

GTAP-WATER

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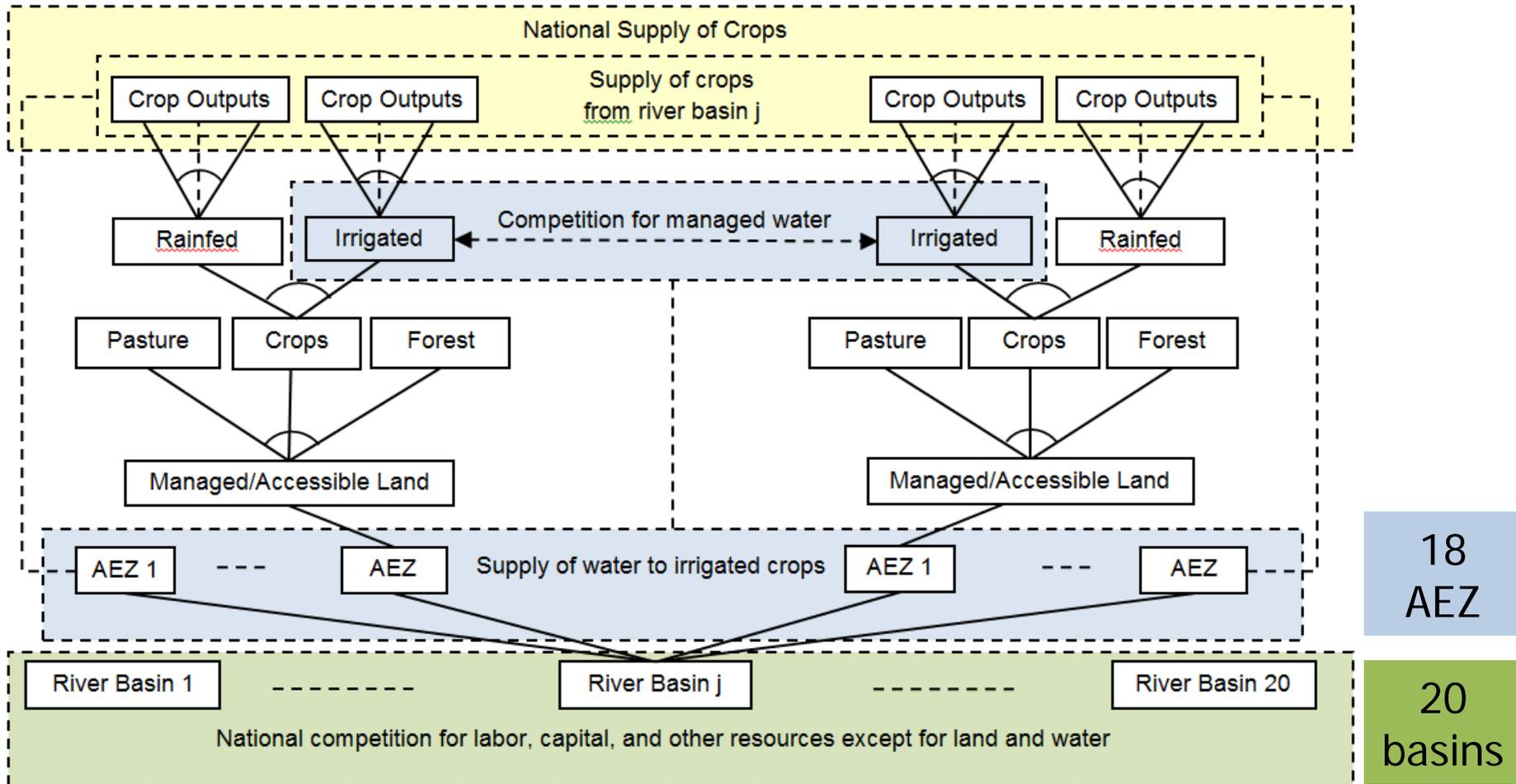
Maria Blanco, Shinichiro Fujimori

GTAP water

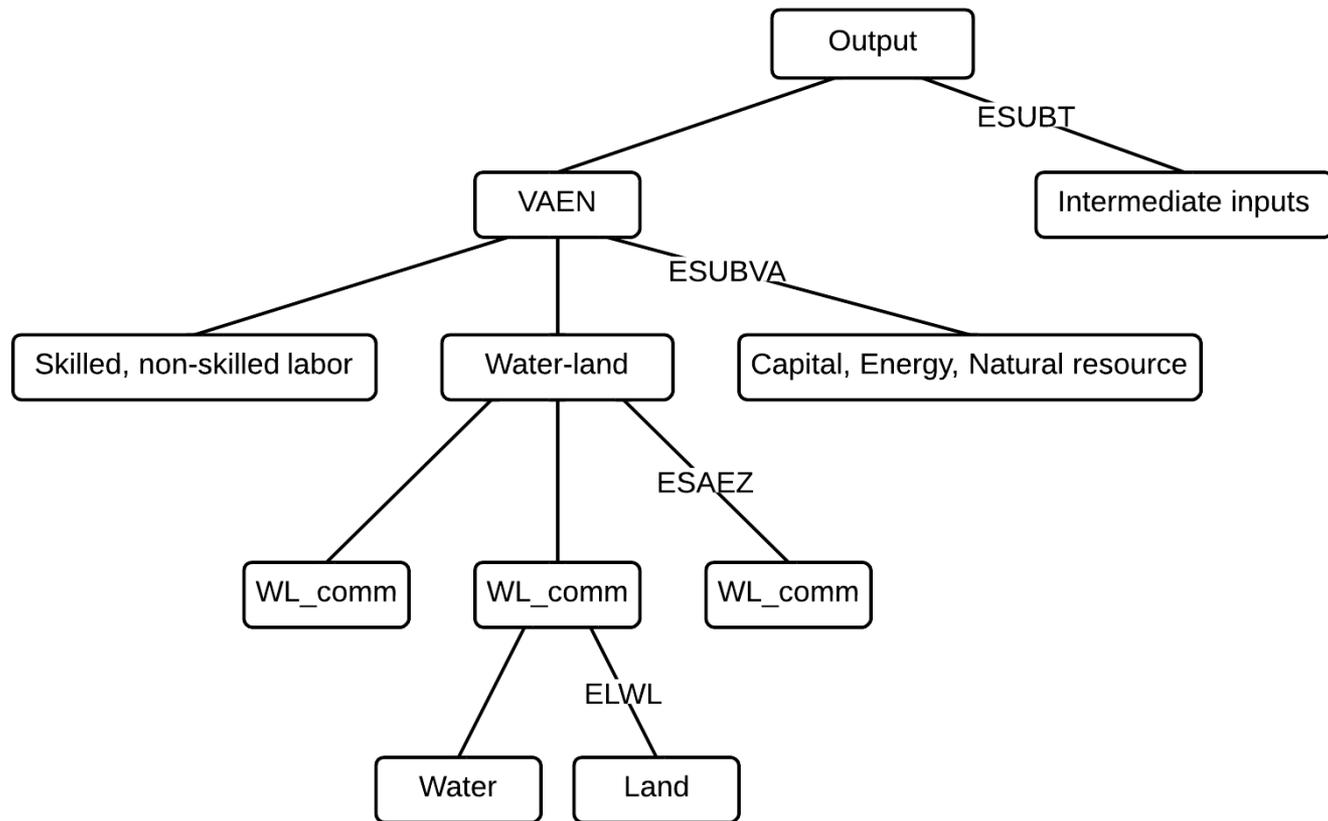
Key features

- ▶ Water is introduced as an explicit input for irrigated crops
- ▶ Supply of water is fixed at river basin level; leading to competition for water at this level
- ▶ Land is fixed at the AEZ level
- ▶ Water and land are complementary inputs in irrigated agriculture at RB-AEZ level
- ▶ Irrigation water is a mobile input for irrigated crops and can move across AEZs within a river basin

