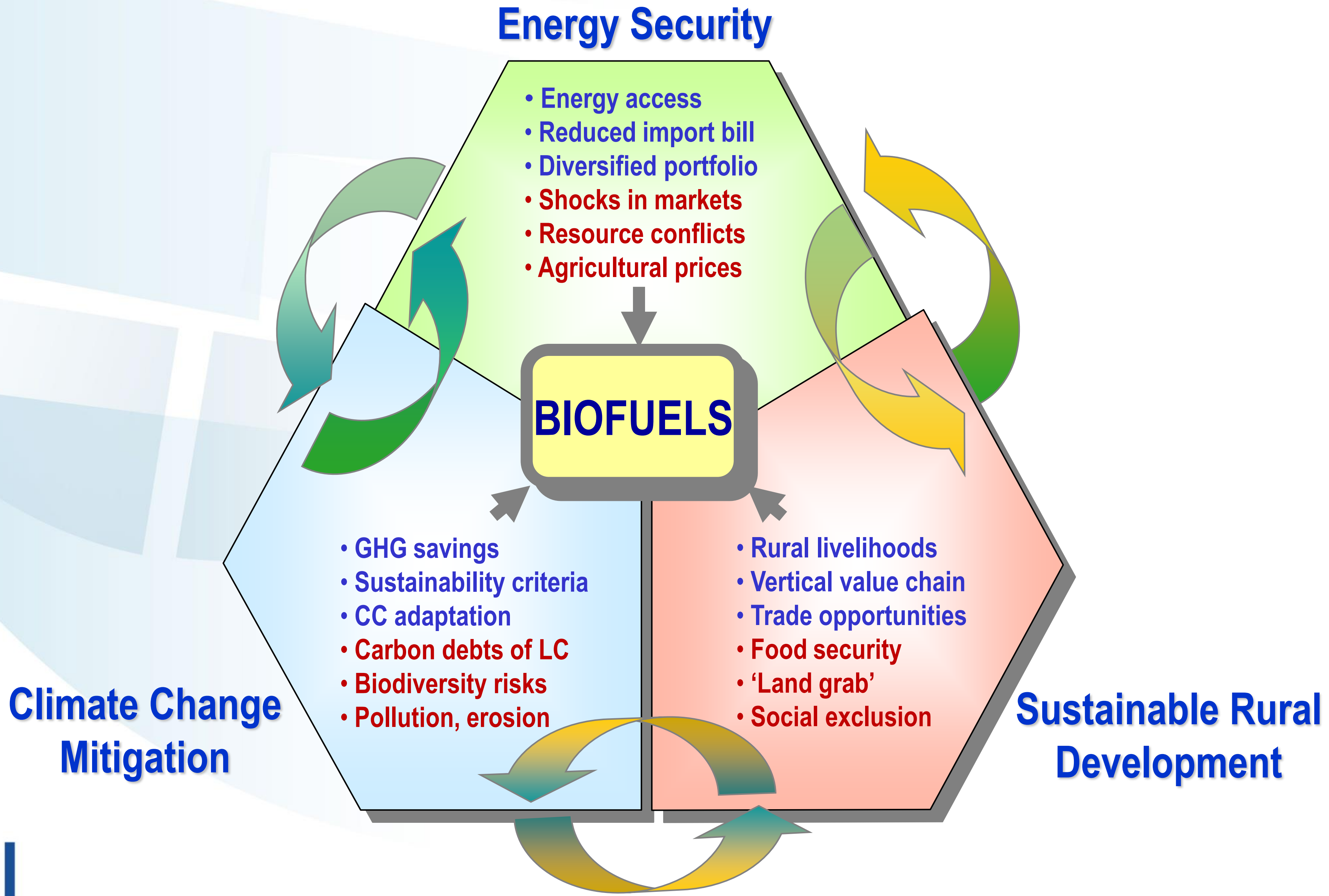
(ii) **L**evel and **portfolio of investments** in agriculture are critical for achieving growth and expansion of agricultural production;

(iii) **Governance systems and institutions** play an important role in determining social aspects, equitable access to resources, resilience and robustness of the system in case of shocks and extreme events;

(iv) **Policies** create incentives, disincentives, economic distortions and protection, the regulatory context both for overall economic development and agricultural development in particular; and

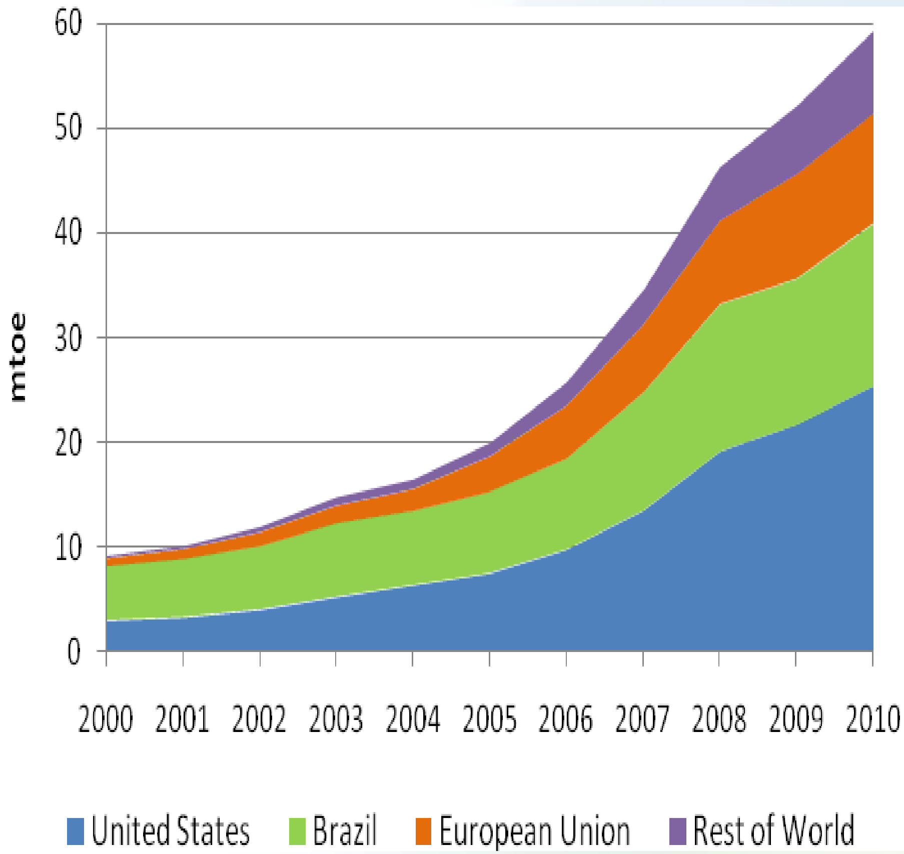
(v) **Demographic change and the human capital.**

Systems Analysis: Biofuels, Food Security, Climate Change

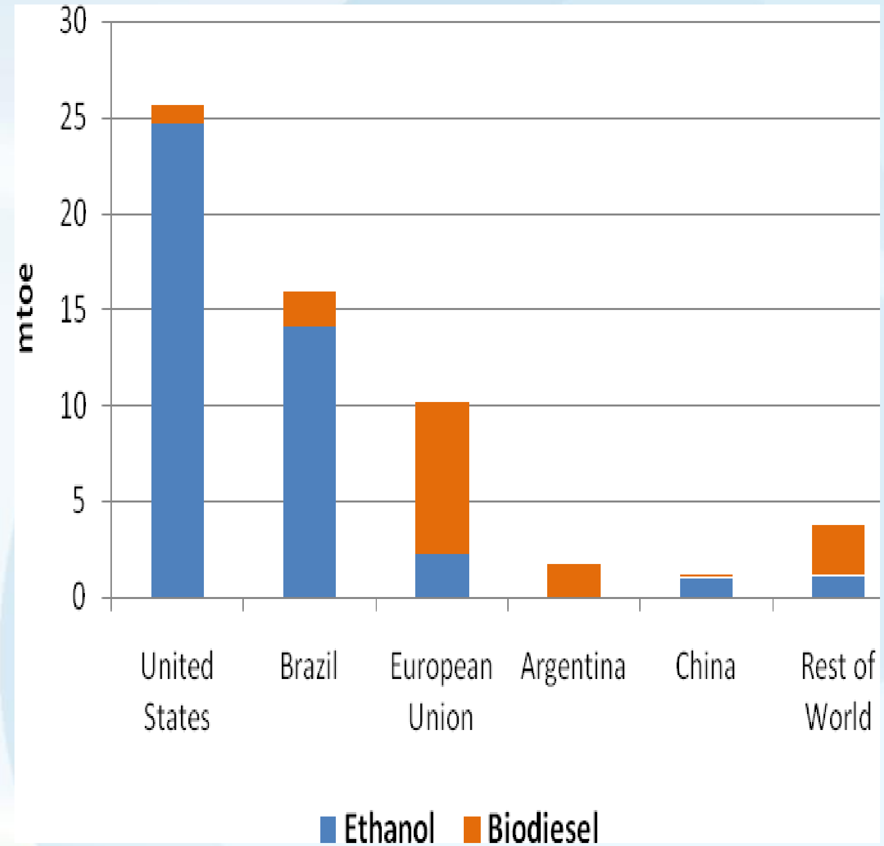


Global Production of Biofuels

Growth of Biofuels, 2000-2010



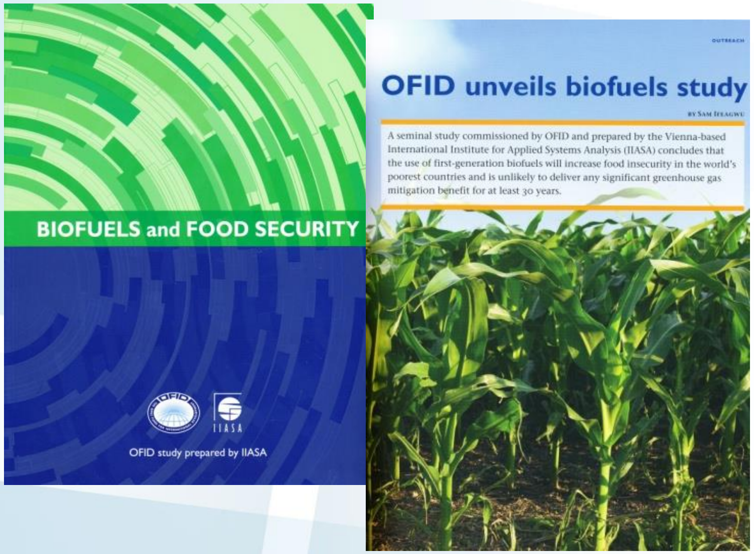
Ethanol and Biodiesel Production in 2010



North- and South America produce about 75% of global biofuels. Ethanol accounts for almost three-quarters of biofuel production; it dominates in USA and Brazil. Europe consumes mainly biodiesel.

Source: BP Statistical Review of World Energy, 2011

Biofuels and Food Security: The Food–Land–Energy–Climate Nexus



Key questions analyzed at IIASA:

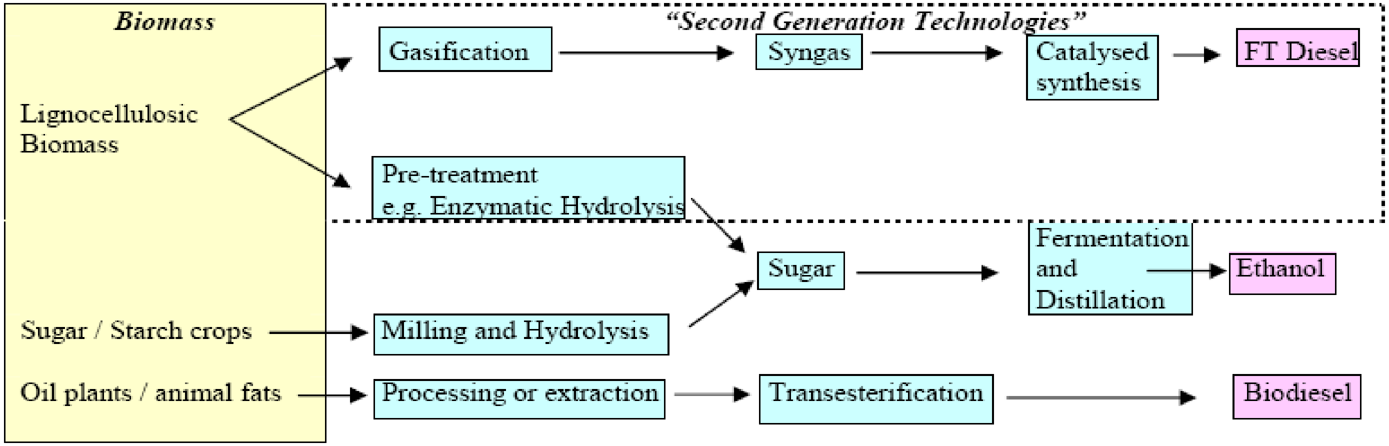
- How will announced biofuel targets affect international agricultural commodity prices, rural incomes and food security?
- What will be the impacts of biofuel expansion scenarios on land use change in developing countries?
- Will the targeted biofuel expansion result in substantial improvements of energy security and net GHG emission reduction?
- How much land and where is available for sustainable production of biomass feedstocks for energy use?
- What are “least disturbing” policies to promote biofuel expansion, i.e. protecting food security, preserving the environment and avoiding disturbances in other biomass sectors.

