Adopting public policies and priorities to encourage climate-smart agricultural practices

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Renewable Natural Resources Foundation Congress
Adapting Food Production to a Changing Climate:
Identifying Strategies and Establishing Priorities
Dec 9-10, 2014

Special thanks to Laurie Houston, Jianhong Mu, and Beau Olen

Themes

- Defining Climate Smart Agriculture
  - Early foundations
  - What's different and safe spaces
- Policies and CSA goals
  - Fundamentals – Economics 101
  - Bringing CSA to USA
  - Farm Bill policies
- Getting us there: integrating economics
  - Doing Impact assessment (RIA)
  - Landscape and local (farm-level) approaches

Background

- Science leads to better policy – consistent with 50+ years of integrated research
- Details are important – **how** do we integrate across sciences
- Borrowing from others (Kneese et al)
  - Unbalanced policy & materials balance approach
  - "Efficiency not enough – poverty, vulnerability"
  - "Production happens in "context" – what aggregate economic models often leave out – ignore heterogeneity
  - Valuing natural capital/ecosystem services in long term prospects

What is Climate-Smart Agriculture?

Climate-smart agriculture (CSA), as defined by FAO at the 2010, Hague Conference on Agriculture, Food Security and Climate Change is composed of three main pillars:

Sustainably increasing agricultural productivity and incomes

Adapting and building resilience to climate change

Reducing and/or removing greenhouse gases emissions, where possible

Why is CSA needed?

Agricultural production will have to increase by 60% by 2050 to satisfy expected demands for food and feed (Conforti, 2011)

Climate change can lead to reductions in production and lower incomes in vulnerable areas (FAO 2014)

In 2005, agriculture(crop and livestock) directly accounted for 13.5% of global GHG emission (IPCC, 2007b) and 6% of total U.S. GHG emissions (USDA 2014)

CSA Approach

CSA promotes coordinated actions towards climate-resilient pathways through four main action areas:

1. **building evidence (identify set of viable options, enabling "tools" to assess different technologies)**
2. increasing local institutional effectiveness
3. fostering coherence between climate (energy) and agricultural policies
4. linking climate and agricultural financing

An approach not a new concept: reduce vulnerabilities, increase adaptive capacity, technically feasible & economically viable

New paper

- Leslie Lipper et al, “Climate-smart agriculture for food security,” *Nature Climate Change vol 4 December 2014*

History of CSA

- 2009: term **C**limate-**S**mart **A**gricultural development
- 2010: 1st Global Conference on Food Security, Agriculture and Climate Change in The Hague - the concept of CSA was presented.
- 2012: At the 2nd Global Conference in Hanoi, Vietnam: Climate-Smart Agriculture Sourcebook advanced the CSA concept intending to benefit primarily smallholder farmers and vulnerable people in developing countries.
- 2013: 3rd Global Conference in Johannesburg, South Africa, discussions began on a climate smart agriculture alliance.
- 2014: Climate Summit in New York, the Global Alliance for Climate-Smart Agriculture Action plan was presented.
- There have been two Climate-Smart Agricultural Global Science Conferences:
  - Wageningen, Netherlands, Oct 24-26 2011
  - Davis, CA March 20-22 2013
  - A third will be in LeCorum Montpellier France, **March 16-18. 2015**

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Building on the past: Green Economy and Sustainable Development

"Climate-Smart" Agriculture

Food security reduction

Agricultural production improvement

Green Economy

Carbon emission reduction

resource-use efficiency enhancement

Sustainable Development

Poverty reduction

Environmental risk reduction

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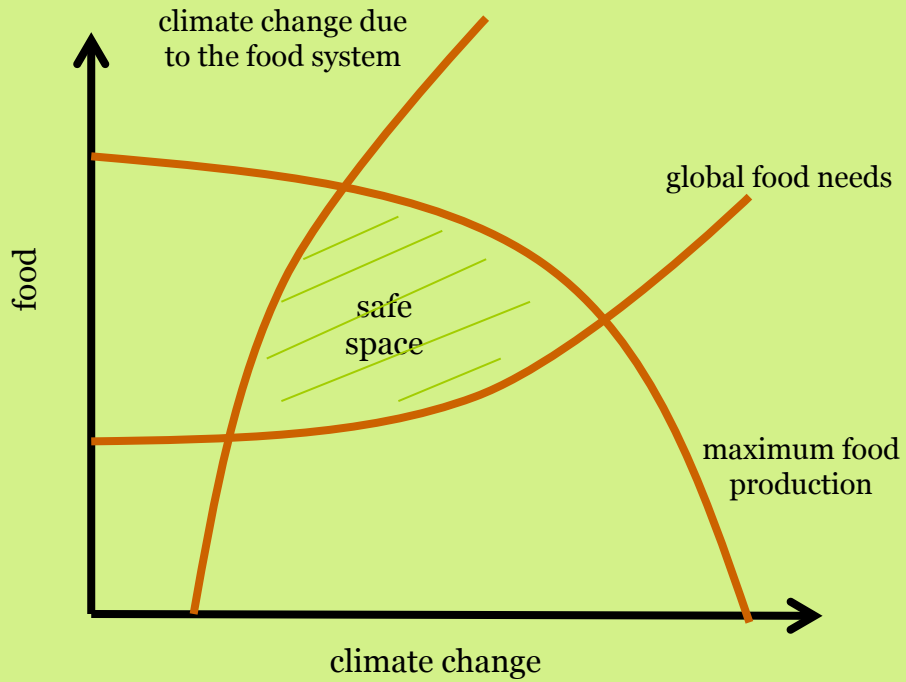
Goal of CSA: Achieving Food Security in the Face of CC