Schema of crop production in GTAP-Water

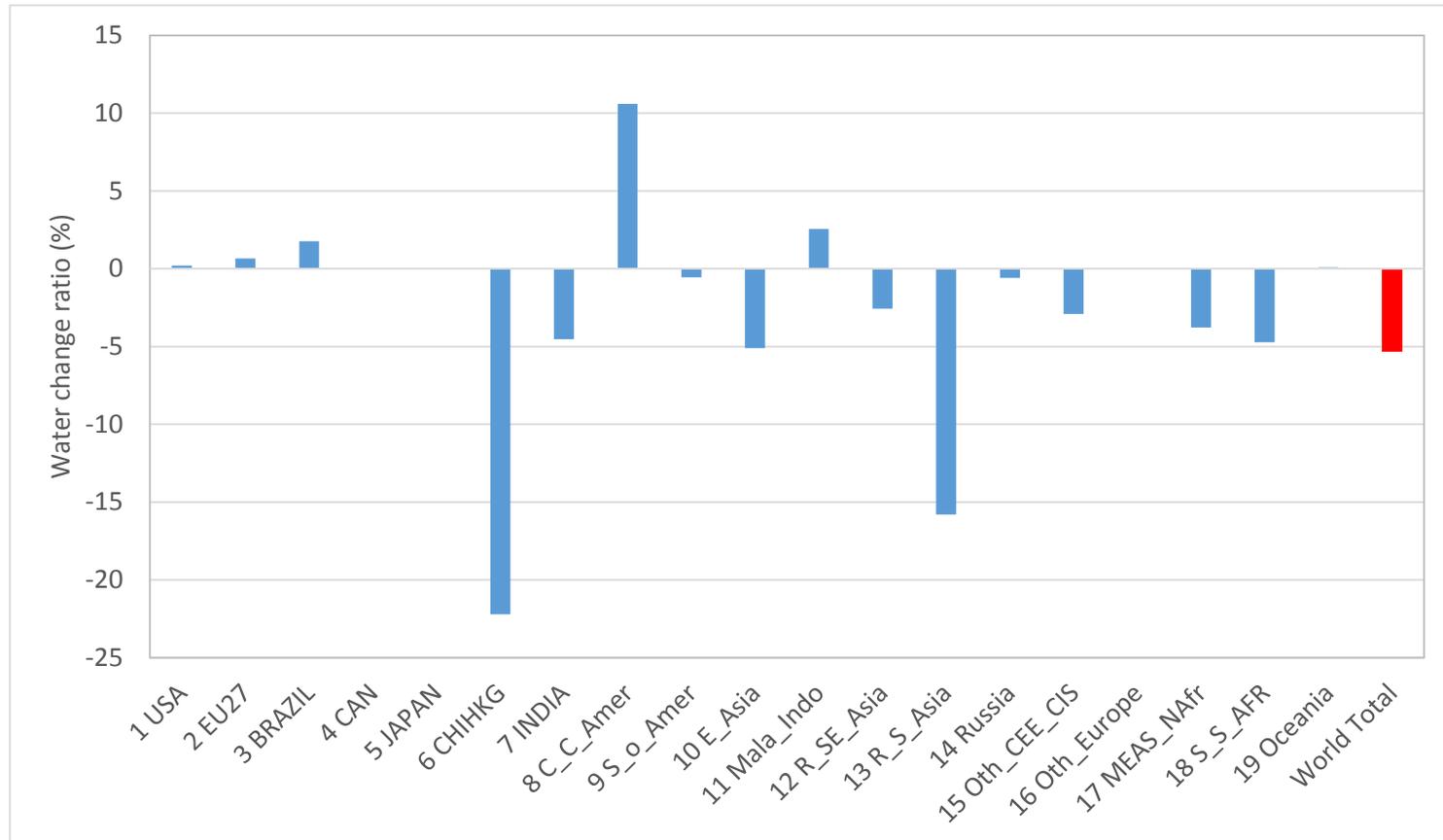


Production structure



Experiment: shock in water availability

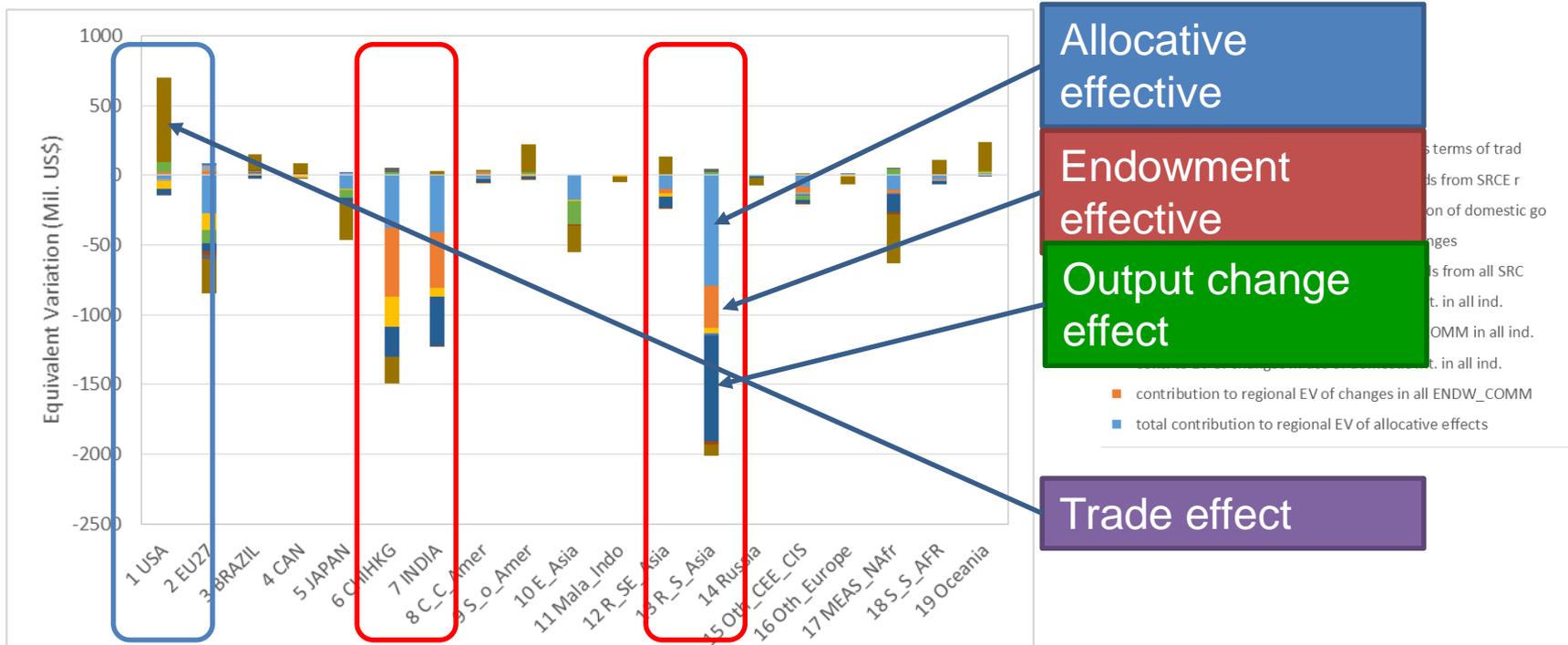
Basin water supply is shocked to reflect water available for irrigation in 2030



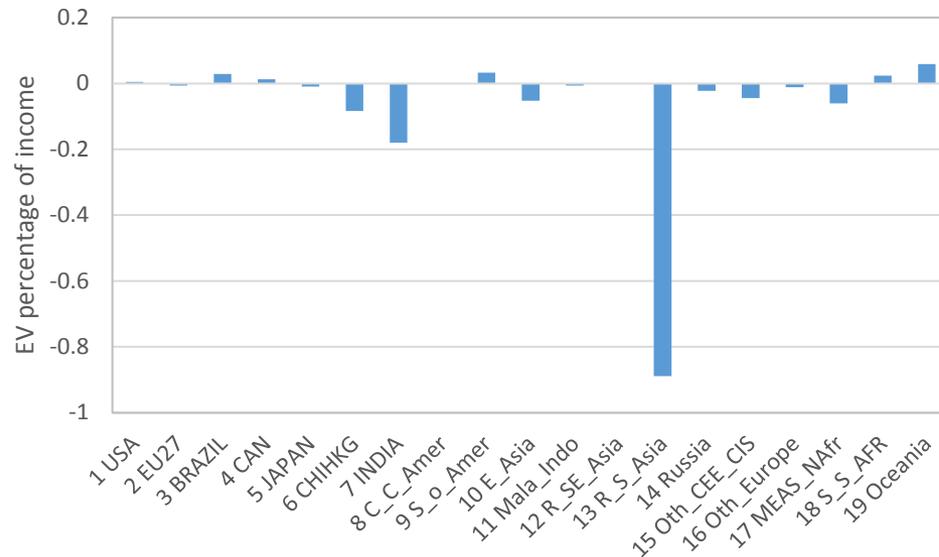
Welfare change caused by water resource change