Bio-fuel Feedstocks

Feedstock groups:

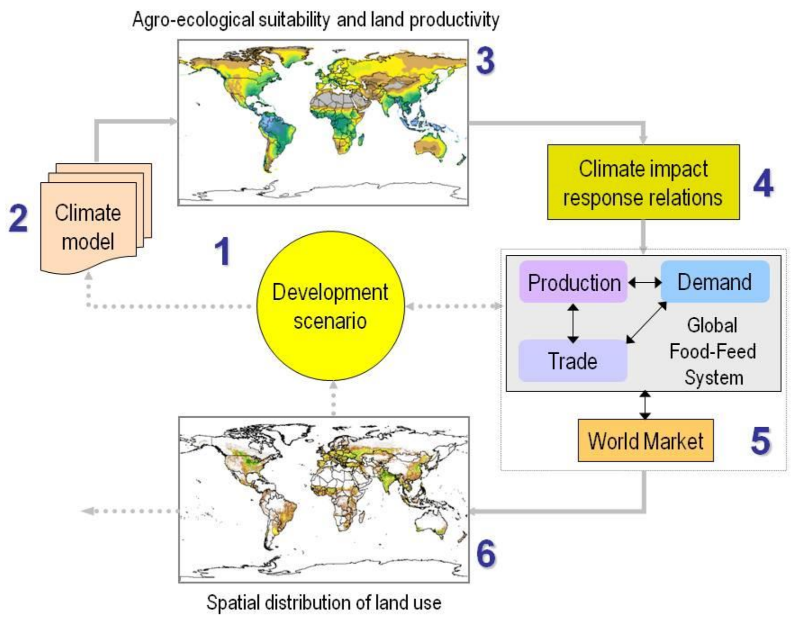
- Oil crops
  Rapeseed; Sunflower; Soybean; Oilpalm; Jatropha
- Sugar crops
  Sugarcane; Sugar beet; Sweet sorghum
- Starch crops
  Wheat; Rye; Triticale; Maize; Sorghum; Cassava
- Herbaceous lignocellulosic plants
  Miscanthus; Switchgrass; Reed canary grass
- Woody lignocellulosic plants
  Poplar; Willow; Eucalyptus

Figure 1. Fuel production pathways



Source: adapted from BMU (2006) and Hamelinck and Faaij (2006)

Biofuels and Food Security:



Major achievements:

- Advanced systems analysis: global integrated multi-scale ecological-economic framework for analyzing social, economic and environmental impacts of biofuel policy options.
- Spatially detailed analysis of land availability and suitability for first- and second-generation biofuel feedstocks.

Policy relevant findings:

- 'Low disturbing' biofuel development requires agricultural productivity increases to exceed food demand growth.
- Focusing policies on narrowing yield gaps in LDC's could bring about rural income growth, improve food security and provide feedstocks without carbon-intensive land conversion.
- The poor in developing countries pay the price for incoherent MDC policies; equally, they may benefit from well-designed and adaptive biofuel expansion.
- For GHG benefits to materialize, yield gap reduction, carefully monitored speed of biofuel expansion and strict regulation to avoid land conversion is important.

- In 2011 the FAO Food Price Index reached the highest level ever calculated since 1990.
- Various factors in commodity markets signal lasting price volatility.
- Raw material prices are expected to remain at high levels.
- The inflation of food prices is concerning.
- Agricultural production expected to grow slowly according to FAO-OECD 2020 projections.
- Growing demand for agricultural feedstocks expected for biofuel production.

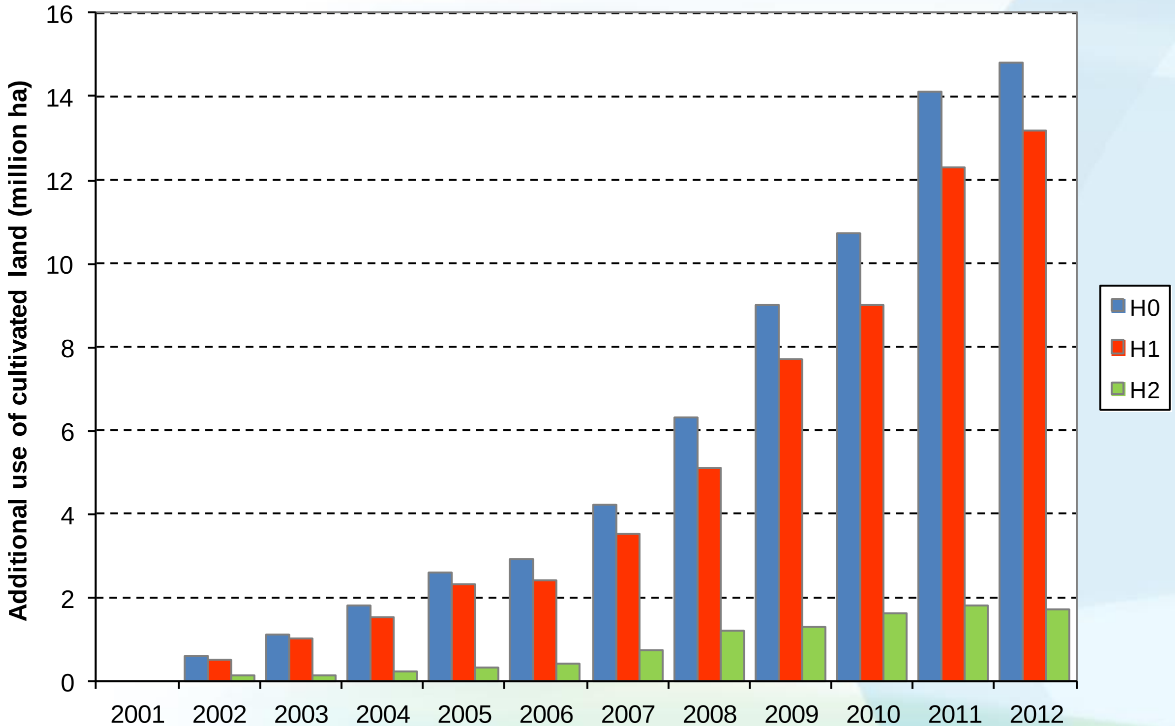
Source: FAO Food Price Index, 6 September 2012

Impacts of rapid biofuel expansion?

- The rapid rise in food prices of 2007 and 2008 coincided with an unprecedented expansion of maize-based ethanol production in the USA and fast biodiesel production expansion in Europe. At the same time various biofuel consumption mandates and targets were established and the industry received substantial subsidies. Agricultural prices dropped in 2009 but reached record high levels again in the beginning of 2011.
- There have been many speculations and accusations as to what the main causes of the food price surges in 2007 and 2008 were and what contributed to the observed high volatility of food prices in recent years.
- The rapid expansion of biofuel production was one of the explanations offered. Other contributing factors brought up in the discussion were poor harvests due to weather related factors, strong demand increases in economically fast growing and population rich developing countries, low levels of food stocks, and financial speculations affecting agricultural commodity markets.

PREBS 2014 Project for the European Commission Results

Figure: Use of additional arable land due to biofuel expansion in 2002-2012 relative to a simulation *H3* without biofuels demand



H0 … all countries
H1 … all countries except EU27
H2 … only EU27
H3 … simulation without observed biofuel expansion

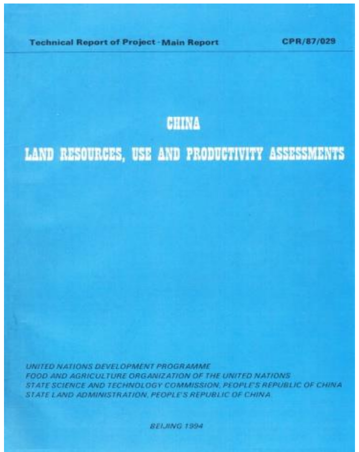
Source: World Food System backcasting scenario simulations, August 2012.

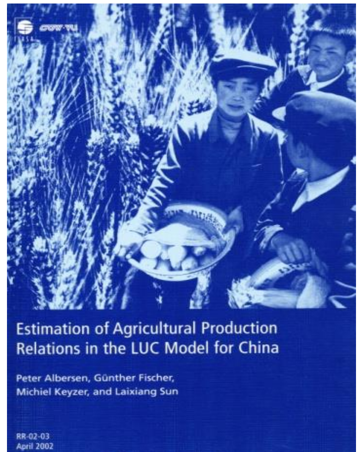
PREBS 2014 Project for the European Commission Results

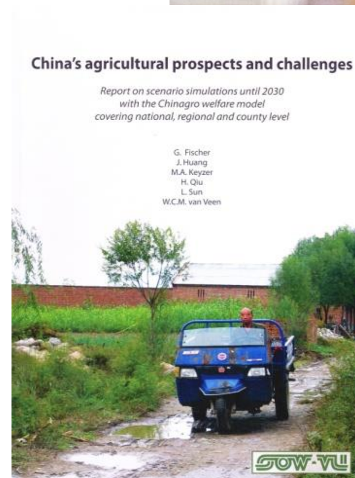
- Simulating the historical biofuel expansion path, cereal prices are up in 2008 by 19 percent and by 23 percent in 2010 (scenario H0) relative to prices simulated without biofuel expansion (scenario H3).
- Both factors, biofuel production expansion and production distortions, have contributed to widening the demand-supply gap especially in 2008 and 2010. The analysis suggests that the combination of the two factors caused a combined impact that was larger than the sum of the two individual impacts, i.e. there was a mutually reinforcing interaction of the two stress factors.
- The back-casting scenario analysis clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases in 2007 to 2010. The impact of EU-27 was more substantial for price increases of non-cereal food commodities, notably through its demand for vegetable oil in the production of biodiesel.

Source: World Food System back-casting scenario simulations, August 2012.