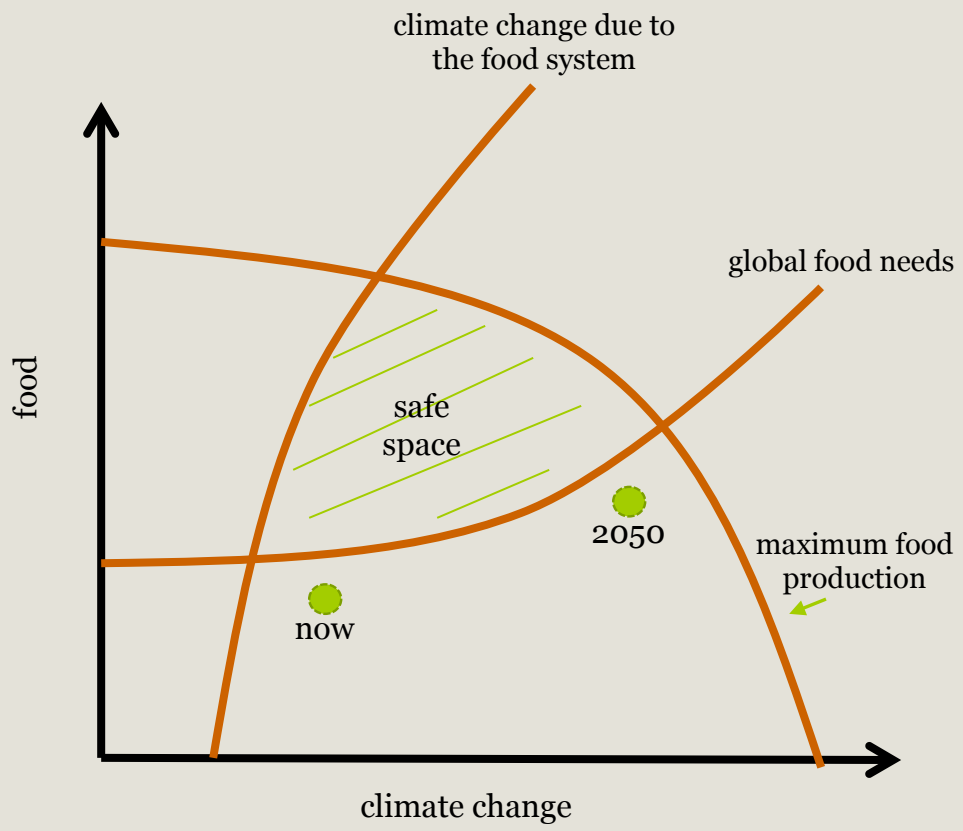
"Safe Operating Space" by promoting CSA



Beddington, John et al The Role for Scientists in Tackling Food Security and Climate Change *Agriculture and Food Security 2012, 1:10*

Global Food Needs Under Climate Change

We are currently operating outside the safe space for sustainability under a changing climate



Source: Achieving food security in the face of climate change Summary for policy makers from the Commission on Sustainable Agriculture and Climate Change, 2011.

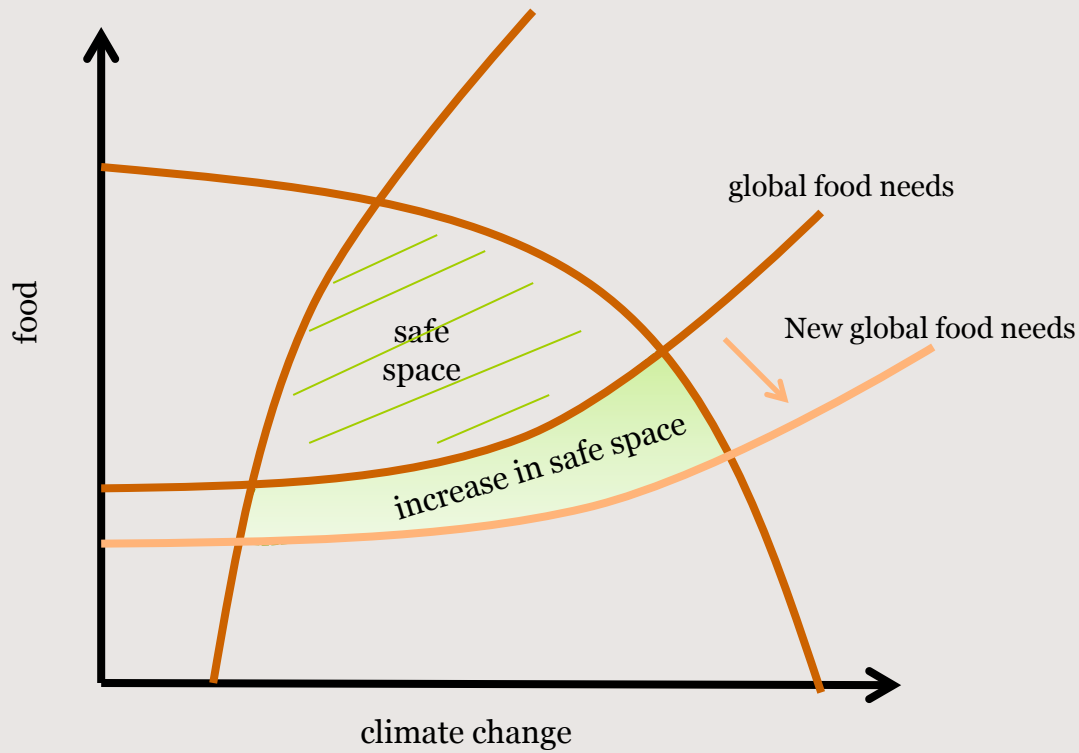
https://cgspace.cgiar.org/bitstream/handle/10568/10701/Climate_food_commission-SPM-Nov2011.pdf