Shinichiro Fujimori

Welfare change due to water availability change

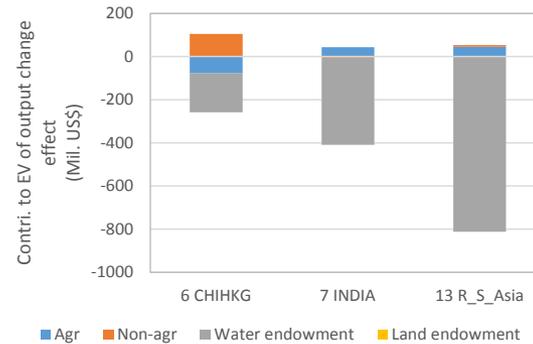
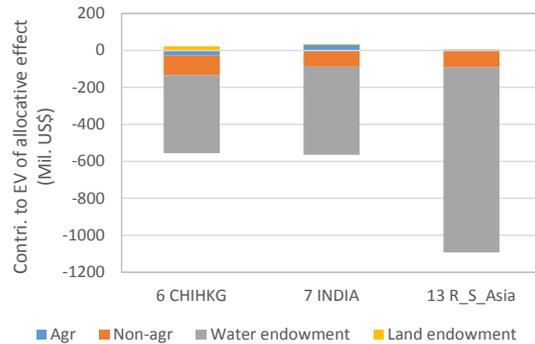


Welfare change due to water availability change relative to income

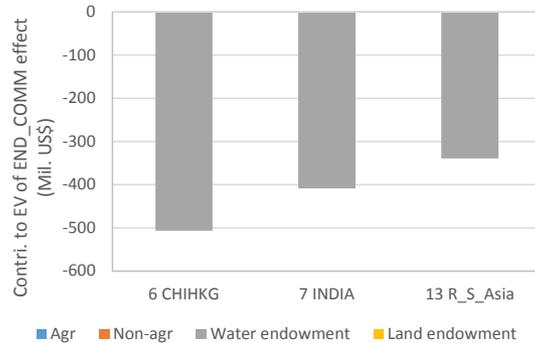


- The rest of South Asia faces around 1% shock
- For the other regions welfare change might not be so significant

Three main EV change factors for CHN, IND and rest of Asia



Allocative effect

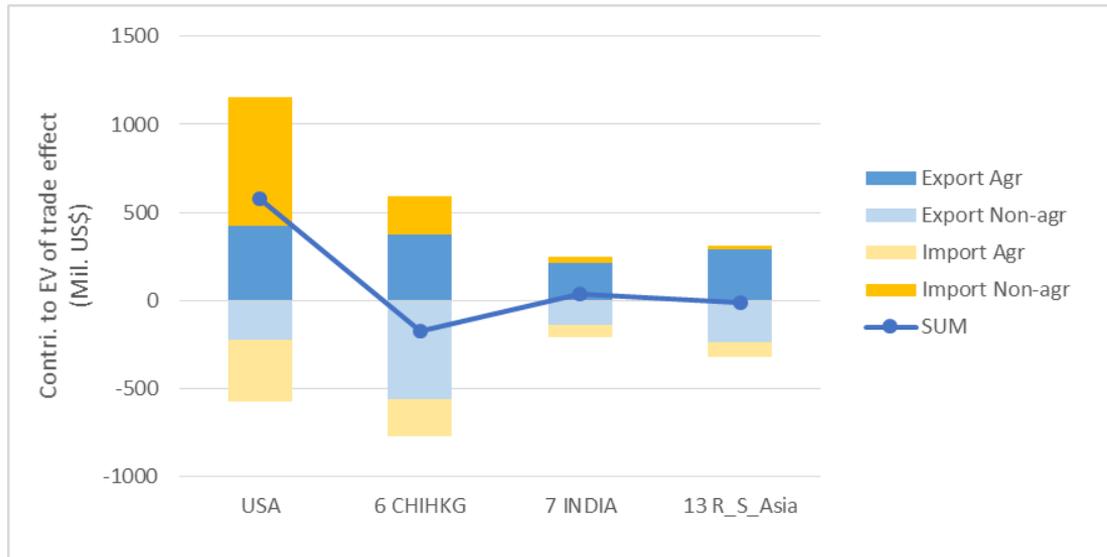


Output change

- Water endowment change is the major factor for the three main welfare change factors
- The strength of each factors vary across regions

Endowment change

USA gain?



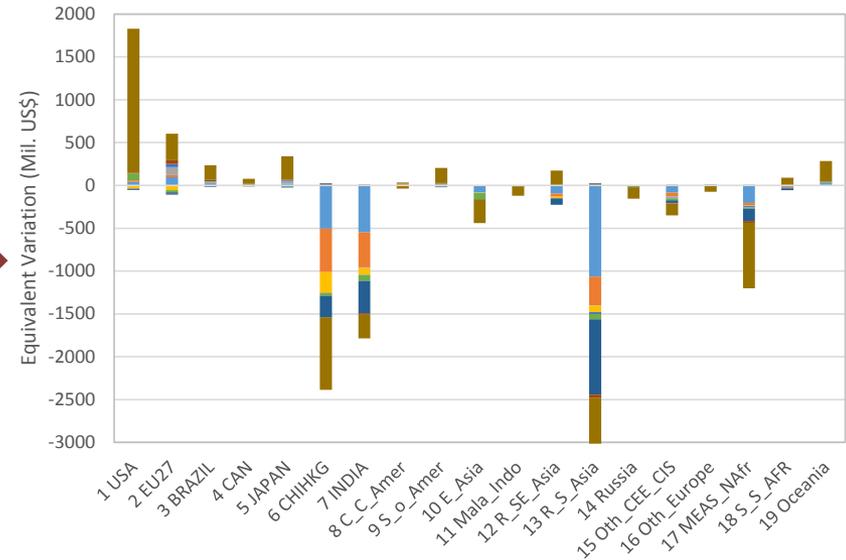
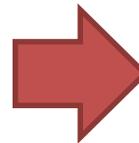
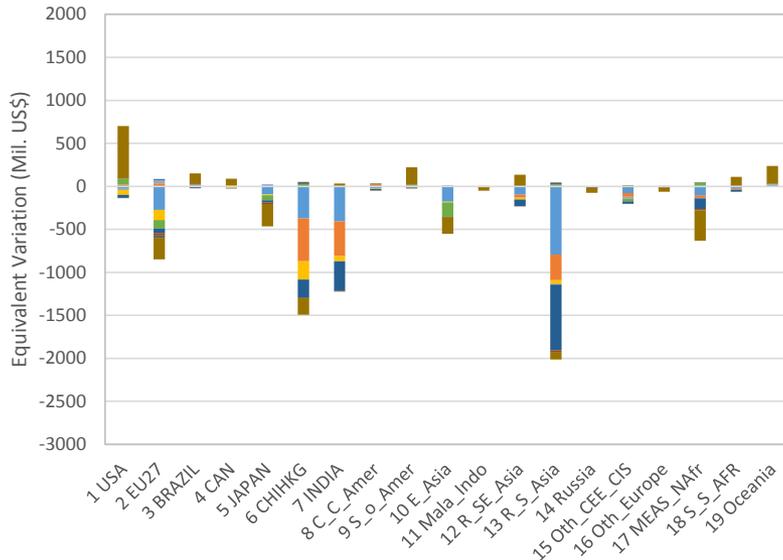
- Export side

- Agriculture increase non-agriculture decrease

- Import side

- Agriculture decrease and non-agriculture increase

What if Armington elasticity is lower?



Standard elasticity in Armington

Low elasticity in Armington (3/4)

- Almost same figures but scale-up with low elasticity
- Trade flexibility matters for the endowment allocations
- Low elasticity makes less flexibility in the adjustment and water scarcity issue more isolated.