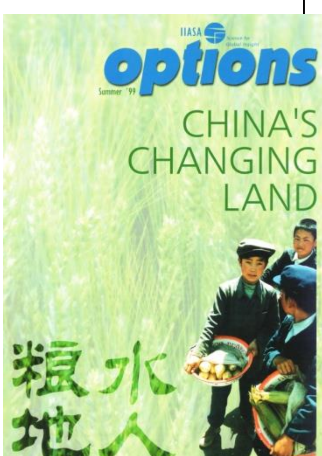
Food, Land and Water in China

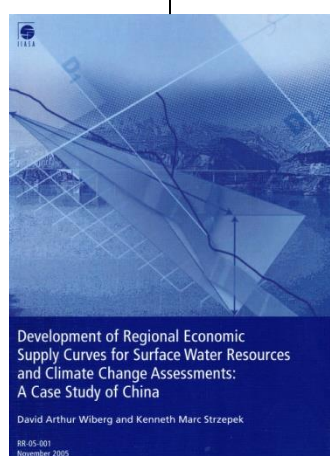


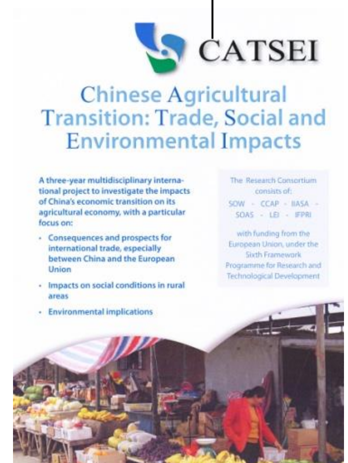




1990's | 2000's | 2010's



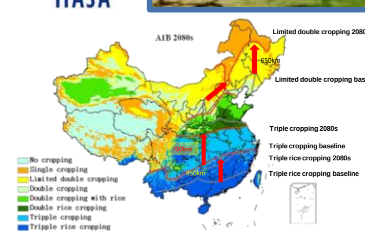


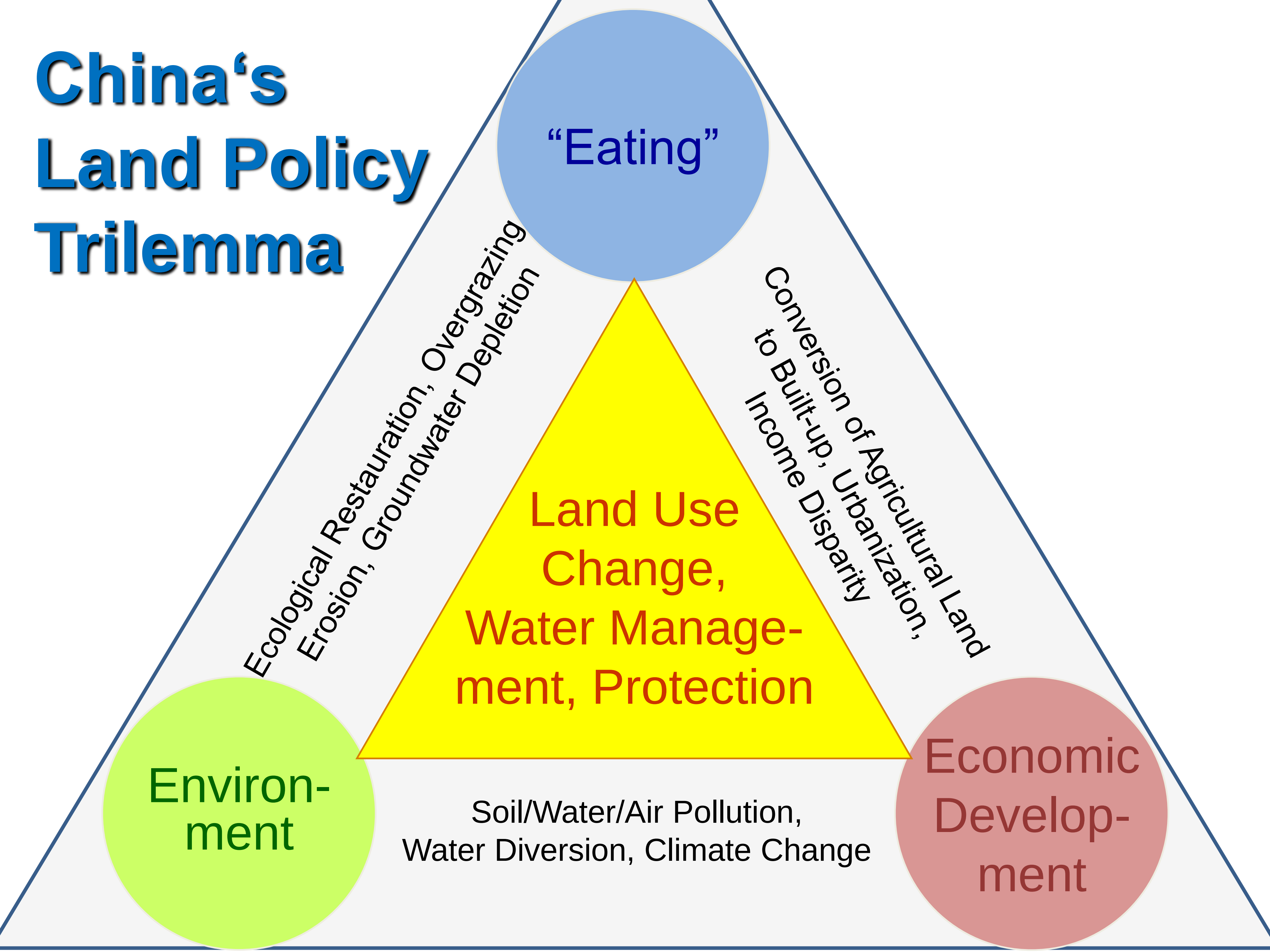


国家自然科学基金委员会

NSFC

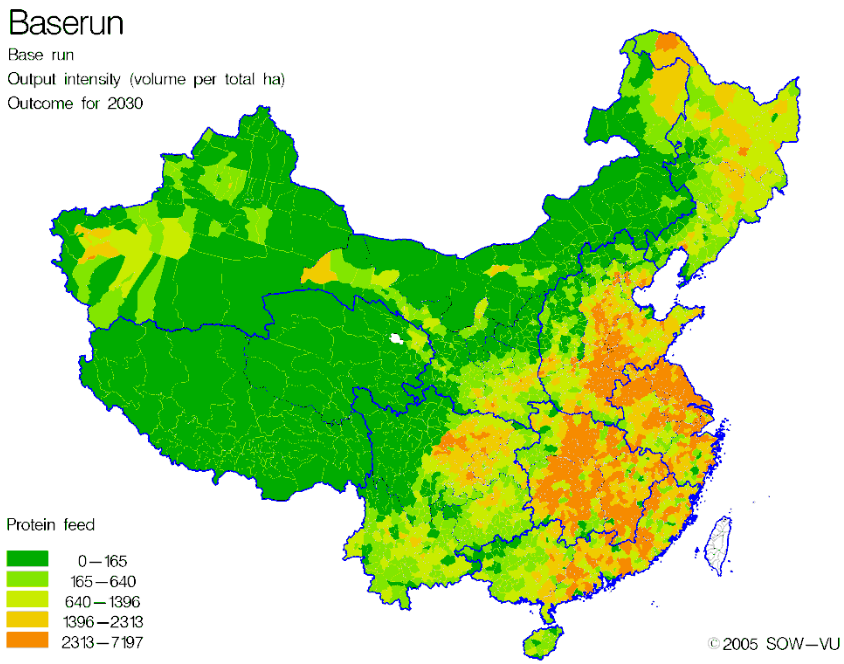
IIASA

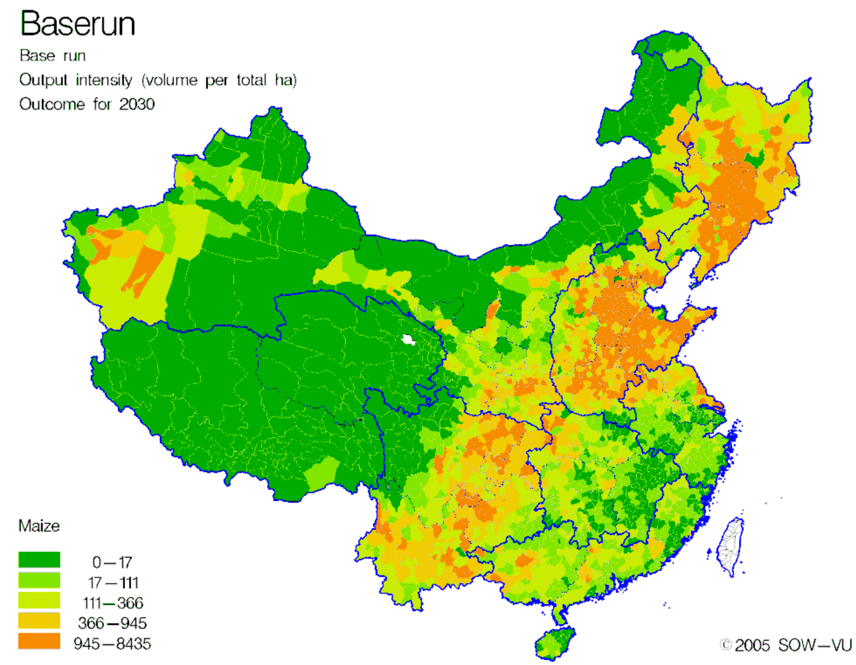


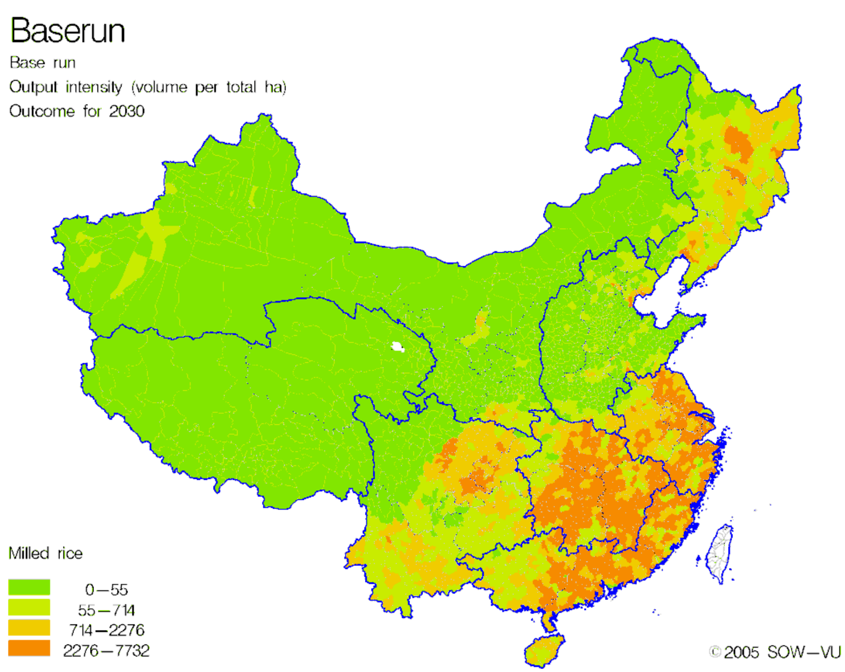

China's
Land Policy
Trilemma
"Eating"
Ecological Restauration, Overgrazing
Erosion, Groundwater Depletion
Conversion of Agricultural Land
to Built-up, Urbanization,
Income Disparity
Land Use
Change,
Water Manage-
ment, Protection
Environ-
ment
Soil/Water/Air Pollution,
Water Diversion, Climate Change
Economic
Develop-
ment

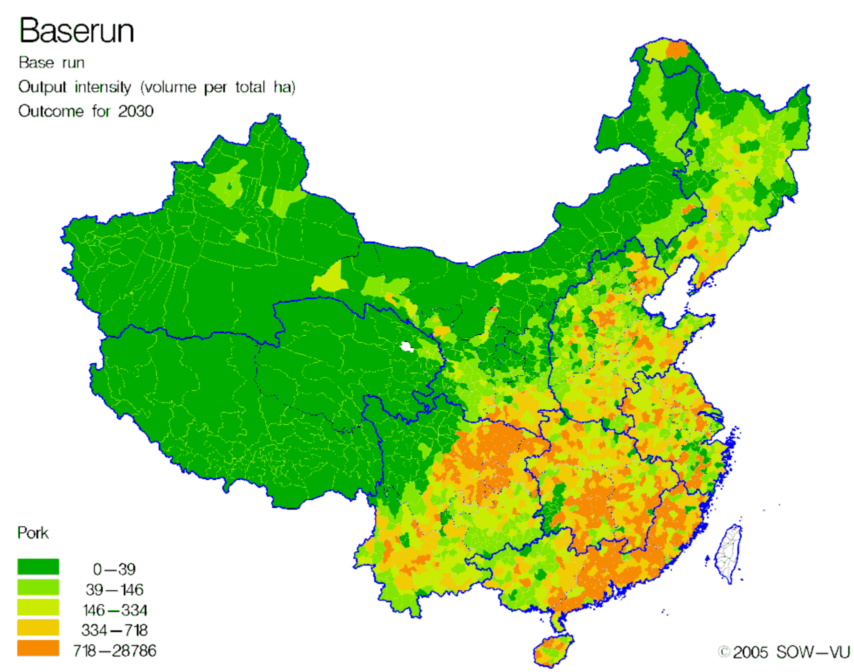
CHINAGRO Model: Main Characteristics and Drivers