How to Reduce Global Food Needs

Eliminate waste in the food chain

Increasing equity and access to food

Shift to vegetable rich diets that demand fewer resources

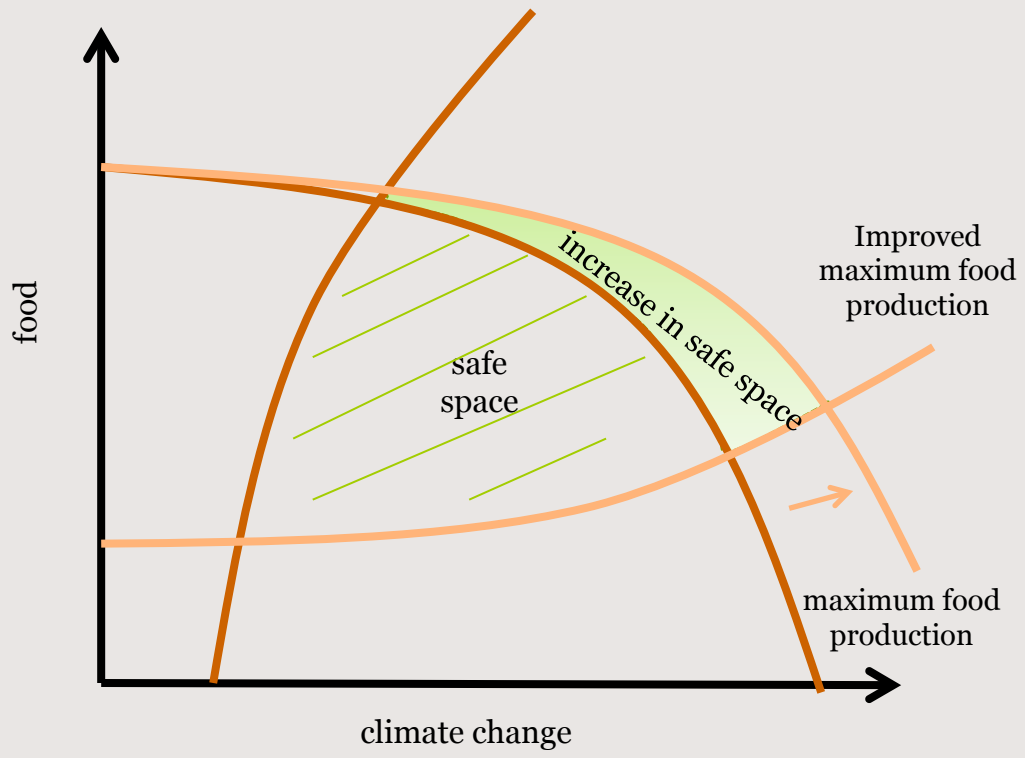


How to Improve maximum food production

Invest in agricultural research and development to improve yields

Adapt crops to future climates through:

- improved genetics
- matching crops to environments

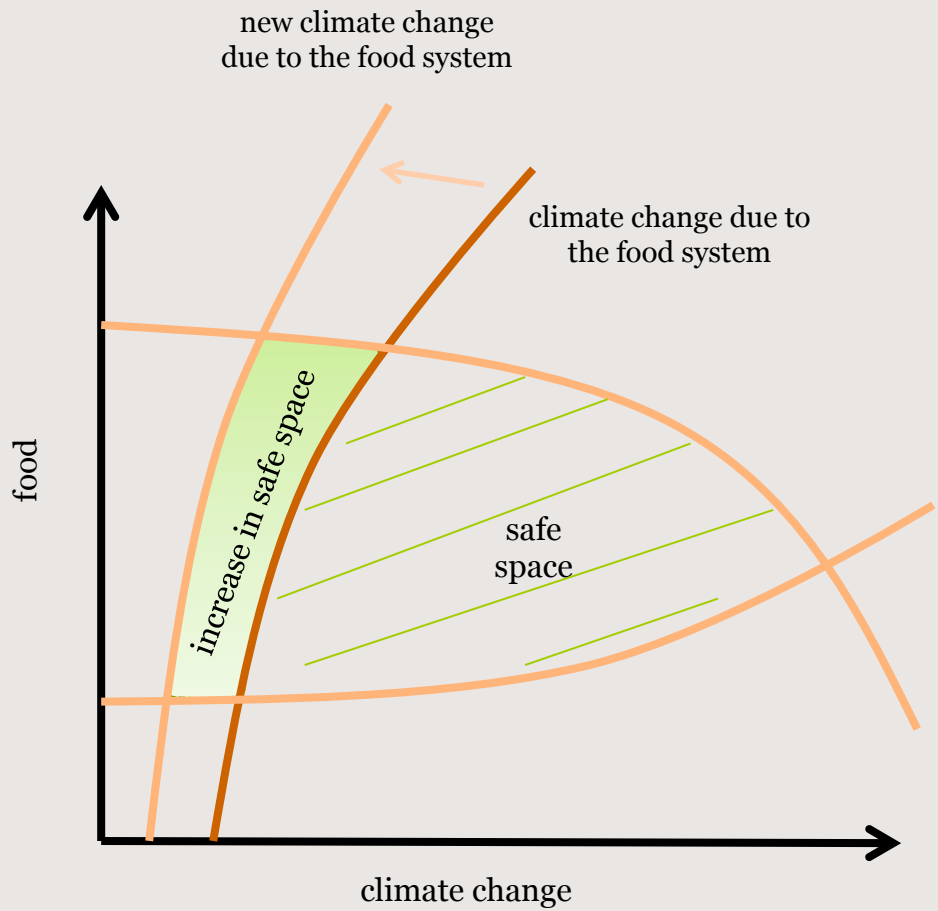


How to mitigate climate change from agriculture

Intensify production on existing agricultural land “sustainable intensification”

decrease onsite agricultural greenhouse gas emissions

reduce deforestation



What is the US Doing to Enhance CSA in the US and Around the World?

As part of its commitment to promoting climate smart agriculture, the U.S. has joined the CSA alliance and supports the following initiatives:

- **"Climate Hubs"** (7) around the country to deliver information to farmers, ranchers and forest landowners to help them adapt to climate change and weather variability.
- **Global Research Alliance** on Agricultural GHGs, aims to improve mitigation research through collaboration and data sharing.
- **Feed the Future**, a global hunger and food security initiative to mitigate risks of climate change by supporting smallholder farmers to enhance food production and quality, improving access to new tools and technologies, and building resilience.
  - Feed the Future has 24 Innovation Labs, supported by more than 60 top U.S. colleges and universities along with many partner country research and educational institutions.
- **Climate and Clean Air Coalition on Short-Lived Pollutants**, which includes an Initiative to address methane and carbon emissions from agricultural burning, paddy rice production, and livestock management.
- The **U.S. Global Climate Change Initiative** provides climate-related assistance to more than 50 developing countries.

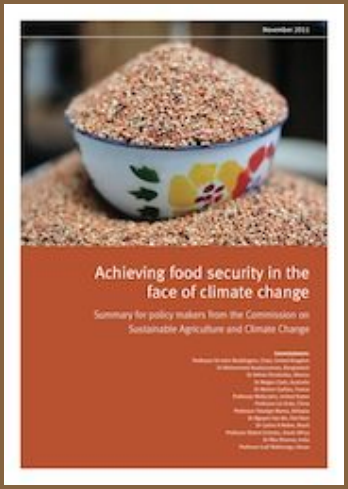
Question: What does all this add up to?

Global Alliance for Climate-Smart Agriculture

The '**Global Alliance for Climate-Smart Agriculture**' was launched Sept 24th, 2014.

This is a coalition of 14 countries and 32 organizations.

The Alliance members, which include governments, farmers, scientists, businesses, civil society, and regional and international organizations, represent 1/4 of the world's cereal production, and 16% of global agricultural GHG emissions.