Messages

- Water endowment change takes out several Asian regions welfare
 - The water shock is harmful for them
 - Several factors may matter but
 - **The magnitude of water shock**
 - Crop mixture and its cost structure (**Rice** is water intensive and these countries rely on it)
 - Trade share (**small import share** in these regions and small flexibility)
 - Share of irrigation
 - Elasticity of substitution of land, factor-input, and trade
- USA gains from trade effect.
 - Export increase in agricultural sectors
 - Import decrease in non-agricultural sectors

The role of trade as adaptation measure to water scarcity

Maria Blanco

Impacts on crop output

At the regional level

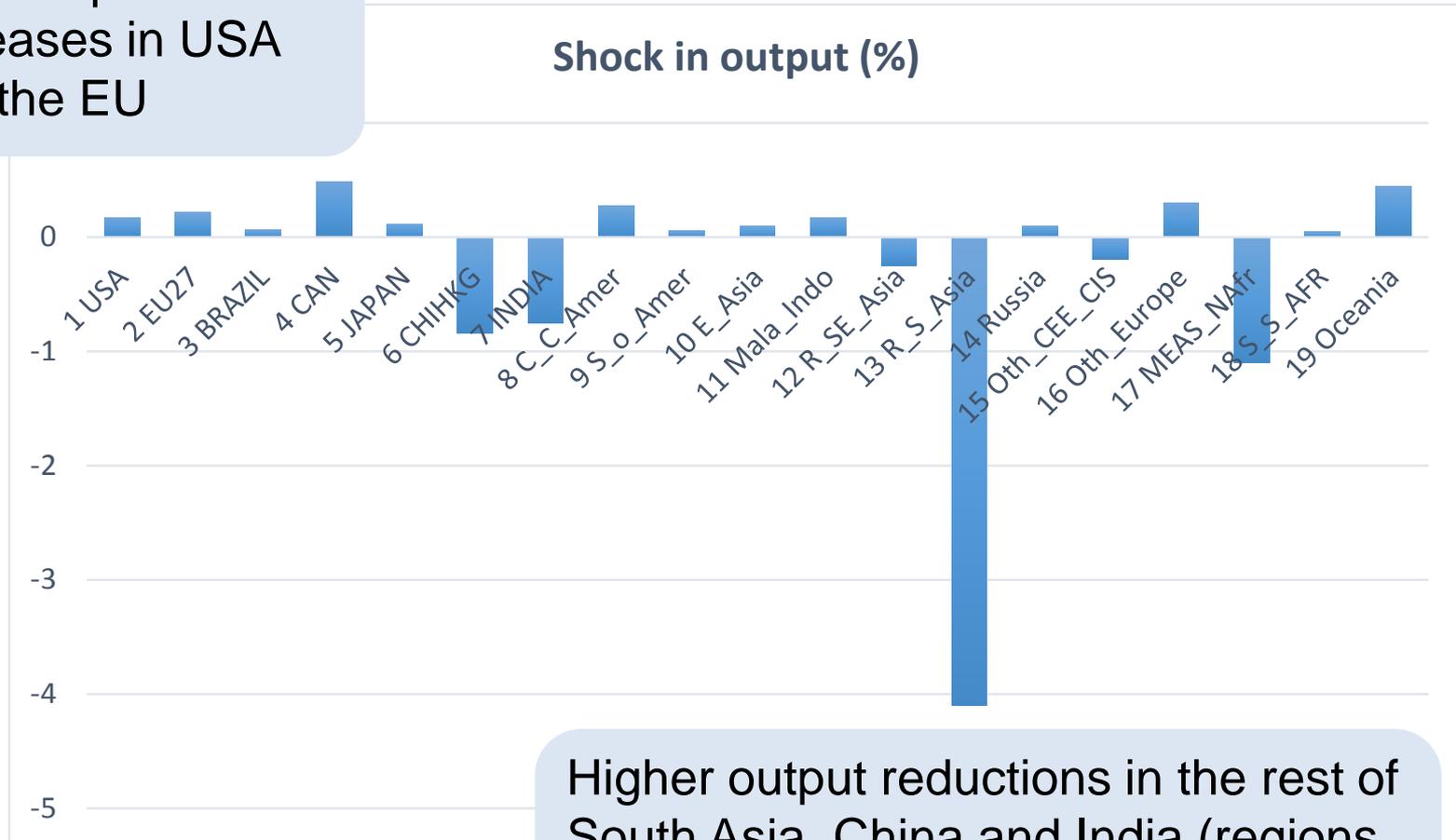
- ▶ Less irrigation water leads to lower output for irrigated crops and higher rainfed output
- ▶ More irrigation water raises both rainfed and irrigated crop output

At the global level

- ▶ Large output decreases in Asian countries outweigh the gains in other regions, leading to a reduction in global crop output

Impact on total crop output

Crop output increases in USA and the EU



Higher output reductions in the rest of South Asia, China and India (regions that face significant water scarcity and rely heavily on irrigation)