- ***CHINAGRO is a General equilibrium model representing consumer and producer behavior, government policies and markets.***
- Main Characteristics:
  - Focus on agriculture (non-agriculture largely given via scenarios)
  - Spatial detail: agricultural supply by county (~2800); commodity detail:
    - 17 tradable commodities (explicit trade flows across regions and from/to abroad)
    - 8 farm types/production activities competing for land and stable capacity in every county
  - Demand more aggregated: 8 regions with 3 rural and 3 urban classes
- Main Drivers:
  - Income growth and urbanization leading to rising meat and feed demand
  - Constraints on agricultural expansion due to environment (land use, pollution, water) and industrialization
  - Steady trade liberalization in agriculture
  - Rural and regional development policies
  - High energy needs but modest bio-fuel targets
- ***CHINAGRO is the most detailed agro- economic model of Chinese agriculture available.***

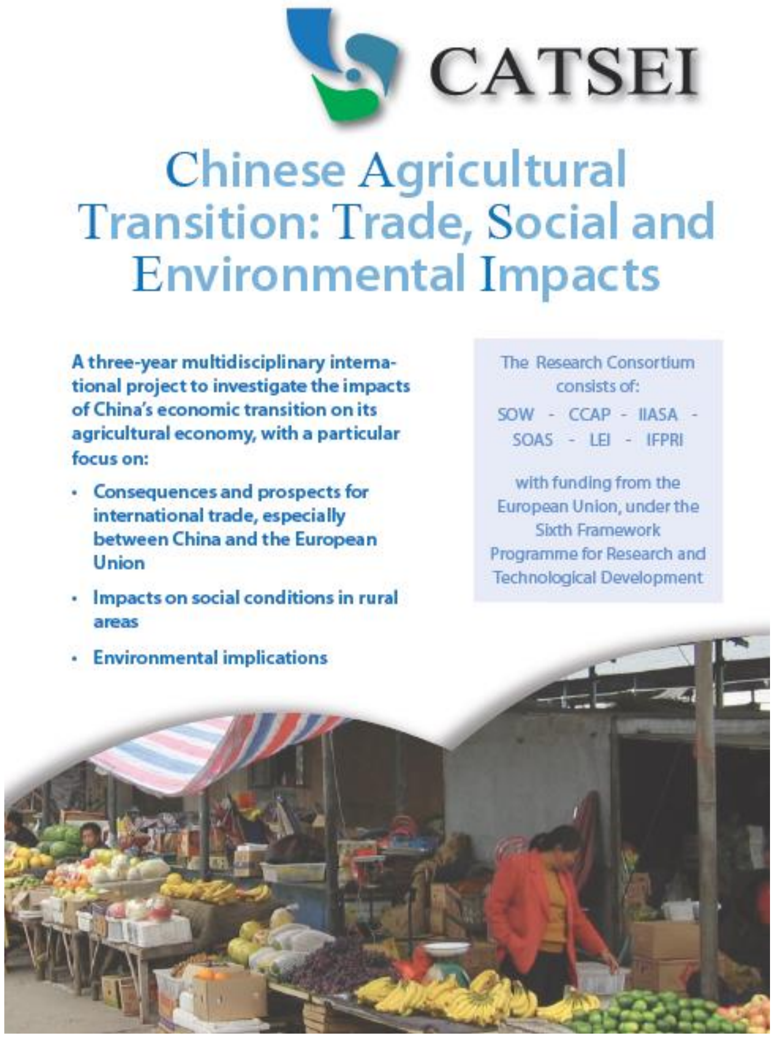

Baserun
Base run
Output intensity (volume per total ha)
Outcome for 2030
Protein feed
0 – 165
165 – 640
640 – 1396
1396 – 2313
2313 – 7197
© 2005 SOW–VU


Baserun
Base run
Output intensity (volume per total ha)
Outcome for 2030
Maize
0 – 17
17 – 111
111 – 366
366 – 945
945 – 8435
© 2005 SOW–VU


Baserun
Base run
Output intensity (volume per total ha)
Outcome for 2030
Milled rice
0 – 55
55 – 714
714 – 2276
2276 – 7732
© 2005 SOW–VU


Baserun
Base run
Output intensity (volume per total ha)
Outcome for 2030
Pork
0 – 39
39 – 146
146 – 334
334 – 718
718 – 28786
© 2005 SOW–VU

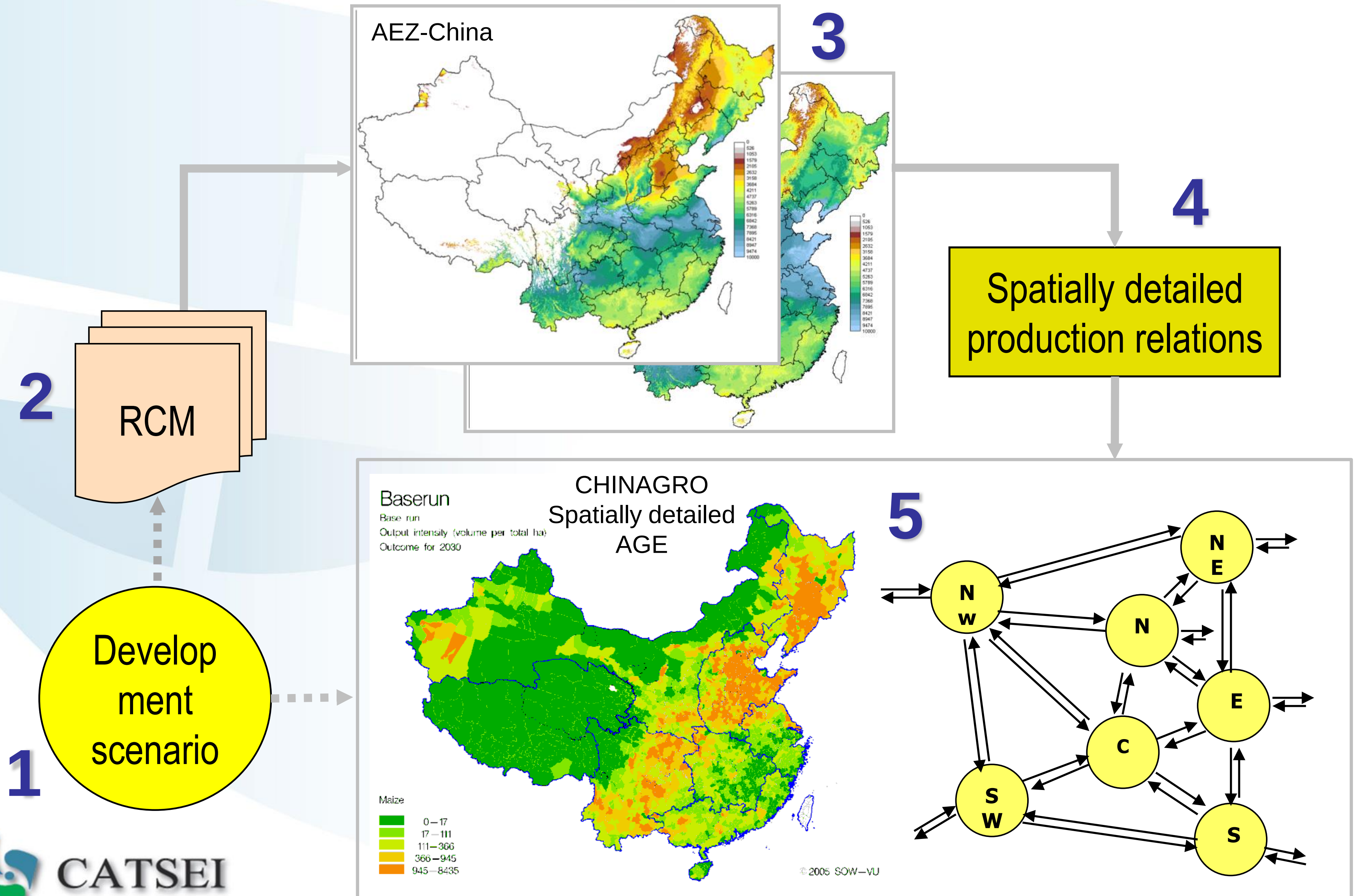
Agriculture, Food and Water: Environmental Impacts and Linkages



The fast growth of consumption in China, meat in particular, has triggered intensification and concentration of production, requiring additional irrigation and leading to increased emissions of pollutants, interacting with climate change and other environmental stresses:

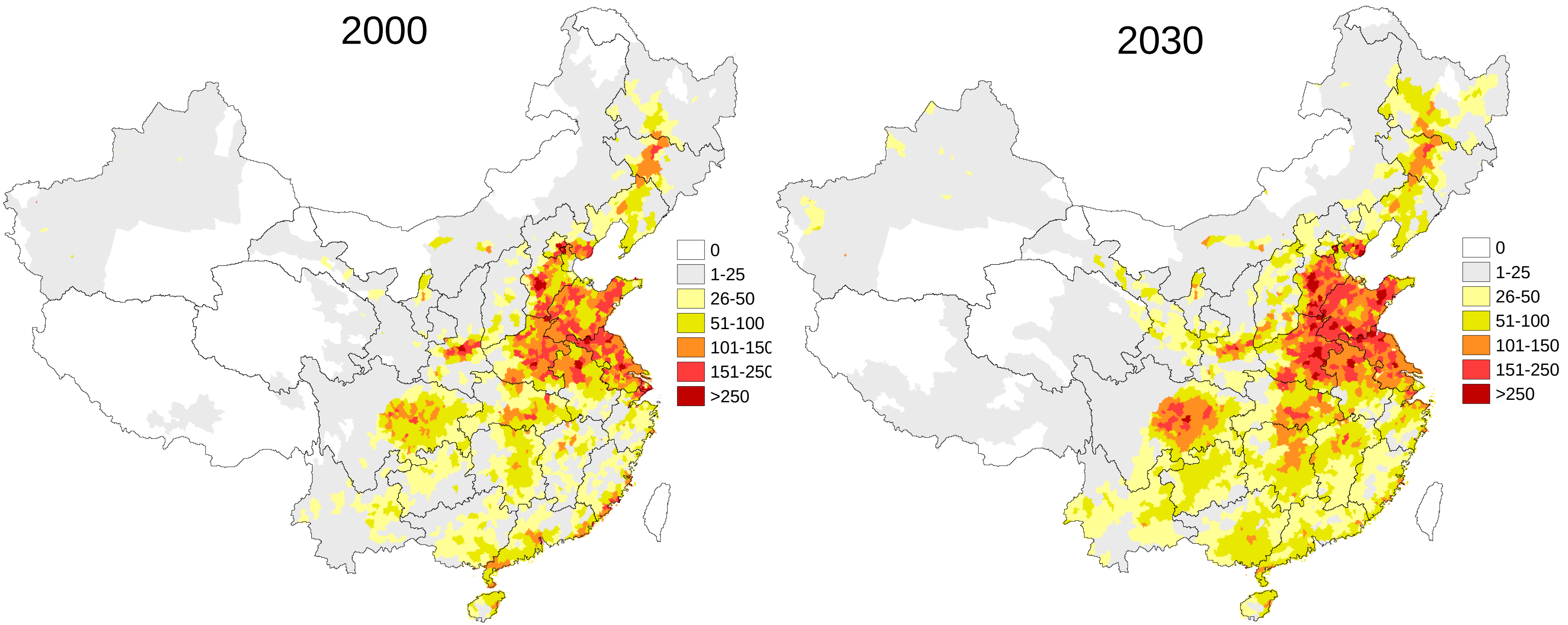
- Water scarcity
- Climate change
- Non-point source pollution
- GHG emissions
- Ground-level ozone