Member Countries

1. Costa Rica
2. Ireland
3. France
4. Japan
5. Mexico
6. Netherlands
7. Nigeria
8. Niger
9. Norway
10. Philippines
11. Spain
12. United Kingdom
13. USA
14. Viet Nam

Key characteristics of Global alliance for CSA action plan

- **Voluntary adoption and implementation** of national or regional climate and agriculture policies, plans, frameworks and strategies
- **Development of enabling environments** that encourage adopting CSA approaches through accessing (a) appropriate national or international expertise, (b) lessons from pilot studies, and (c) resources needed to establish the necessary operating principles, extension services and farmer support schemes;
- The **engagement** of businesses, foundations, civil society, development agencies and intergovernmental organizations in support of this agenda - in ways that bring benefits to the people whose livelihoods are most threatened by the impact of climate change on agriculture;
- **Integration of CSA approaches into ongoing rural development programs,** aiming at improved integration and coordination.

(Government) Policies and CSA

- Do current policies (2014 Farm Bill) incentivize resilience to climate stresses? Consistent with CSA?
- What are the types of policy tools available to influence and promote a more climate smart ag?
- What do we need to know, what do we know -- to do Impact assessment (model structure)

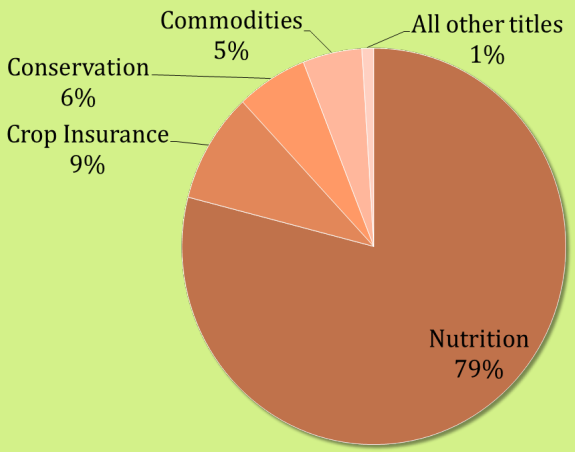
2014 Farm Bill and CSA

The Farm Bill is the primary Agricultural Policy Tool of the United States Government.

Of 12 titles in the Farm Bill, Commodities, Conservation and Crop Insurance have the greatest potential to significantly affect CSA, providing a safety net and increasing resilience.

Farm Bill Titles	
1. Commodities	7. Research
2. Conservation	8. Forestry
3. Trade	9. Energy
4. Nutrition	10. Horticulture
5. Credit	**11. Crop Insurance**
6. Rural Development	12. Miscellaneous

Distribution of Payments in the 2014 FB by Title

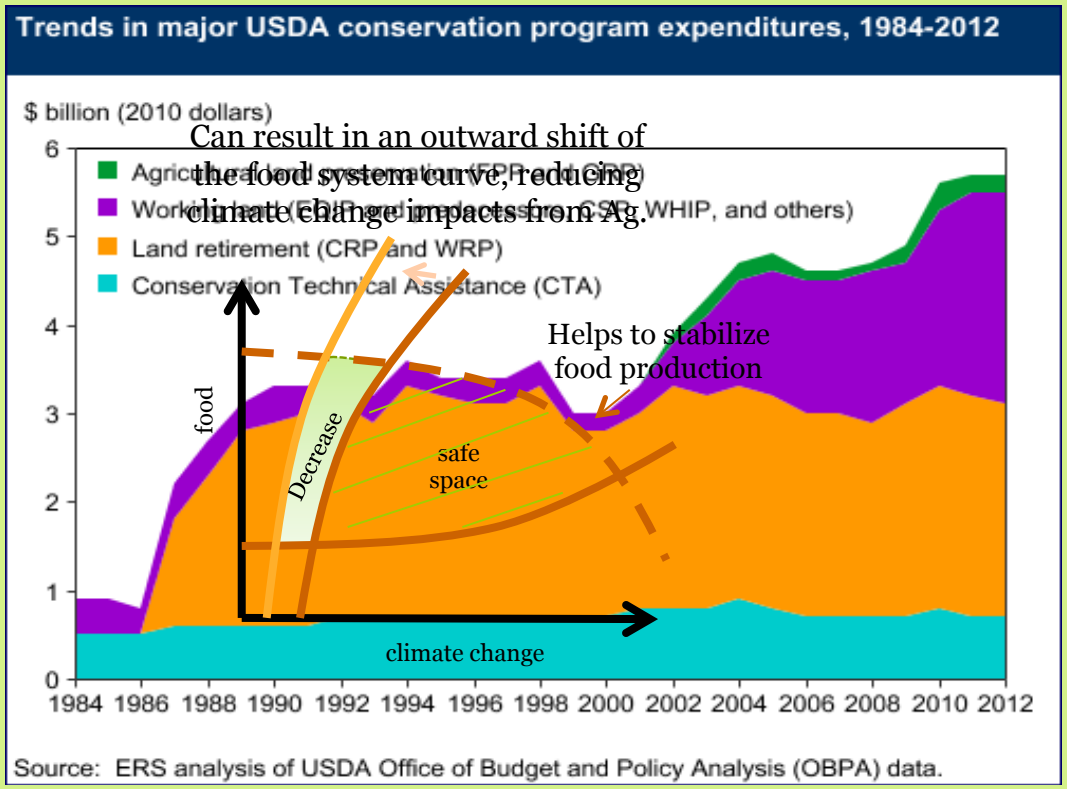


Conservation Compliance (+)

- Conservation compliance links basic conservation requirements to crop insurance premium subsidies, commodity support programs and all conservation programs.
- Farms that have highly erodible land or wetlands must follow a conservation program to be eligible to receive government payments. Non-compliance may affect:
  - FSA loans and disaster assistance payments
  - NRCS and FSA conservation program benefits
  - Federal crop insurance premium subsidies

Conservation (+)

- The shift towards working-lands conservation recognizes the multiple benefits of agriculture – (food, healthy soils, clean water, clean air, wildlife habitat, renewable energy, and other conservation benefits).