Global impacts on agricultural prices

World price index increases for all agricultural products

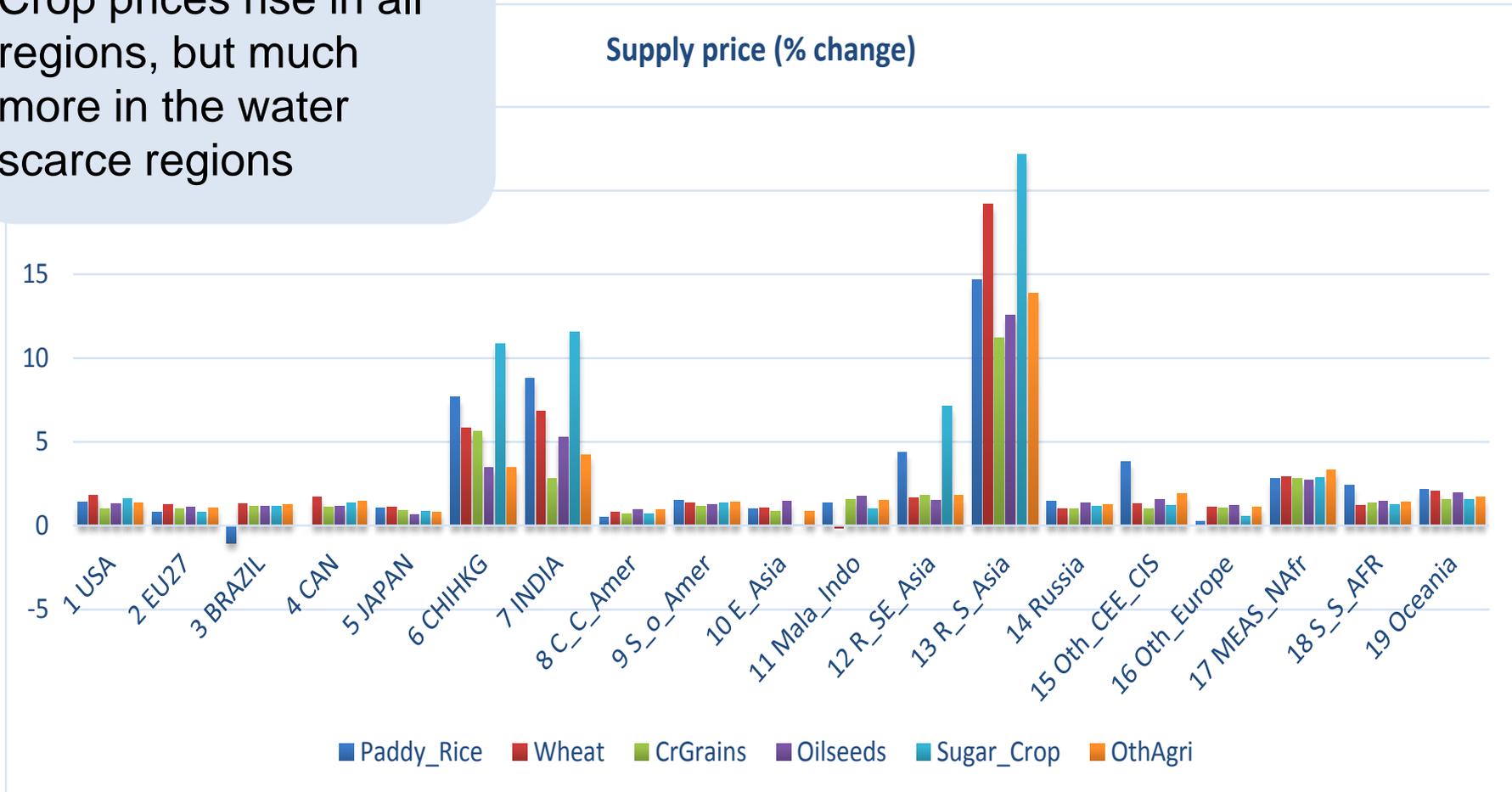


Higher effects on crops

Livestock and processed food also affected

Effects on regional supply prices

Crop prices rise in all regions, but much more in the water scarce regions

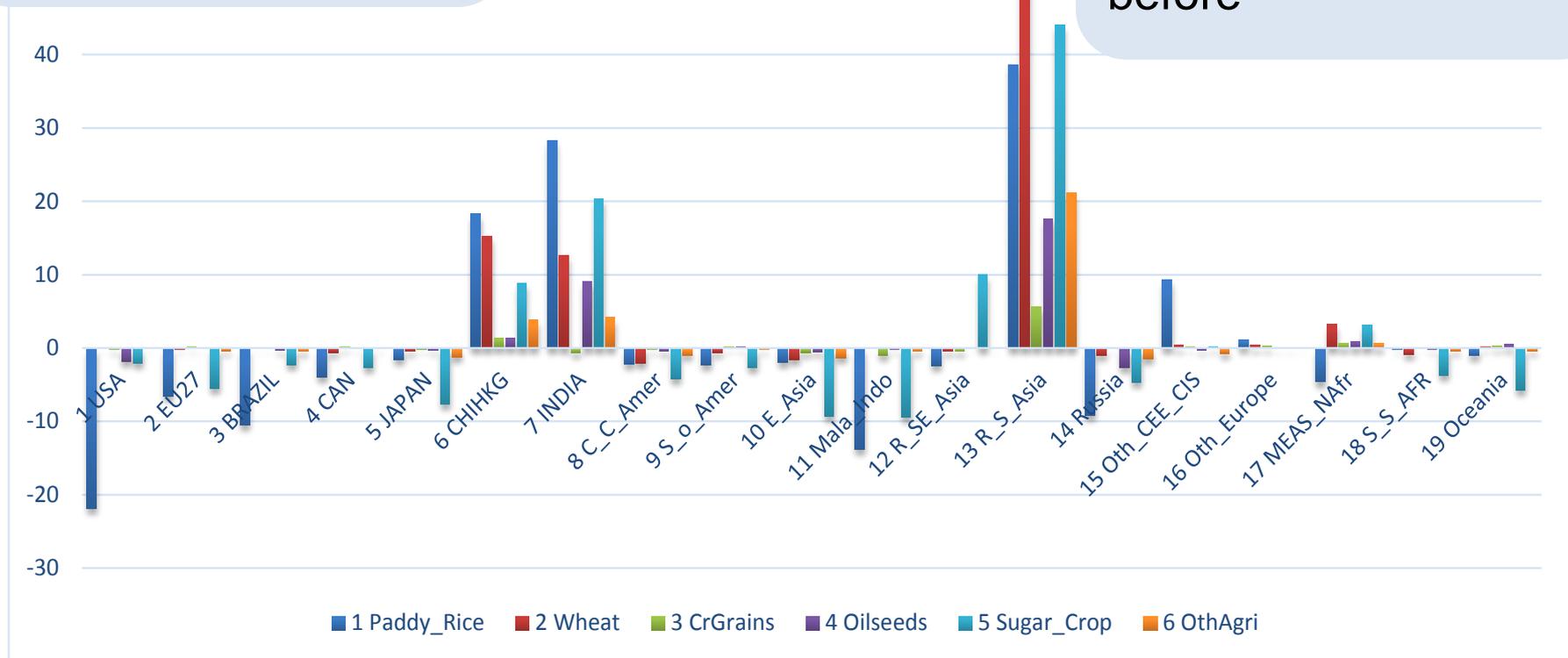


The role of international trade

Global import value rises due to both larger quantities and higher prices

% change in imports

Water scarce regions import more and export less than before



Thank you!

Any comments, questions?

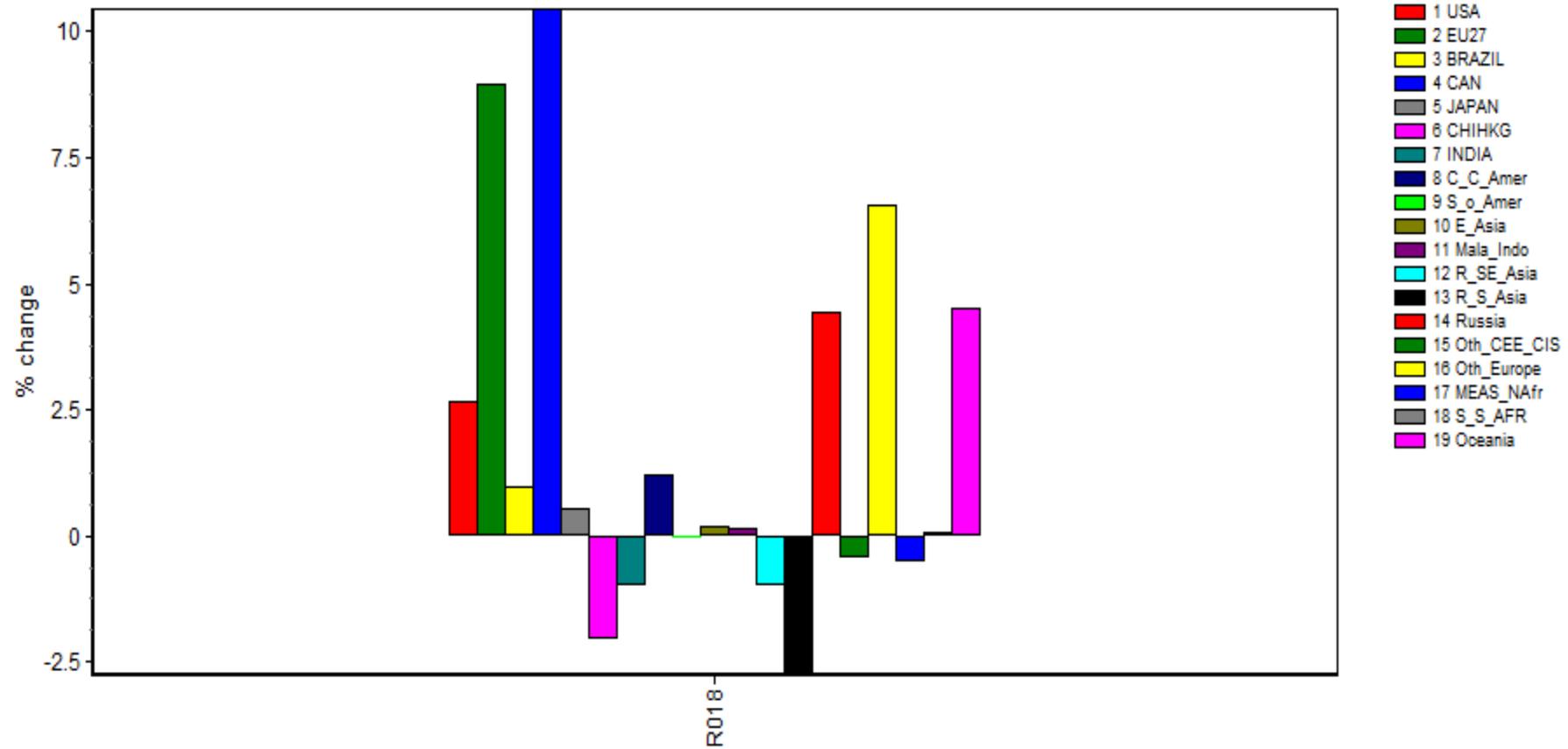
The Impact of Water Scarcity on Rice Industry in East Asia Region

- Production and Trade Patterns

SOO HYUN (CATHERINE) OH

KIEP & SAIS AT JHU

Changes in Rice Production in 2030



Rice Industry in East Asia region after 2030

- Domestic Production of Rice in East Asia
 - Production of rice increases slightly in East Asia.
 - Rice production increases by 0.19% in the period.
 - Pre-shock : \$ 9,316.71 million (=VOM)
 - Post-shock : \$ 9,334.41 million (=VOM*(1+qo))
- Trade Pattern in Rice also changes.
 - Export of rice is limited.
 - One of major Import partner (China) is largely affected by Water scarcity shock.

Top importers of Rice to East Asia

Value of exports of paddy rice from all regions to East Asia valued FOB (VXWD in share)

Ranking	Country	Pre-shock Share	Post-shock Share
1	Japan	0.970	0.980
2	China / Hong Kong	0.020	0.012
3	USA	0.005	0.004
4	Rest of SE Asia	0.004	0.003
Total Share		0.99	0.99
Total Value (VOM)		\$952.74 million	\$1,024 million

Changes in Trade Patterns in Rice Sector

(\$ million, %)

	E Asia	Japan	China Hong Kong	USA	Rest of SE Asia
Trade Balance_rice	-76.09	80.06	-13.71	23.16	22.64
Market Price_rice	1.90	1.57	3.95	6.94	4.73

- Decomposition of Trade Balance shows China's rice export drops \$13.08 million.
- Japanese rice becomes relatively cheaper, it leads to large increase of import from Japan mainly from endowment effect.
- Except small number of countries, most countries including East Asia experience welfare loss due to the increase in world price of rice.