CHINAGRO – A Spatially Detailed National Food System Assessment Framework



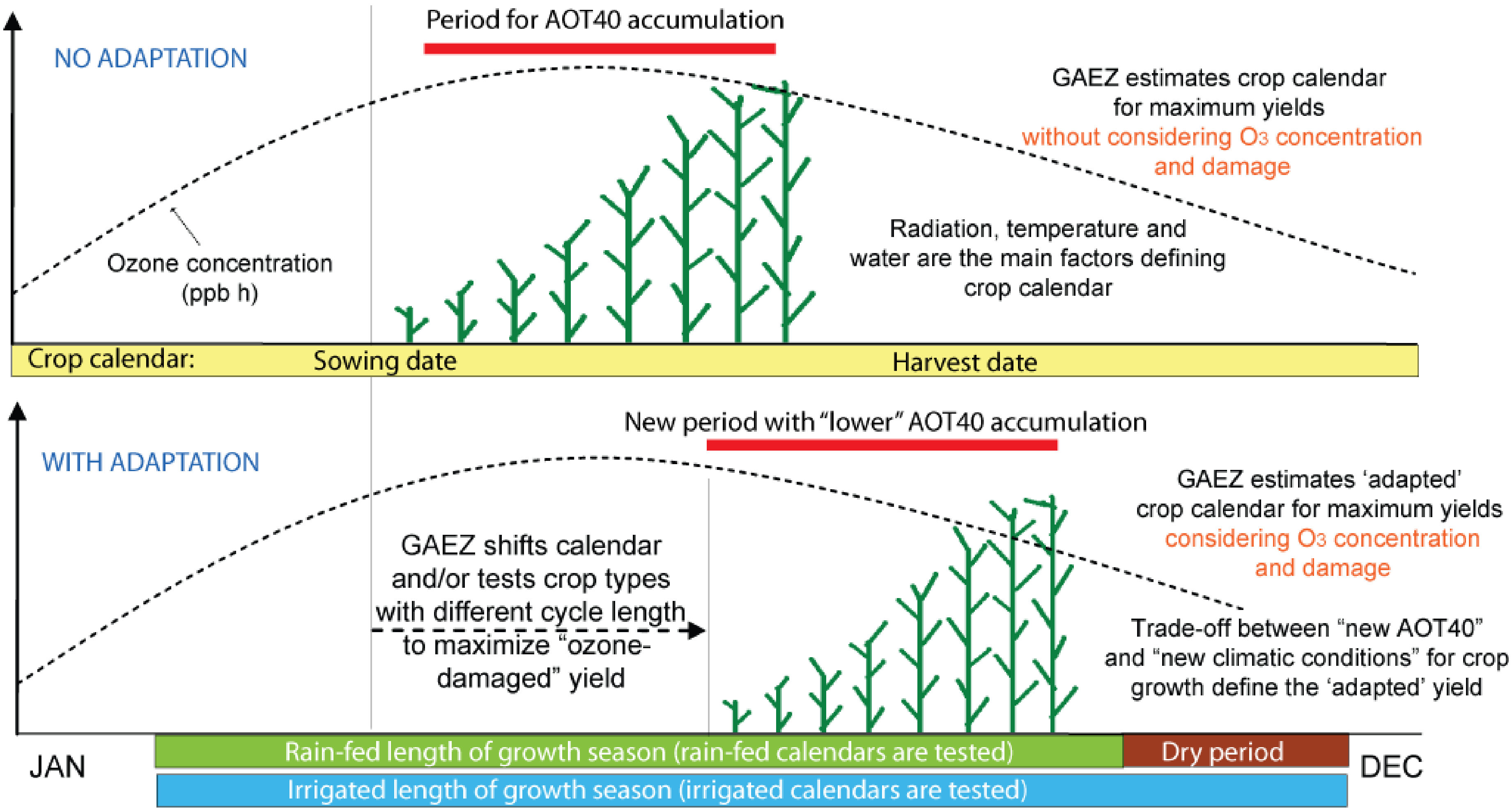
CATSEI

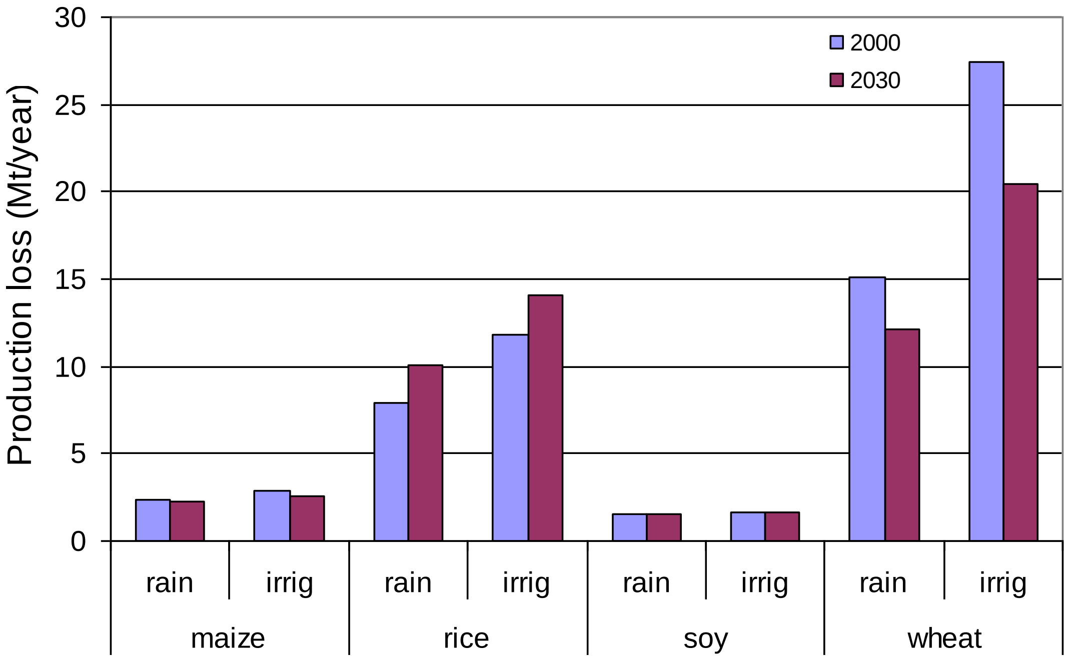
Intensity of nitrogen losses (kg N/ha total land)

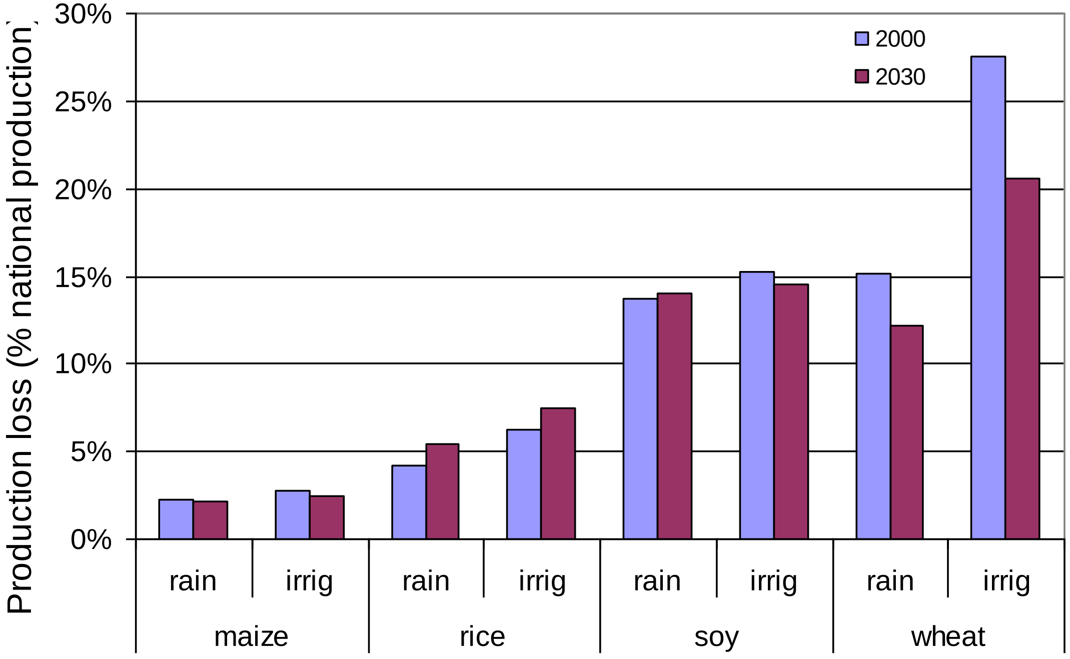


The nitrogen surplus is one of the factors undermining the supply potentials of China's agro-ecosystems. Negative impacts of increasing excess nitrogen such as ***lowering soil quality, water and air pollution*** would ***diminish future crop production***. There are also obvious ***impacts on climate change and public health***. The national cropland nitrogen surplus has raised concern of local and central government institutions, e.g. Shanghai Meteorological Bureau (SMB), China Meteorological Administration (CMA) and China Ministry of Agriculture (MOA).

Using GAEZ to test adaptation to O_3







China

Yield loss due to ground-level ozone

Assumptions:

- TM5 runs
- IIASA CLE emissions scenario
- AOT40 index
- Rain-fed and irrigated systems independent

Teixeira et al., (2008, forthcoming)

"Assessing the Impact of Climate Change and Intensive Human Activities on China's Agro-Ecosystem and its Supply Potentials"

- Establish a common database of bias-corrected climate projections to 2100 using high resolution RCMs;
- Simulate the spatial and temporal distribution of China's agro-meteorological resources, such as cumulative temperature sums, moisture index, length of growing period and multi-cropping conditions under different future climate projections.

1. Characterize ***climate and agro-meteorological resource change of China*** with IPCC SRES Projection, two Regional Models

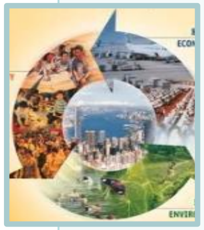
- Apply new data-model fusion method to up-scale the site specific crop model (DSSAT), providing a site-informed "micro foundation" for AEZ model.
- Assess the climate change impact on the production potential of main crops.

2. Establish an ***integrated multi-scale data-modeling fusion framework*** for agro-ecosystem analysis.

- Quantify the influence of population growth and changes in domestic diet structure on food demand and supply;
- Simulate land-use changes, rural labor supply and possible adaptations to climate change;
- Assess their combined impacts on the supply potential of China's agro-ecosystems.

3. Project ***land use changes and population dynamics*** consistent with future climatic and socio-economic trends.

- Develop and apply policy assessment tools to simulate input and output management options for sustainable development of Chinese agriculture in general and the climate change issue in particular.



4. Assess different policy issues: ***climate change impacts*** on China's food economy; feeding ***China's livestock***.