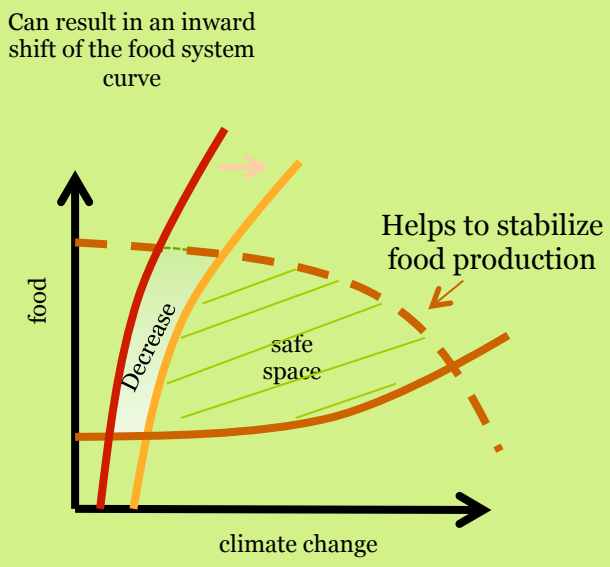
EQIP provides financial assistance to plan and implement conservation practices that improve soil, water, plant, animal, air and related resources.

Crop Insurance (+ / -)

- + Crop Insurance is a risk management tool which can help stabilize farm income by smoothing out the boom-bust ag cycles, which stabilizes food production over time.
- + Whole-Farm Revenue Protection provides protection for all commodities on a farm under one insurance policy (including specialty crops and livestock) encouraging diversity.

- – The crop insurance program (coupled with price signals) has encouraged growth in hazard-prone areas.
  - Between 2007 and 2013 federal exposure to potential losses for insured property grew from $1.3 trillion to $1.4 trillion.
- – Increases in extreme weather events from climate change may further increase such losses in coming decades (50 to 100% increase by 2100).

Tends to encourage crop production in hazard prone areas and discourage CSA innovations.
(linking crop insurance to conservation compliance helps minimize this impact)

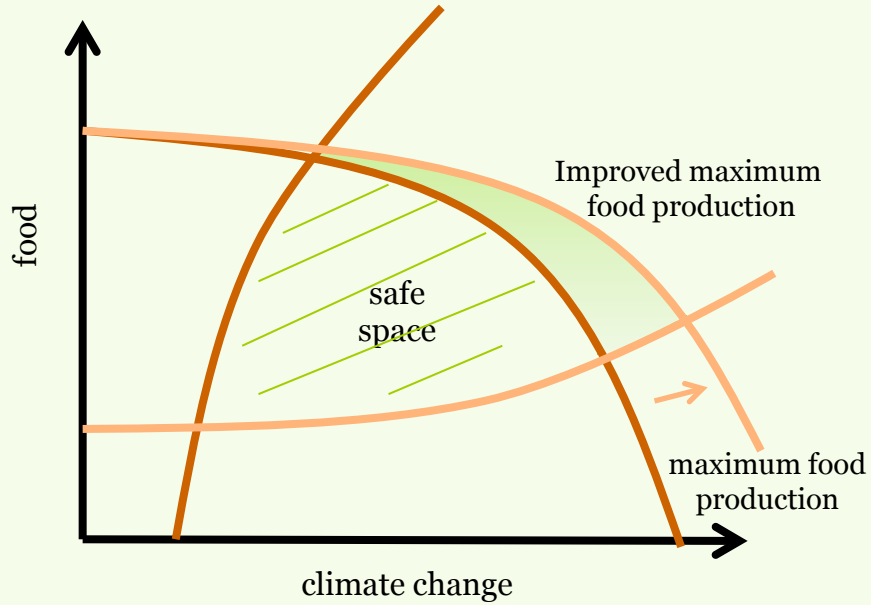


Commodities (+/-)

Covered commodities include wheat, oats, barley, corn, grain sorghum, rice, soybeans, oilseeds and peanuts

Direct Payments t programs.
Producers must on) and ARC
(revenue protect

- **PLC**: Farmers w ational average price is below its y-crop basis (using the farm's
- **ARC**: Based on tee option or the county guarante e from all covered commodities is l an the individual guarantee.



These programs provide a safety net for producers, which may increase their income and may make them more resilient but it does not encourage adaptation.

Designing polices: Fundamentals

- Incentives matter; prices (taxes, subsidies), markets, quantity/quotas, best practices
- For adaptation: understanding tradeoffs – and opportunity costs

- Building evidence (relates to CSA action area 1)
- Understand what is the question(s) we are asking & how to structure the counterfactual and setup the integration

Core questions

What question do we want answered when we do impact assessment for climate change

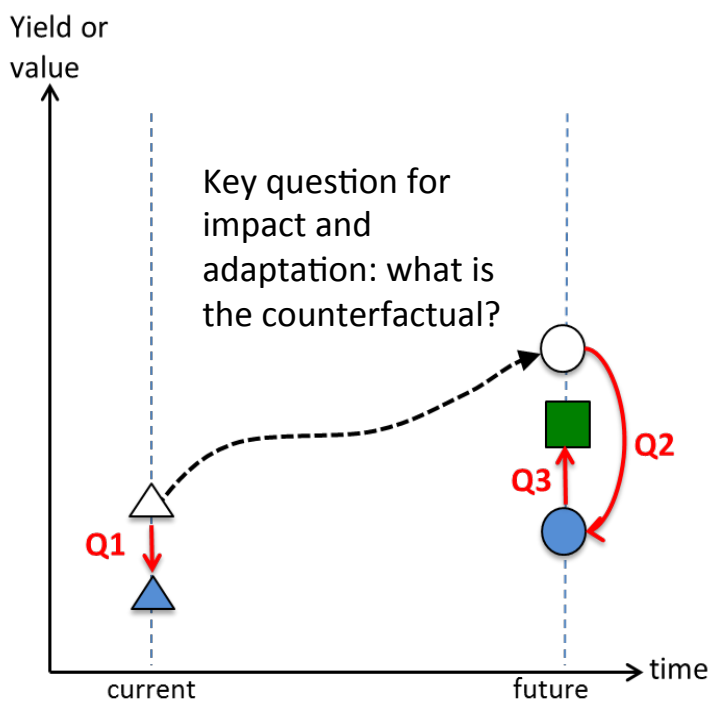
Typically: What is the economic potential for adoption of alternative systems, what are their economic, environmental and social impacts?

- Q1: what is climate sensitivity of current systems?
- Q2: what are *future* climate impacts w/o adaptation?
- Q3: how useful are prospective adaptations in the future?