Changes of Others crops (includes vegetables, fruit & nuts) Import from Central America to USA region after 2030 Water Crisis

Introduction

USA import vegetables & fruits from Central America. This study projected water scarcity for 126 river basins in the year 2030.

The objective is to know changes in imports from Central America to USA.

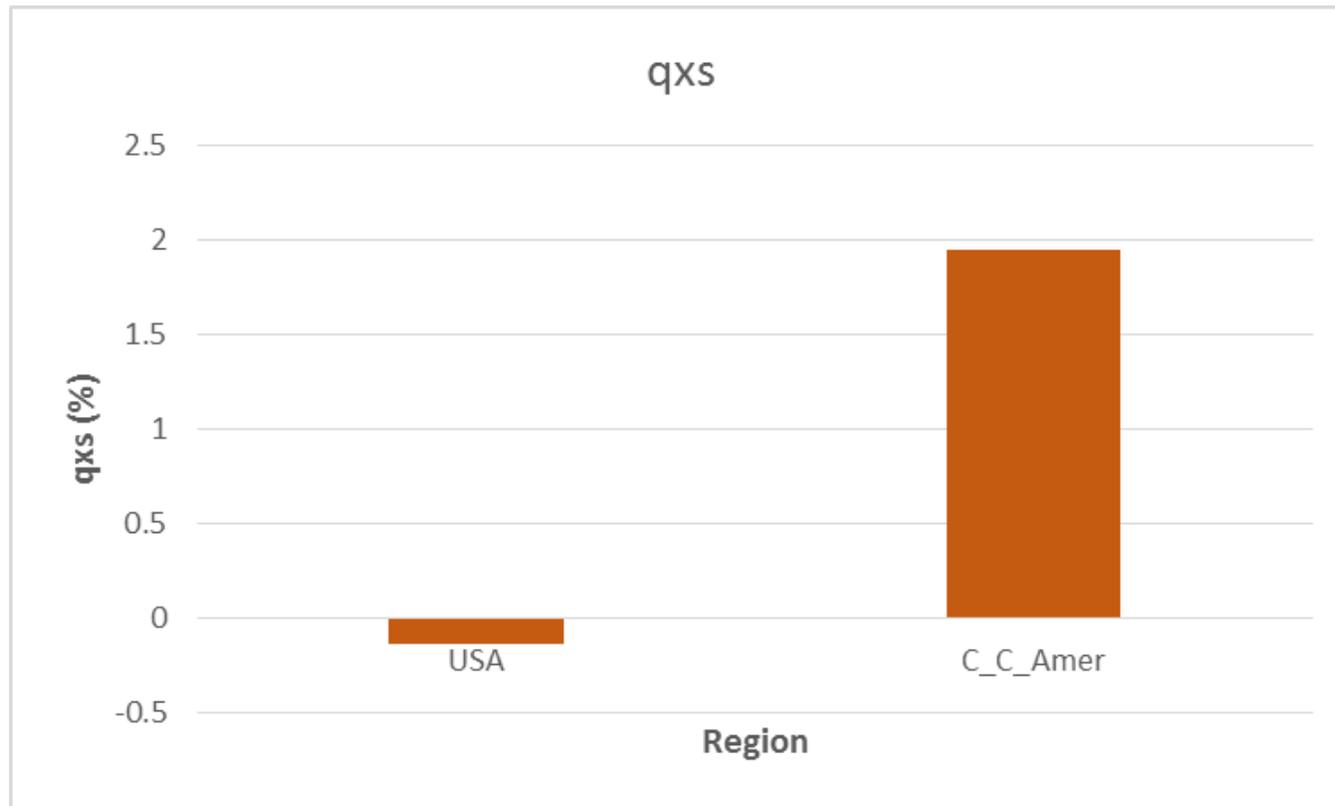
Domestic Production of Other Crops in USA after 2030

- Domestic Production of Other Crops in USA
 - Other Crops Production Increases by 17% in the Period
 - Pre-shock : \$ 63,859 million (=VOM)
 - Post-shock : \$ 76,631 million (=VOM*(1+qo))

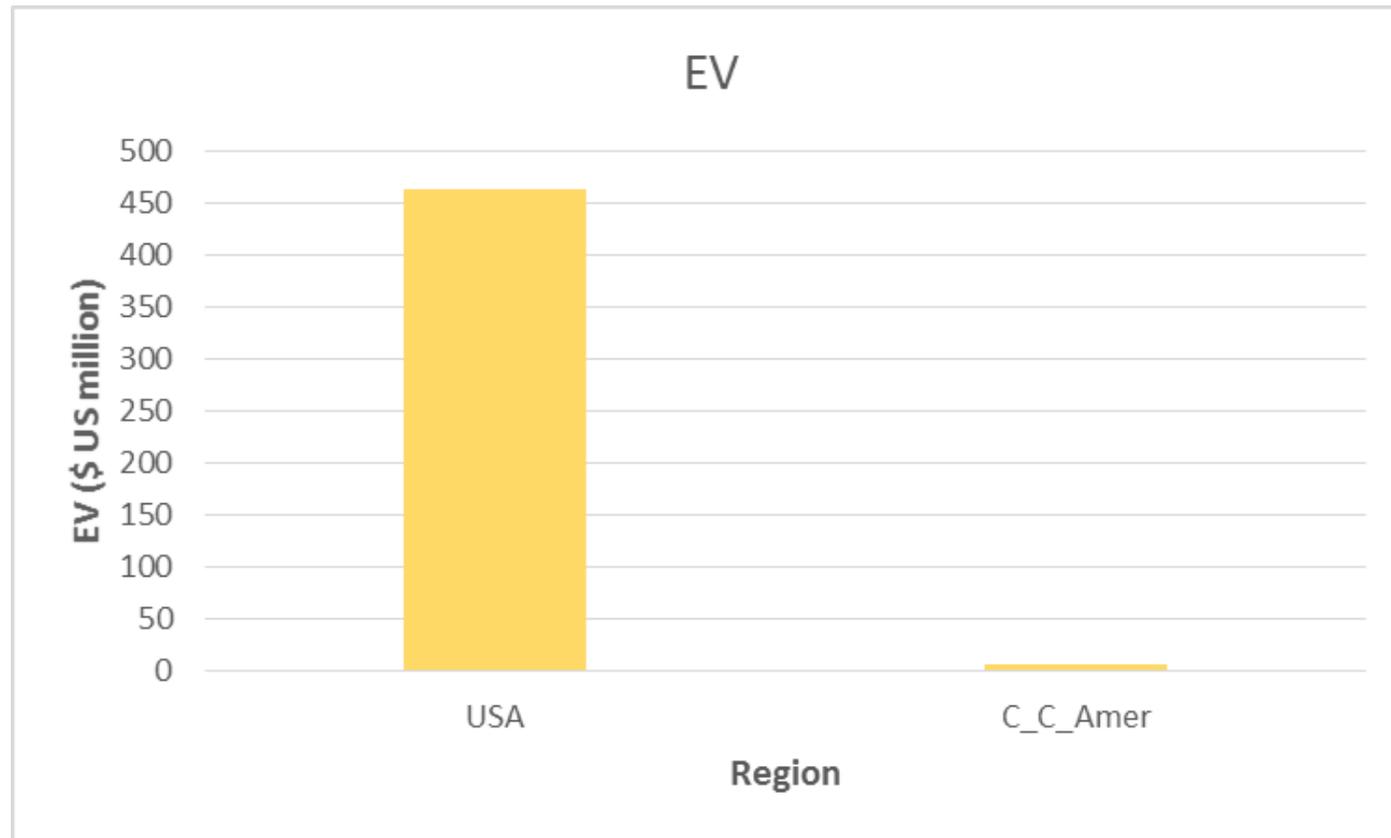
Domestic Production of Other Crops in Central America Region after 2030

- Domestic Production of Other Crops in Central America
 - Other Crops Production Increases by 37% in the Period.
 - Pre-shock : \$ 28,125.54 million (=VOM)
 - Post-shock : \$ 45,282.12 million (=VOM*(1+qo))

Changes in Others crops Production after 2030



EV(\$ US million)



Decomposition of EV (\$ US million)

	USA	EU27	BRAZIL	CAN	JAPAN	CHIHKG	INDIA	C_C_Amer	S_o_Amer	E_Asia
EV	464.06	-506.14	127.86	78.39	-340.47	-994.95	-784	6.36	192.98	-349.76

	Mala_Indo	R_SE_Asia	R_S_Asia	Russia	Oth_CEE_CIS	Oth_Europe	MEAS_NAfr	S_S_AFR	Oceania
EV	-13.38	-2.65	-1191.11	-59.14	-118.28	-42.42	-481.23	67.66	220.05

Conclusions

- ❖ The regional production impacts are quite heterogeneous, depending on the size of the shortfall, the irrigation intensity of crop production, as well as the global commodity price effects.
- ❖ In USA production (qo) increase, so imports decrease (- 0.14).
- ❖ In Central America the production (qo) increase, but imports increase too (1.95).
- ❖ Despite the different effects, increase the welfare of both regions.
- ❖ The global welfare loss amounts to \$3.7 billion (2001 prices) both due to the reduction in irrigation availability, as well as due to interactions with domestic support for agriculture.