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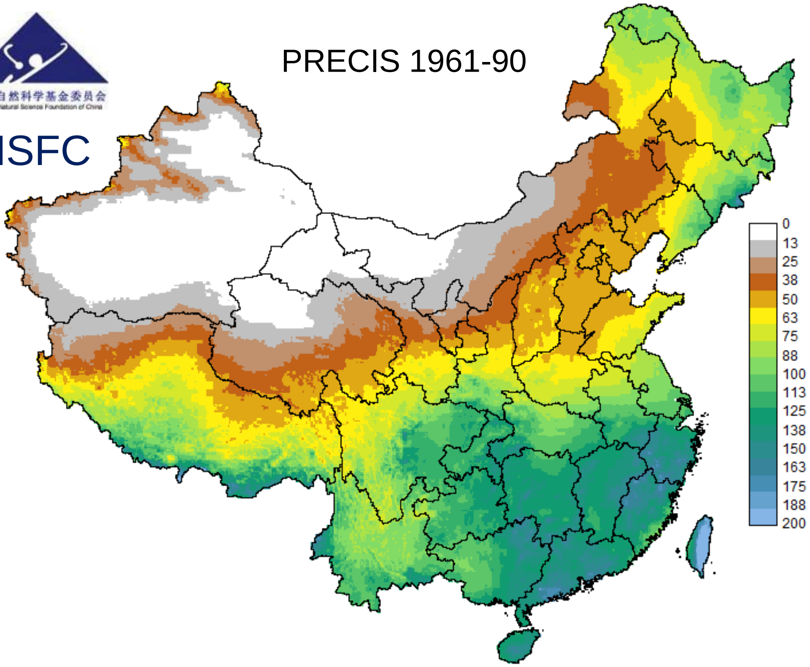
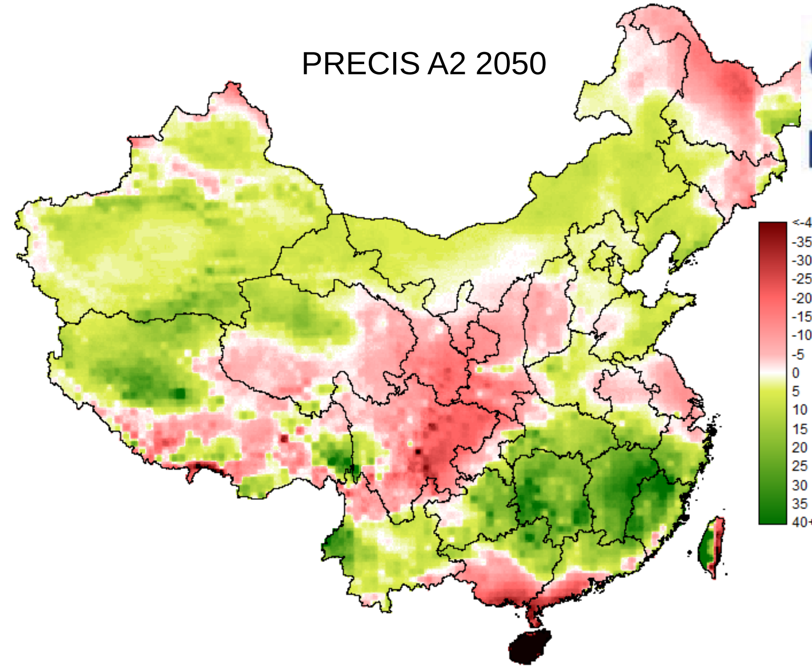
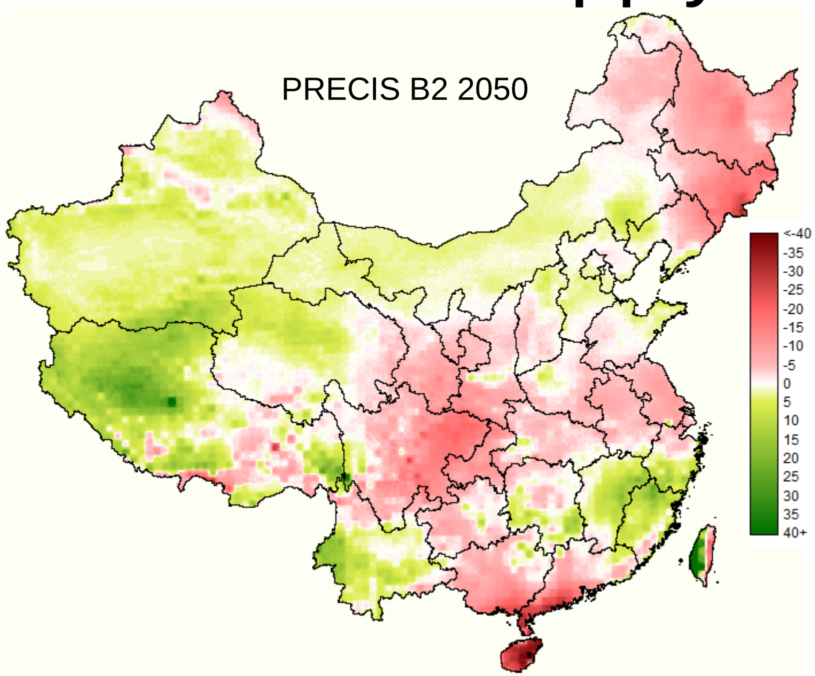
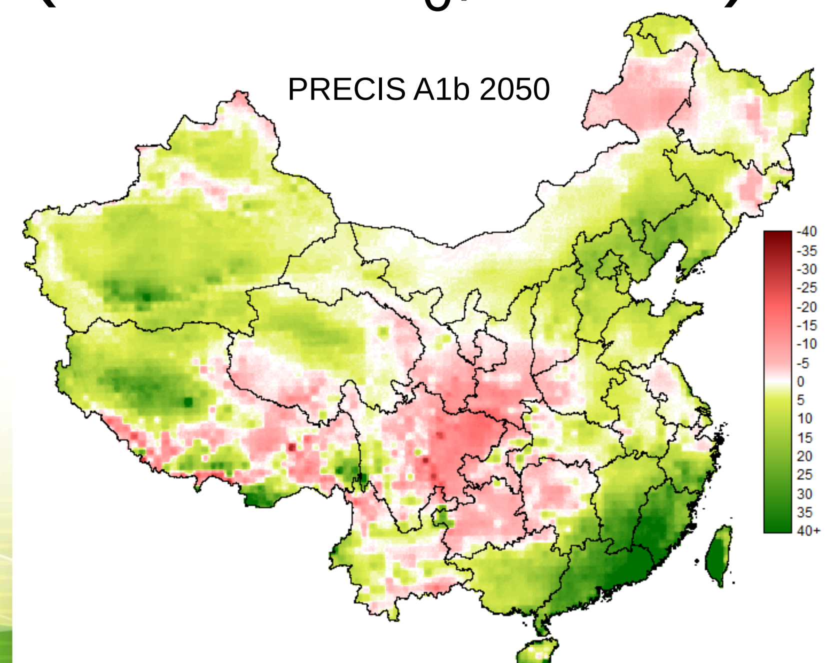




Moisture Supply Index (100*P/ET$_0$, Δ MSI)





Northward Shift of Cropping Systems Zones

(2071-2100, PRECIS, A1B)

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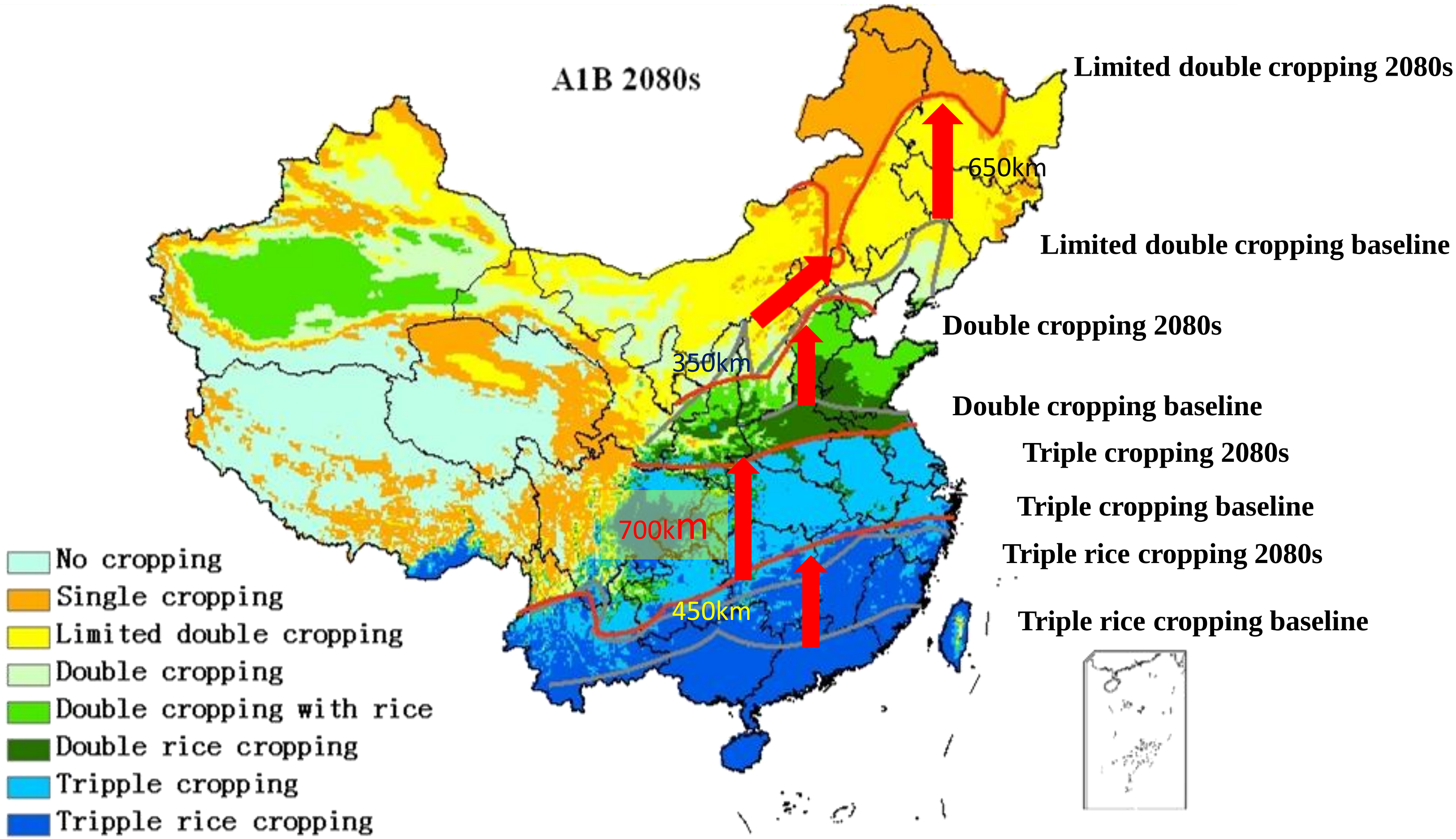
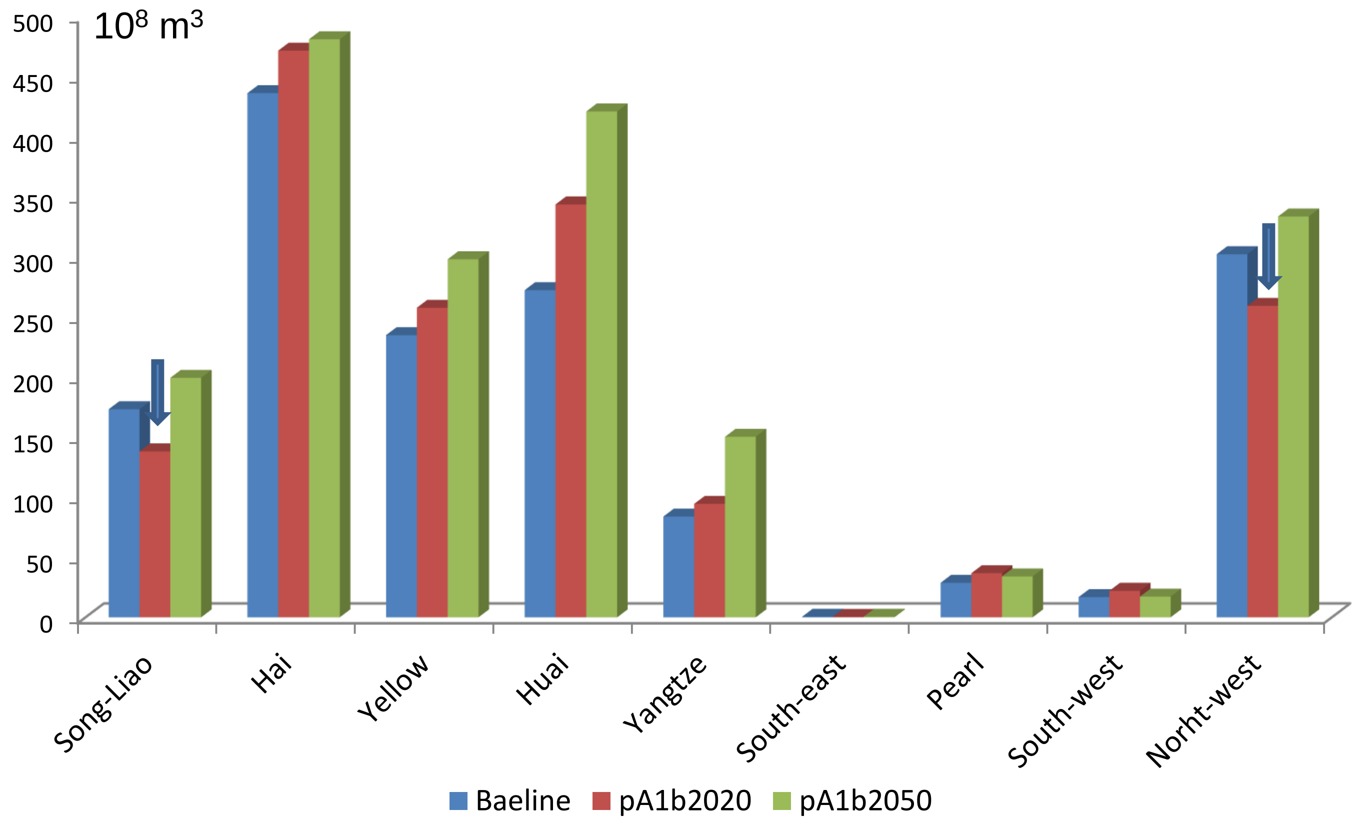