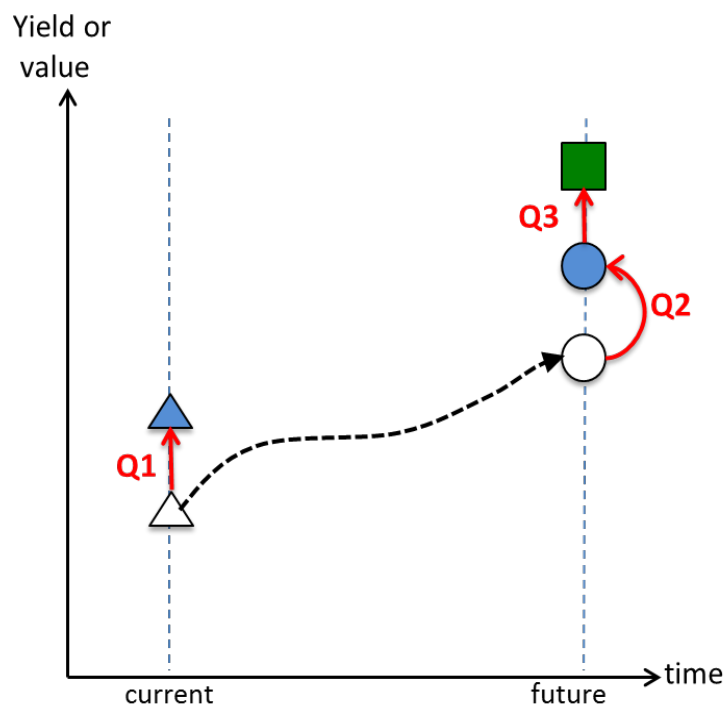
Definition of symbols and outputs

	System 1	System 2	Key Outputs
Question #1	Production system in Current Period with Current climate	Production system in Current Period with Future Climate	***% gainers & losers and net impacts*** % change in mean farm income % change in per capita income % change in Poverty rate
Question #2	Production system in Future Period with Current climate **Productivity and price trends with no climate Change and RAPs**	Production system in Future Period with Future Climate **Price trends with climate Change and RAPs**	***% gainers & losers and net impacts*** % change in mean farm income % change in per capita income % change in Poverty rate
Question #3	Production system in Future Period with Future Climate **Price trends with climate Change and RAPs**	Adapted Production system in Future Period with Future Climate **Price trends with climate Change, RAPs and Adaptation Package**	***Adoption rate (%)*** % change in mean farm income % change in per capita income % change in Poverty rate

Illustration of three Questions regarding Climate Change Impact Assessment



Negative impacts



Positive impacts

An alternative model structure

- "Hybrid semi-reduced form" structure for Impact assessment : combines process-based models with empirical economic models
- Appropriate when:
  - Assess impacts outside the range of observed behavior (physical or biological non-linearities and thresholds)
  - effects of spatial and temporal heterogeneity in the biophysical conditions are important
  - need to assess the value of as-yet unobserved technological adaptations

Tools for Smart-Policy Analysis and Decision Making

Landscape Level Tools

- **SWAT** (Soil and Water Assessment Tool) water quality and quantity simulator designed to predict the environmental impact of land management practices.
- **EPIC** (Environmental Policy Integration Model) compares land management systems and their effects on environmental indicators like water availability, nitrogen and phosphorous levels, and greenhouse gas emissions.
- **TOA-MD** (Tradeoff Analysis for Multi-Dimensional Impact Assessment) uses a statistical description of a farm populations in a region to simulate the adoption and impacts of a new technology or a change in environmental conditions.

Farm Level Tools

- **Comet 2.0™** is an online tool that provides estimates of CO_2 sequestration and net GHG emissions for US farms and ranches.
- **Cool Farm Tool** is an online GHG emissions calculator. It lets farmers test alternative management scenarios and identify practices that may reduce GHG emissions.
- **Pioneer Field360™** is a DuPont Pioneer software that combines current and historical field data with real-time agronomic and weather information to help growers make informed management decisions.
- **AgTools™** is designed to help growers assess operational investment choices.

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Examples of Tools for Measuring Tradeoffs

Landscape Scale

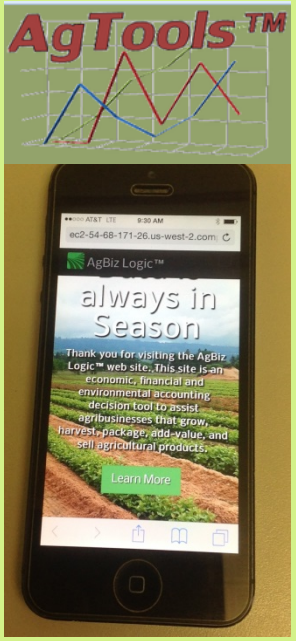
TOA-MD

Is a modeling tool that can be used to improve the understanding of agricultural system sustainability and inform policy decisions.