Impacts on Wheat Sector:

USA and MENA

by

Katherine and Bennet

LAND USE CHANGES IN TWO COUNTRIES

- Land dedicated to wheat production shifts as a result of this shock

	USA IWheat	USA RWheat	USA Total Wheat	MENA IWheat	MENA RWheat	MENA Total Wheat
Base Area	1,206,099.77	21,344,118.18	22,550,217.95	5,319,027.20	8,918,042.96	14,237,070.16
Updated Area	1,247,578.61	21,567,515.26	22,815,093.87	5,072,390.95	9,532,377.33	14,604,768.28
Change	41,478.84	223,397.08	264,875.92	(246,636.24)	614,334.37	367,698.12
Percent Change		3%	1%		-5%	7%
Proportion Base		5.3%	94.7%		37.4%	62.6%
Proportion Upd		5.5%	94.5%		34.7%	65.3%

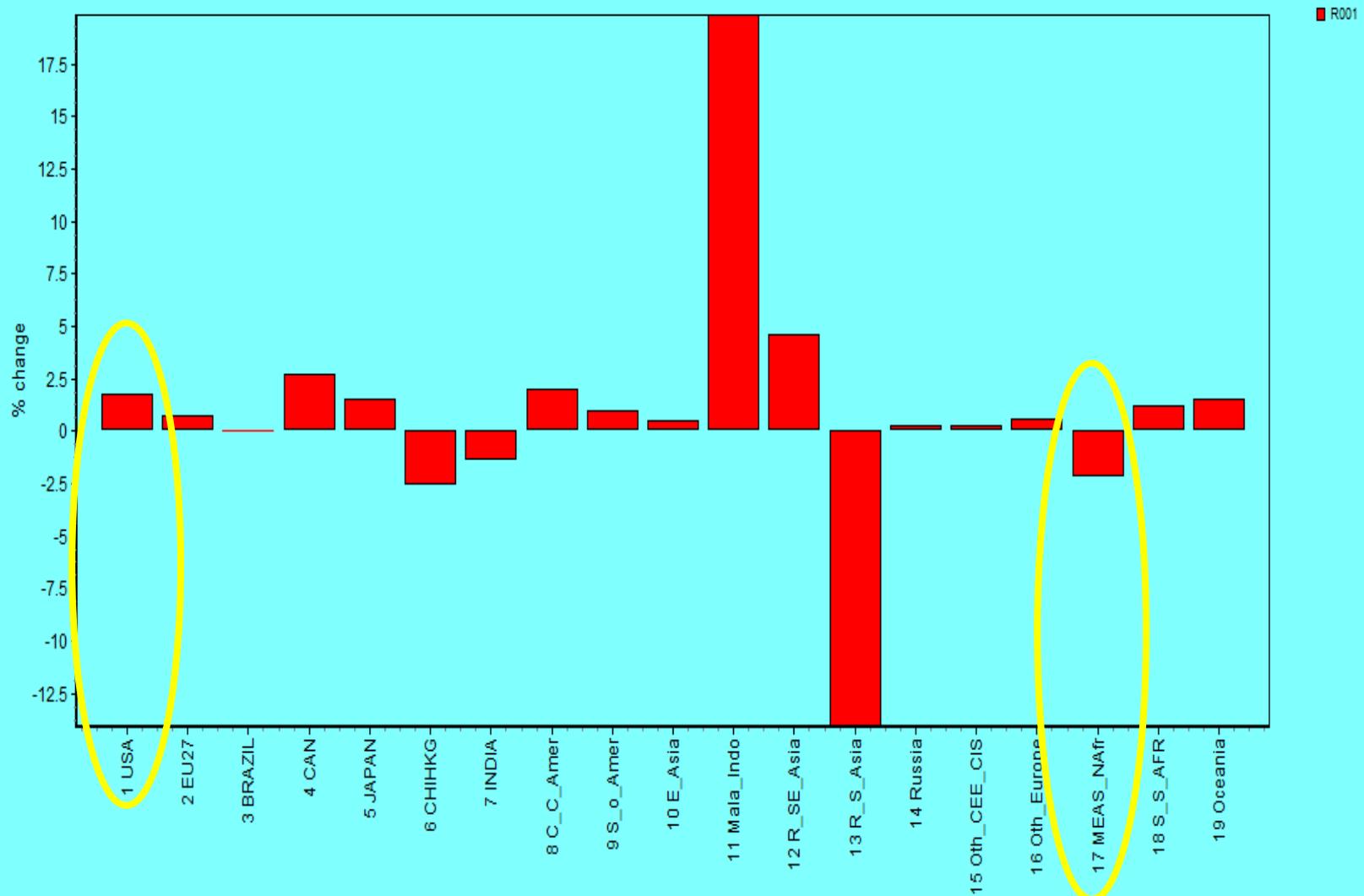
- Yield differences by cropping method are substantial

Comparative US Wheat Yields	
Irrigated	5.785
Rainfed	2.582

Comparative MENA Wheat Yields	
Irrigated	3.598
Rainfed	1.160



CHANGE IN PRODUCTION



IMPACT OF THIS QUANTITY CHANGE ON WORLD MARKETS

	USA	MENA
% World Production (base)	11%	5%
% Exported (base)	60%	1%
qo	1.73	-2.22



PRICE CHANGES

- US sees factor prices increase in wheat production
 - Factor price changes occur in each AEZ/basin unit
 - Rental rates for wheat land increase by an average of:
 - 11.9% for irrigated wheat land
 - 9.3% for rainfed wheat land
- MENA factor prices also increase
 - Increases are much more dramatic
 - 23.1% for irrigated wheat
 - 33.0% for rainfed wheat
- Output prices increase
 - USA: 1.8%
 - MENA: 2.9%



CHANGES IN CONSUMPTION

United States

Negligible/Slight fall in consumption by 0.03%

Own-price elasticity is -0.057

MENA

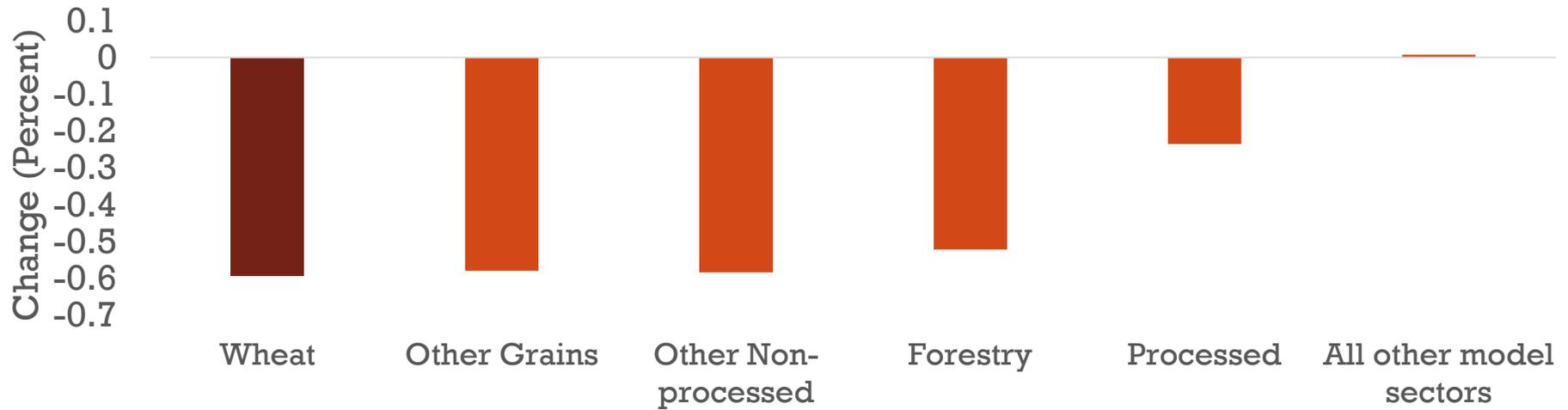
Fall in wheat consumption by 0.5%

Own-price elasticity is....