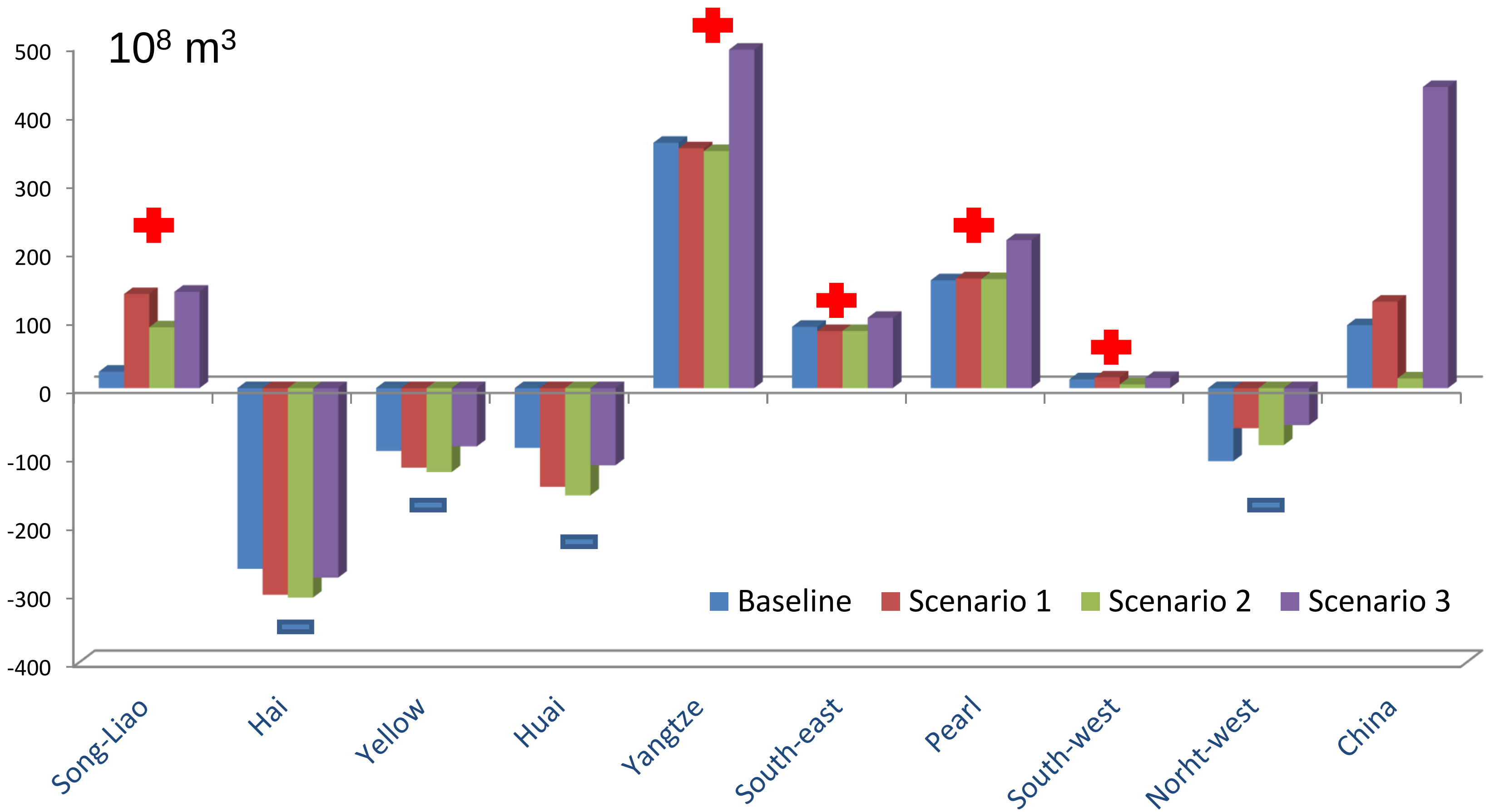
Under the A1B scenario in 2080s, the ***cropping systems will move northwards***, increasing potential multi-cropping and sown area. This could ***increase the potential crop production especially in Northeast and Northwest China***. The AEZ analysis demonstrates that the cropping systems will change significantly and multi-cropping zones will shift by several hundred kilometers.

Estimated Irrigation Water Requirements



The Northern basins like Yellow, Huai, Hai & North-west basin have large requirements for irrigation water. Song-Liao and North-west requirement will reduce in 2020s. In 2050s the irrigation requirements will be greater than Baseline in all 9 major river basins. Total net irrigation water requirements will increase **5%** in A1B 2020s and **25%** in A1B 2050s.

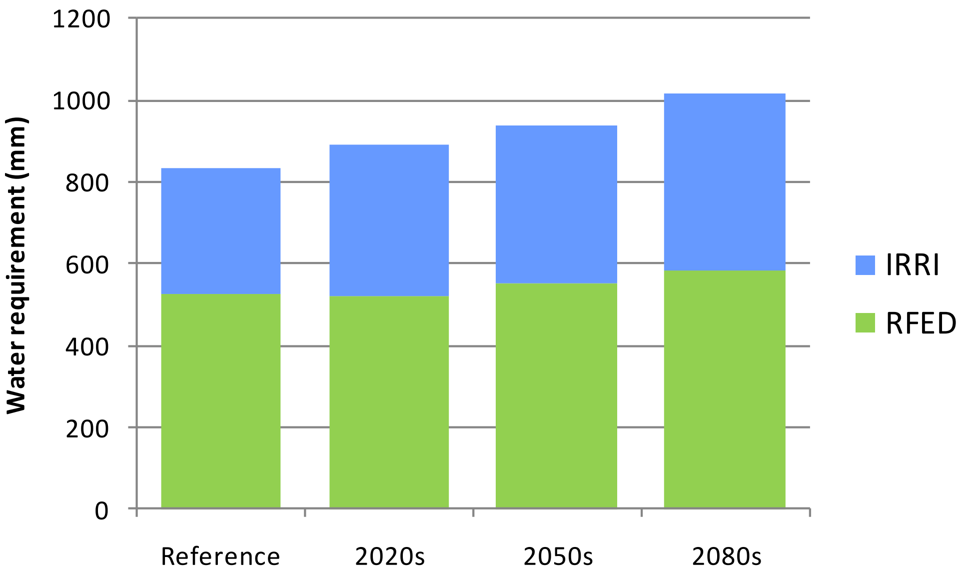
Water Resources Budget in the Nine River Basins



unit:$10^8 m^3$	Scenario 1	Scenario 2	Scenario 3	Diversion in 2030
Hai basin	-301.9	-306.0	-276.9	163.4
Yellow basin	-116.2	-122.8	-85.2	97.6
Huai basin	-144.2	-156.7	-112.8	218.6

China: Climate Change Impacts on Crop Yields and Water Requirements

HadCM3, IPCC A2 Scenario



With climate change the share of irrigation in total crop water requirements as well as the total amount of water to be supplemented by irrigation increases, varying with scenario/ climate model.

Policy relevant findings:

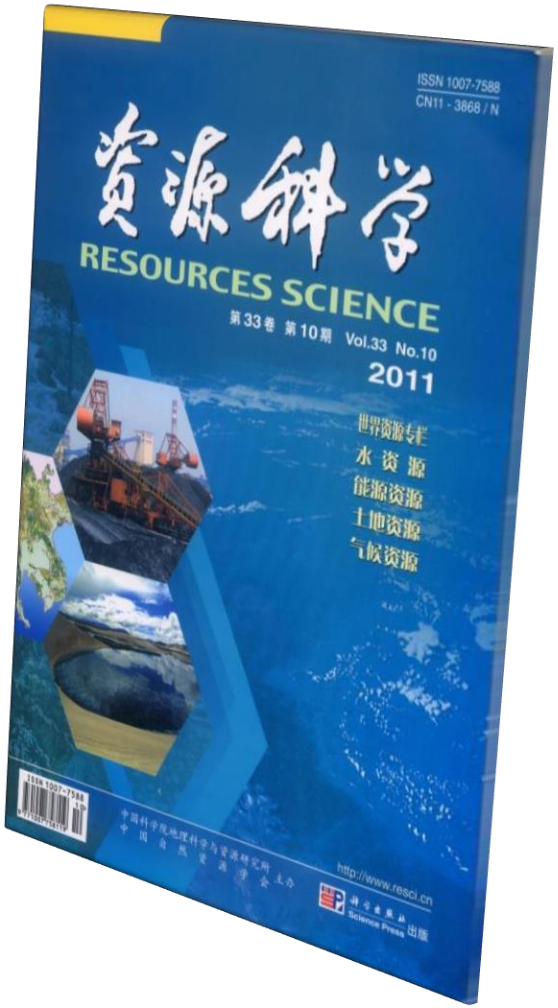
- Climate change requires substantial adaptation of cropping systems in China's regions;
- Crop production potential is shifting northwards with climate change;
- Positive temperature effects may be limited by soil moisture deficits and more frequent extreme events;
- Crop water requirements projected to increase more than10% by 2050; a growing fraction to be supplied by irrigation;
- High risk that water stress will increase with climate change. Magnitude of effects varies with GCM and scenario.

The impacts of climate change on China's agriculture will largely depend on the consequences for regional water resources.

Published Papers

- Peer-reviewed papers

1. TANG Xu, YANG Xuchao, TIAN Zhan et al. Impacts of Climate Change on Agro-Climatic Resources in China, Resources Sciences, 2011,33(10):1962-1968
2. XU Xinliang, MIN Xibi, TIAN Zhan. Simulation and Prediction of Urban Expansion in Shanghai City based on GIS and LTM Mode. China Population, resources and environment, 2010, 20(5):136-139
3. Yang Honglong, Xu Yinlong, Tao shengcai et al. Vulnerability to Heat Waves and Adaptation: A Summary. Science and Technology review. 2010, 28(19): 5-9
4. SHI Jun, CUI Linli, HE Qianshan, SUN Lin. The Changes and Causes of Fog and Haze days in Eastern China. Acta Geographica Sinica, 2010, 65(5): 533-542
5. Ming ZHANG, Projection of Water Demand under Changing Land-Use in Beijing Municipality, Population and Environment. 2011:1-12
6. Jikun Huang, Huanguang Qiu, Michiel Keyzer et al. Biofuel development, food security and the use of marginal land in China. Journal of Environmental Quality. 2011, 40(4): 1058-1067
7. TIAN Zhan, CAO Guiying, SHI Jun et al. Urban Transformation of a Metropolis and its Environmental Impacts: A Case Study in Shanghai. Environment Science and Pollution Research (in press)



Policy Briefs

1. **Who will feed China's lives… - A policy report on feed security issue in the future.** This policy report … *of livestock feed security is of more concerns tha…* …nd more effort should be made to imp… …a both domestic production and the i… …oluables (DDGs). *This report was well rec… …state council.*

2. **Assessment on th… …ication and its impact on environment in…** *…nment highly appreciated our research, … …e nitrogen surplus.*

3. **"The status … …plication and its implications to environ…** …t suggested that *low-carbon and orga…* … implemented in the regions with se… *…to China Meteorological Admi…*


国家自然科学基金委员会办公室

国家自然科学基金委员会
简报（内参）信息采用通知

上海气象局：

你单位汤绪、田展同志参与撰写的"谁来养活中国的畜禽——对我国未来饲料粮安全的分析和政策建议"，被科学基金内参2011年第1期采用，于2011年8月通过国家自然科学基金委向中办和国办报送。该期内参得到中央首长批示。

特此通知。

感谢对我们工作的大力支持，希望继续关注和支持科学基金政务信息工作，及时将科学基金资助的重要科研成果、重大政策建议等重要信息报送基金委办公室，为国家科技决策、科学基金发展等作出更大贡献。