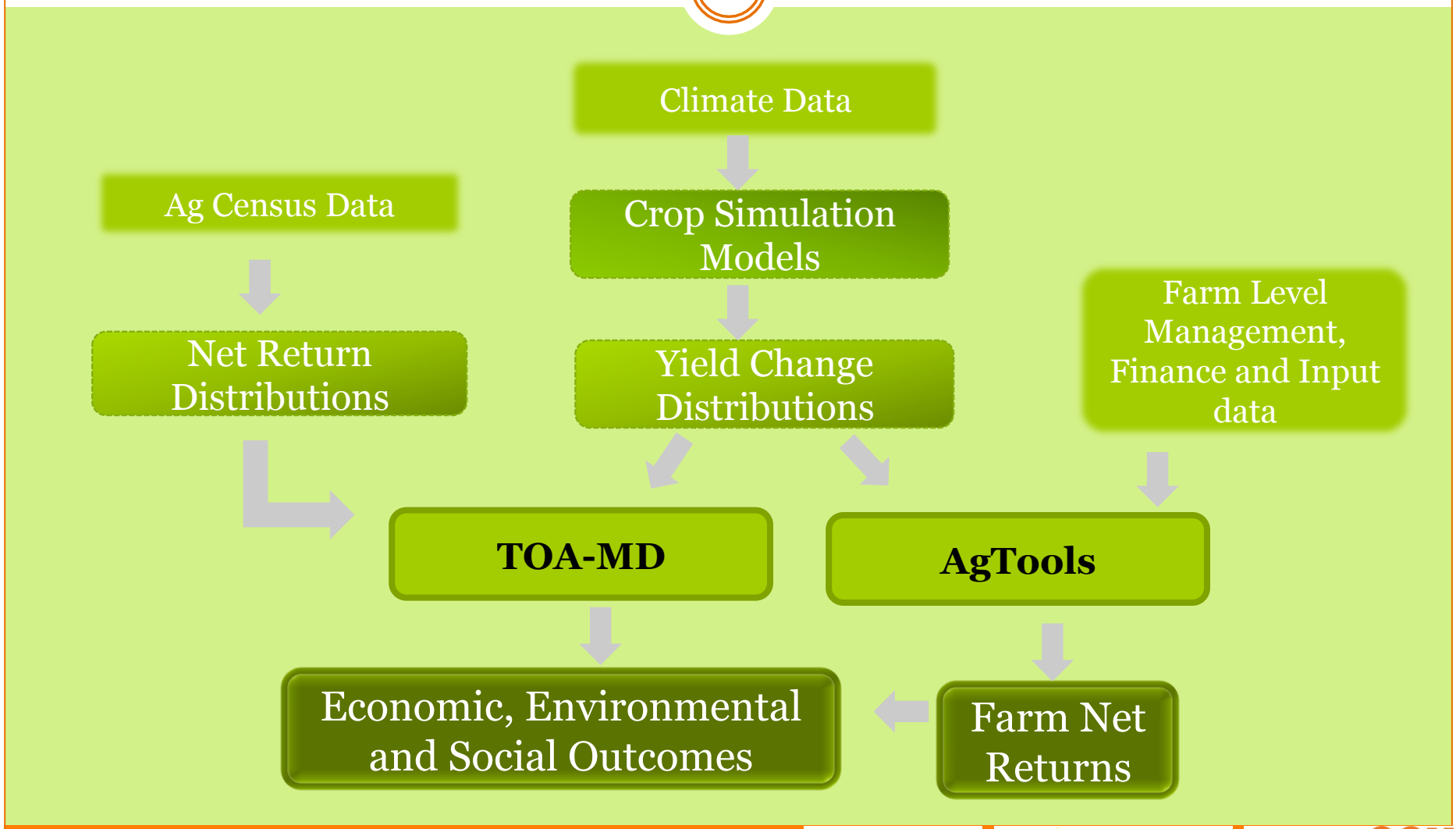
Farm Scale

AgTools™ containing a suite of software programs including:

- AgProfit™
- AgLease™
- AgFinance™
- AgEnvironment™



Data, Models and Expected Outputs



TOA Model Setup for REACCH

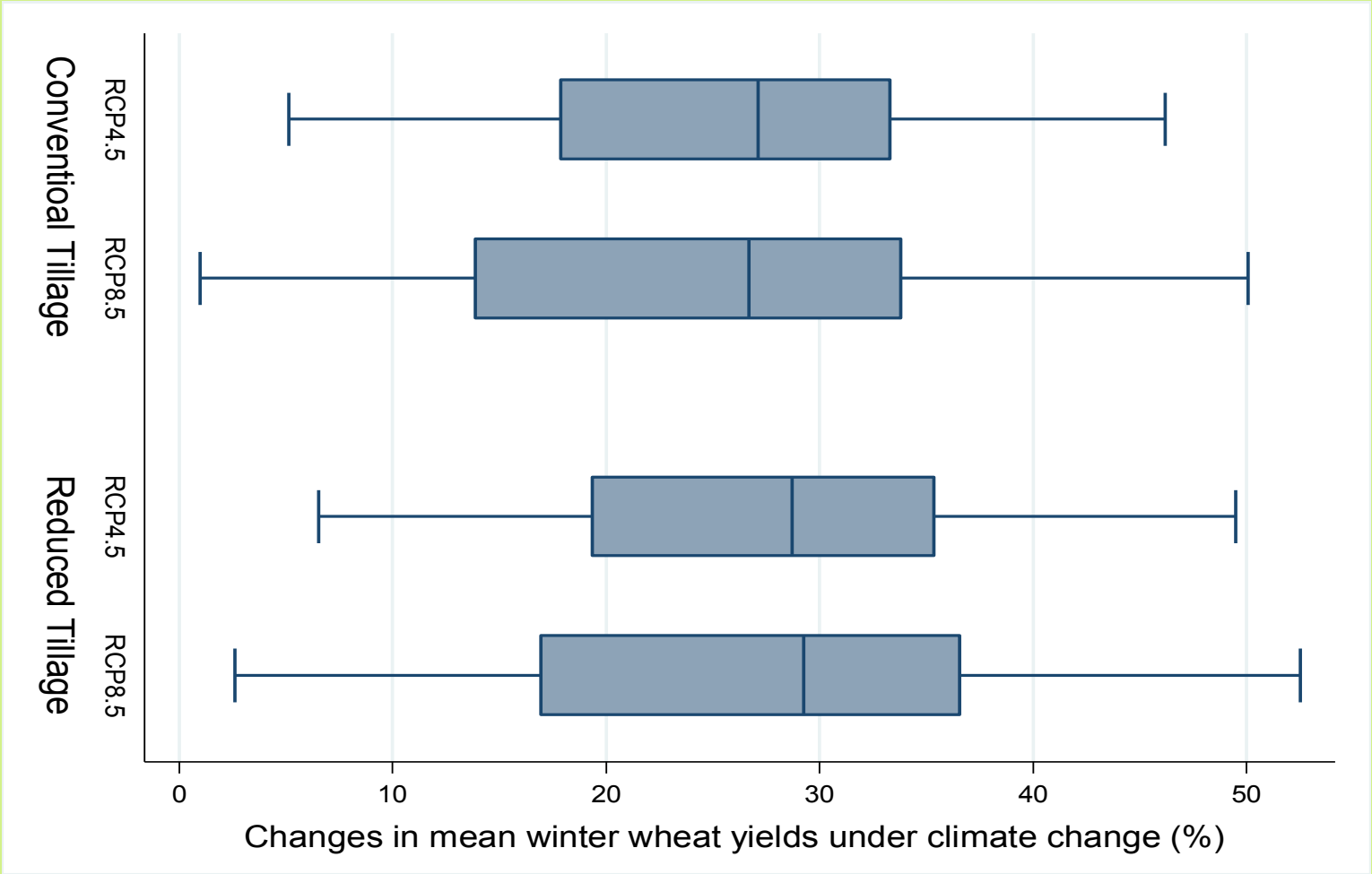
- Farm size: **small or large** based on total land acres including cropland, fallow, pasture and rangeland.
- If total land acre is below the median of all farms, it is classified as a small farm.
- RCP: **Representative Concentration Pathways** refer to greenhouse gas concentration t for REACCHrajectories adopted by the IPCC for its fifth Assessment Report (AR5) used for climate modeling and research. They describe possible climate futures, all of which are considered possible depending on how much greenhouse gases are emitted in the years to come.
- In RCP 8.5, emissions continue to rise throughout the 21st century