联系人：

联系电话：010—62327085

E-mail: shenlf@nsfc.gov.cn

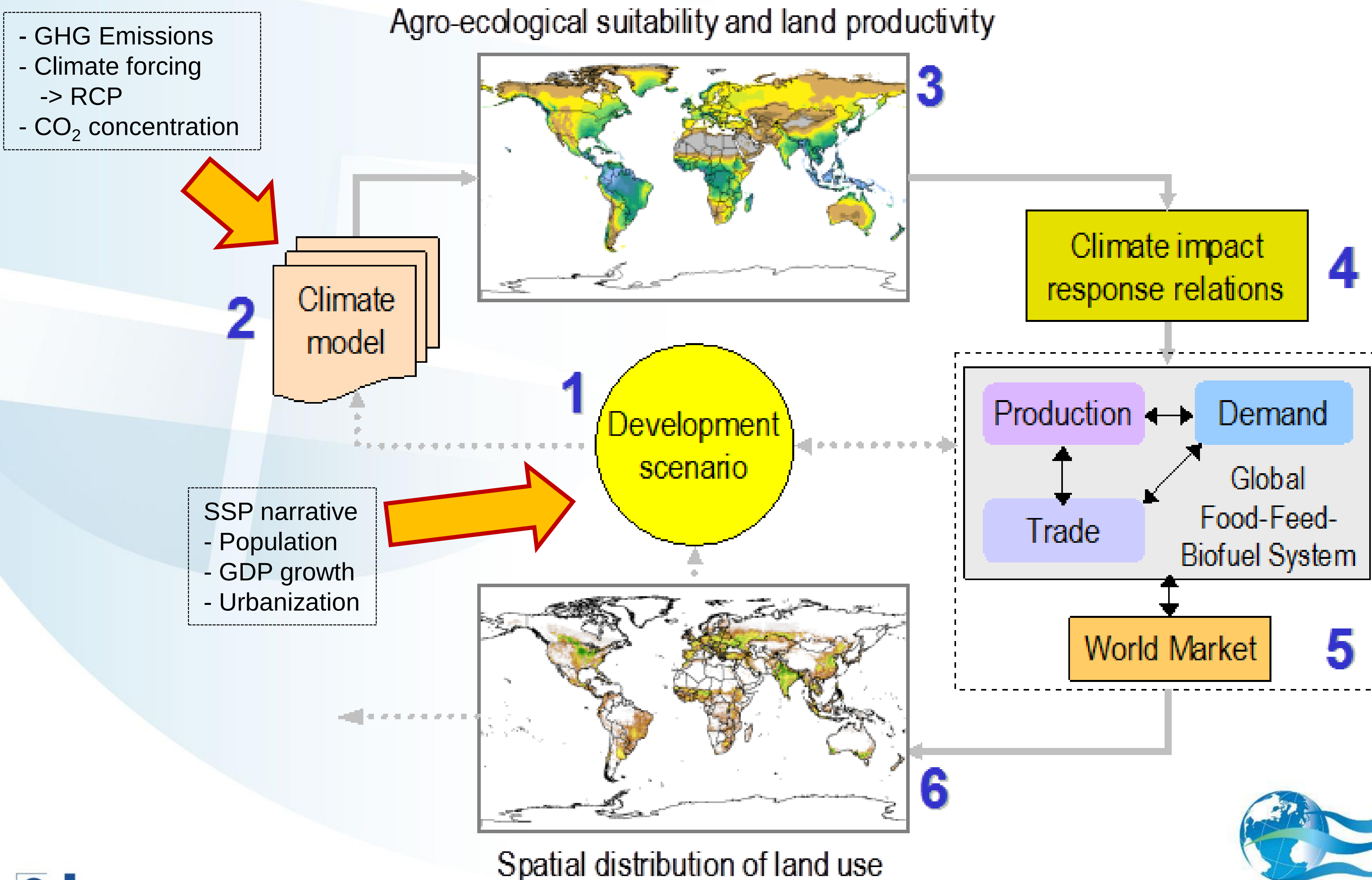
二〇一二年三月七日

IIASA

Water and Agriculture:

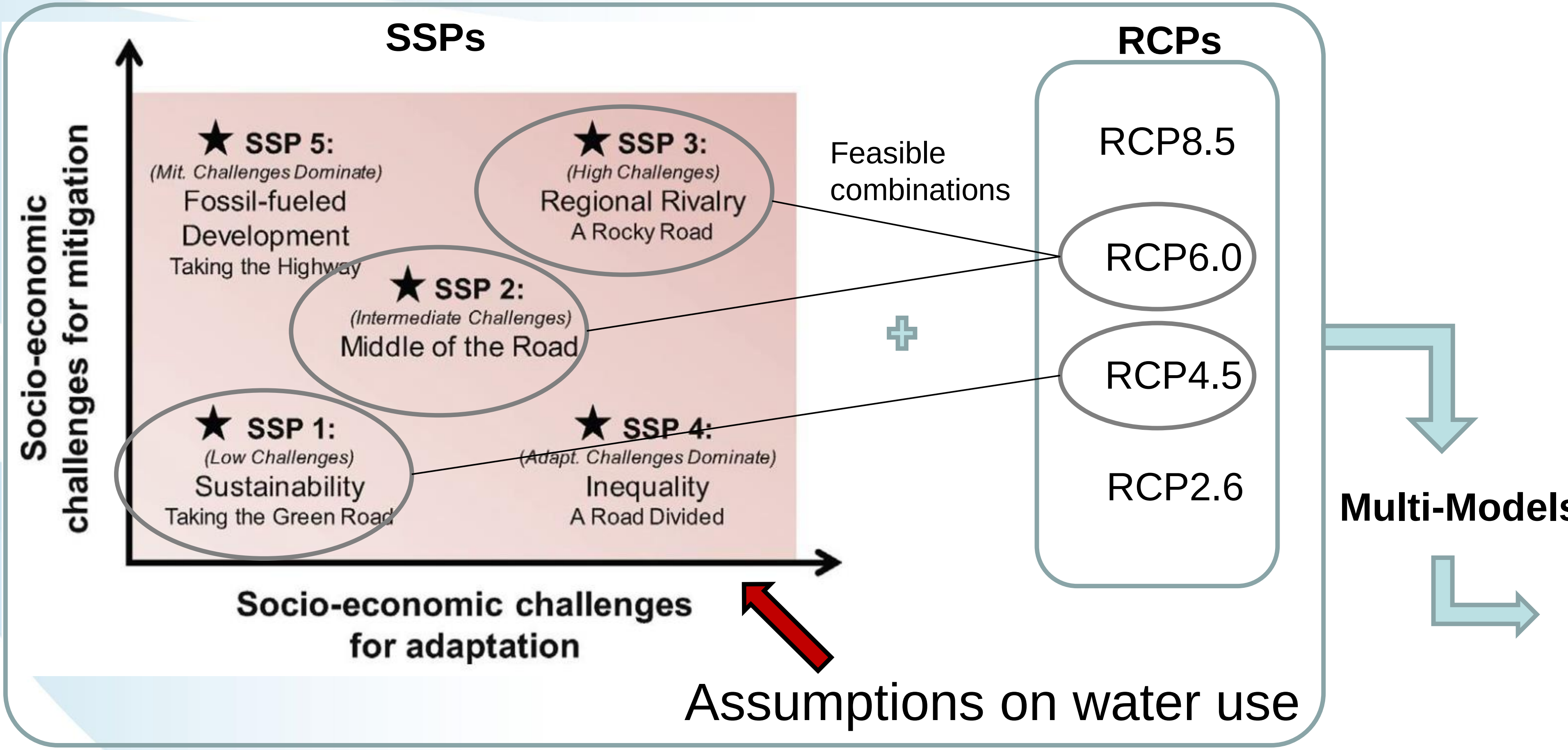
- Irrigated area has expanded to about 300 million ha worldwide, about 20% of total cultivated land.
- Agriculture is the largest user of water among human activities: irrigation water withdrawals are 70% of the total anthropogenic use of renewable water resources.
- Agriculture is in competition with other water users and has impacted negatively on the environment.
- In many areas water availability rather than warming per se is expected to be the most critical CC impact factor.

Framework for Global Food and Agriculture Systems Analysis



Source: IIASA, WAT Program WFS simulations, Jan 2016

Food and Water Future Scenarios



① Socio-Economic change scenario:
Shared Socioeconomic Pathways (SSPs) (IIASA data archive)

② Climate change scenario:
Representative Concentration Pathways (RCPs)

Food and Water – Main Messages

- Food security in Central, East and South Asia is vitally dependent on water resources generated in the high mountain regions.
- Changes in volume, timing or variability of water resources will affect food production and hydropower generation.
- The Asian water crisis is intensifying and, if unmitigated, will be affecting economic development, food and energy security.
- Preparedness for greater variability and more frequent extreme events.
- Need to adapt cropping patterns, management guidelines and extension services to the changing agro-ecological conditions and water availability.
- Promote healthy diets (less meat, sugar; more vegetables, fruit) with co-benefits of reducing the environmental burden of agriculture.
- Water is cross-cutting. Consistent and robust solution portfolios need to be identified that work across economic sectors, borders, and scales of management and are tailored to the specific basin conditions.

Systems Approach needed!

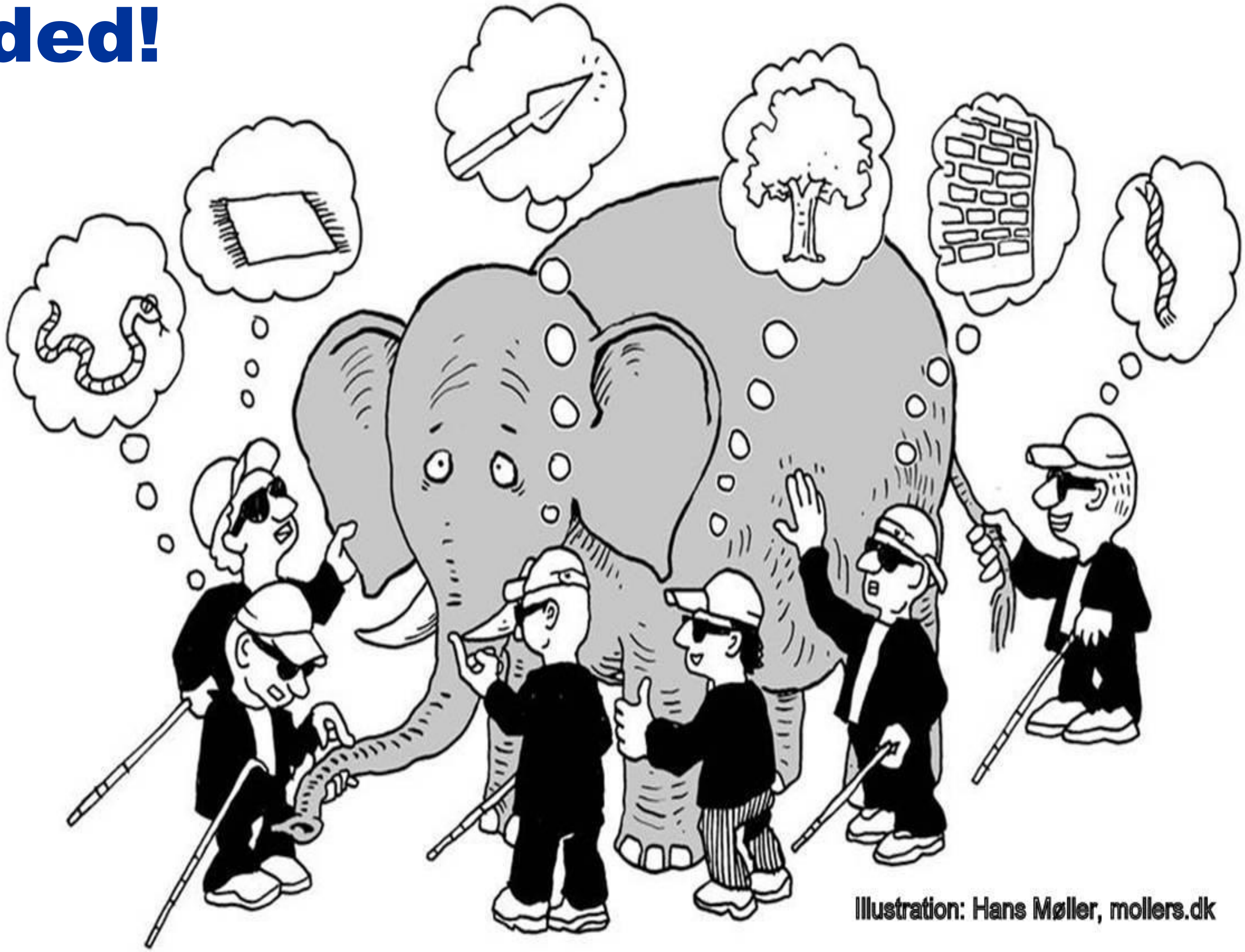


Illustration: Hans Møller, mollers.dk

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Successful Systems Analysis at IIASA: What does it require?

- A global or universal problem
- An identification and understanding of the system at stake at the appropriate scale(s) and level of detail
- Identification of stakeholders and understanding of stakeholder perceptions, needs and priorities
- A clear solution strategy and rigorous methodological approach
- Reliable research partners providing expertise, local knowledge, access to data and dissemination channels
- Funding to do the work
- A comparative advantage in carrying out the research
- A window of opportunity to elaborate or adapt adequate analytical tools

and

- A motivation to make the future world a better place

IIASA

Thank you!