RCP Projections for Temperature Increases

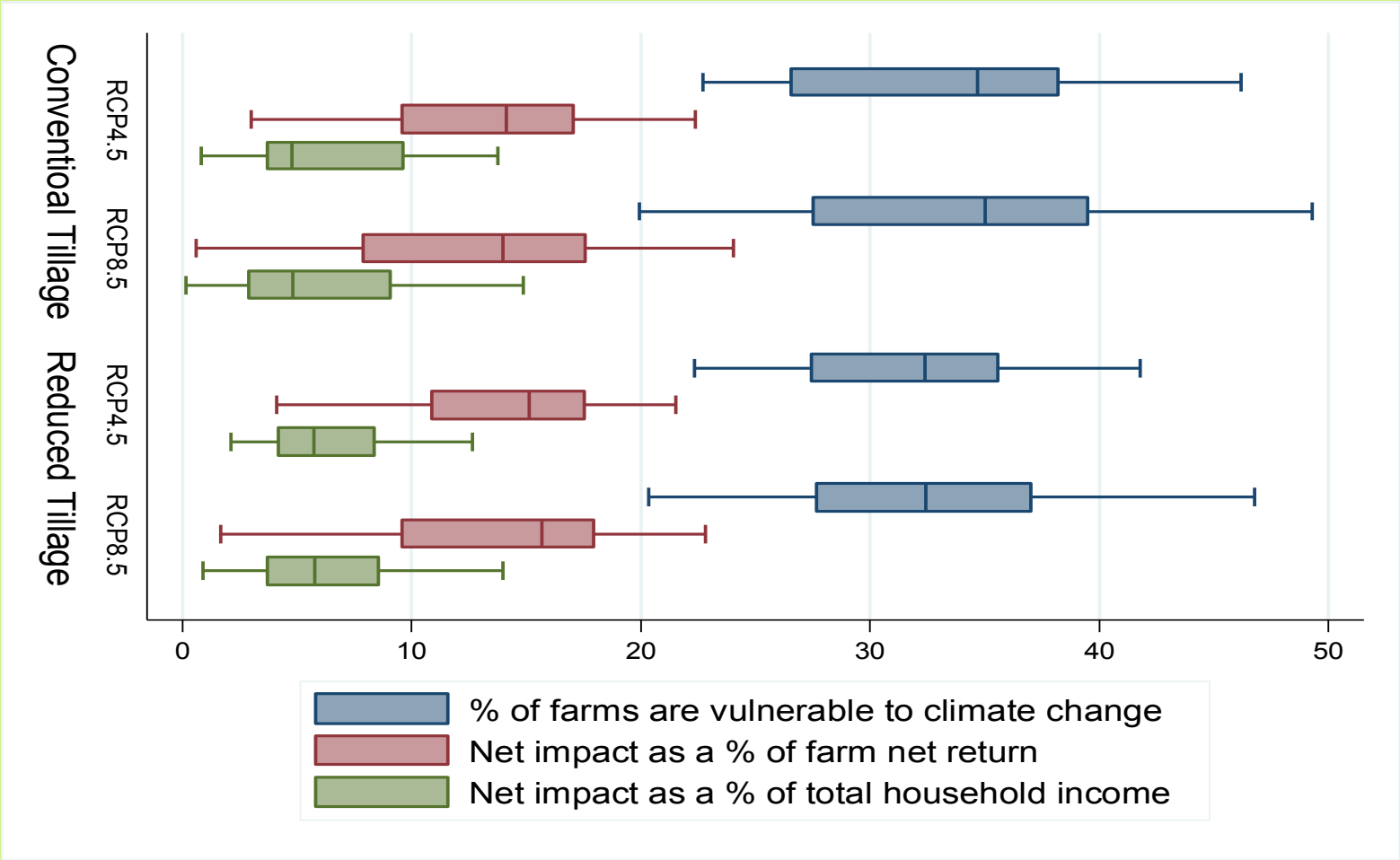
AR5 global warming increase (°C) projections[5]

	2046-2065	2081-2100
Scenario	Mean and *likely* range	Mean and *likely* range
RCP2.6	1.0 (0.4 to 1.6)	1.0 (0.3 to 1.7)
RCP4.5	1.4 (0.9 to 2.0)	1.8 (1.1 to 2.6)
RCP6.0	1.3 (0.8 to 1.8)	2.2 (1.4 to 3.1)
RCP8.5	2.0 (1.4 to 2.6)	3.7 (2.6 to 4.8)

More Yield Increase for Reduced Tillage (Prelim results)



Less Farms are Vulnerable to Climate Change (Prelim results)



Farm Level Decision Tool (AgTools™)

Decision: Should I change my crop rotation and invest in new equipment based on expected changes in climate and crop yields?

Gather Data: Equipment expenses, changes in input use (labor, fertilizer, herbicide, pesticide) and spatially relevant information on yields

Decision Tool: Farmers can use AgTools to examine changes in yields or management practices in terms of net returns, as well as the farm's liquidity, solvency, and repayment capacity.

Outcome: Based on economic and environmental outcomes, farmers can decide if the investment is feasible for their operation given their resource constraints.

Comparison of Net Returns with and without Climate Change

Comparison of Net Farm Incomes by Crop Alternative with and without Climate Change				
Year	Wheat Fallow	Annual Cropping Wheat Pea Canola	Wheat Fallow	Annual Cropping Wheat Pea Canola
	without climate change		with climate change	
1	$6[illegible]	[illegible]	[illegible]	$926,912
2	$1,2[illegible]	[illegible]	[illegible]	$1,589,845
3	$1,369,[illegible]	$1,064,897	$2,318,826	$2,623,531
4	$1,617,041	$1,559,722	$2,579,045	$3,244,301
5	$1,958,106	$1,805,944	$3,117,153	$3,960,545
6	$2,3[illegible]	$2,197,921	$3,588,771	$4,637,359
7	$2,661,540	$2,408,959	$4,274,336	$5,511,392
8	$3,161,348	$2,784,440	$4,686,576	$6,007,462
9	$3,118,194	$2,999,211	$5,038,352	$6,942,800
10	**$3,032,582**	**$3,331,412**	**$5,014,827**	**$7,381,349**

Accumulative Net Farm Incomes includes annual cash flows, +/- inventory changes in current assets and liabilities from the balance sheet, + interest from annual operating, intermediate and long-term loans, + capital lease payments and any down payments associated with acquiring a lease, + depreciation.

Suggested outcome: Yes! Switch to annual cropping rotation that includes seed oil (canola).

Note: outcome is highly dependent on projected yield assumptions.

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