..... -0.182 and cross-price elasticities between wheat and other agricultural commodities are near-zero.

Change in Consumption of Agricultural and other Goods in MENA
(2000-2030)



TRADE FLOWS

United States

Exports to MENA increase by 2.28% (23% of world export market at beginning of simulation)

Imports increase is negligible (0.01%)

MENA

Exports decrease by 9.97% (0.6% of world export market at beginning of simulation)

Imports increase by 3.3%



TRADE FLOWS: IMPORTS INTO MENA

- US prices increased more than composite import prices in ME, making US relatively less competitive in the ME market. For example, EU prices increased relatively less than composite import price into ME, and indeed their exports to ME increased more than US exports
- However, ME increased demand for imports (expansion effect) is much greater than the substitution effect, so imports from US increase by 2.28%.



Future water shocks: income distribution and possible poverty impacts

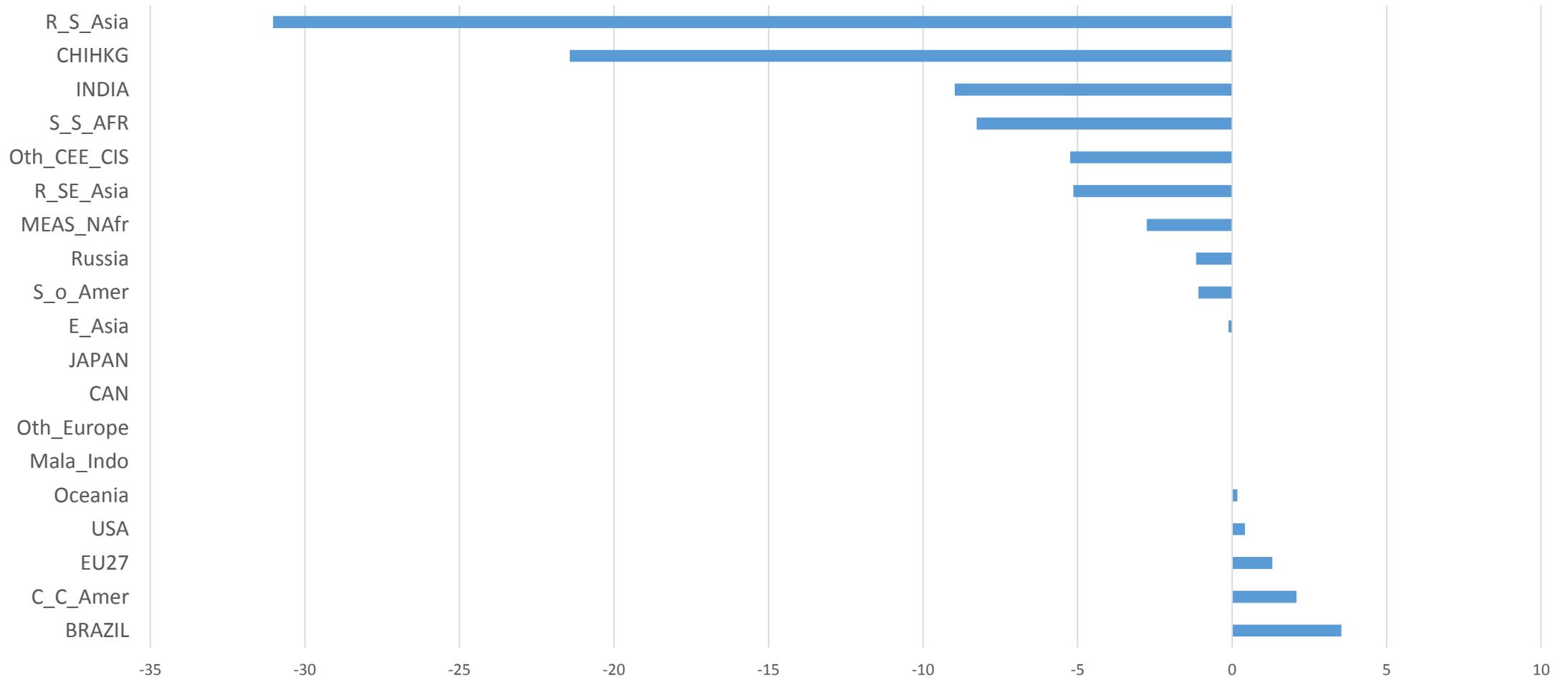
Ziping Wu (Agri-Food and Biosciences Institute)

Dominique van der Mensbrugge (Purdue University)

Potentially large impact on some regions...

Aggregate IFPRI water index shock by basin, averaged by base year water use, percent

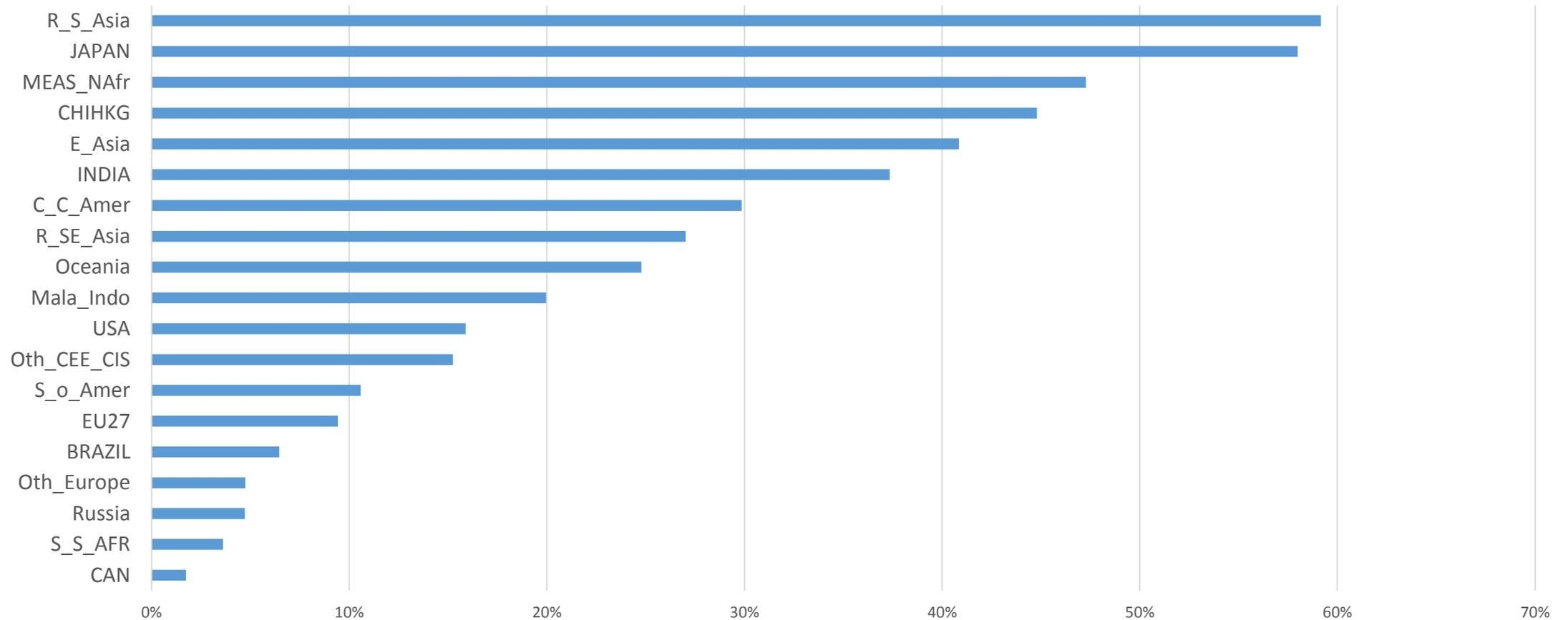
Average water shock on irrigated land



The relative importance of irrigated land

Irrigated harvested area, as percent of total

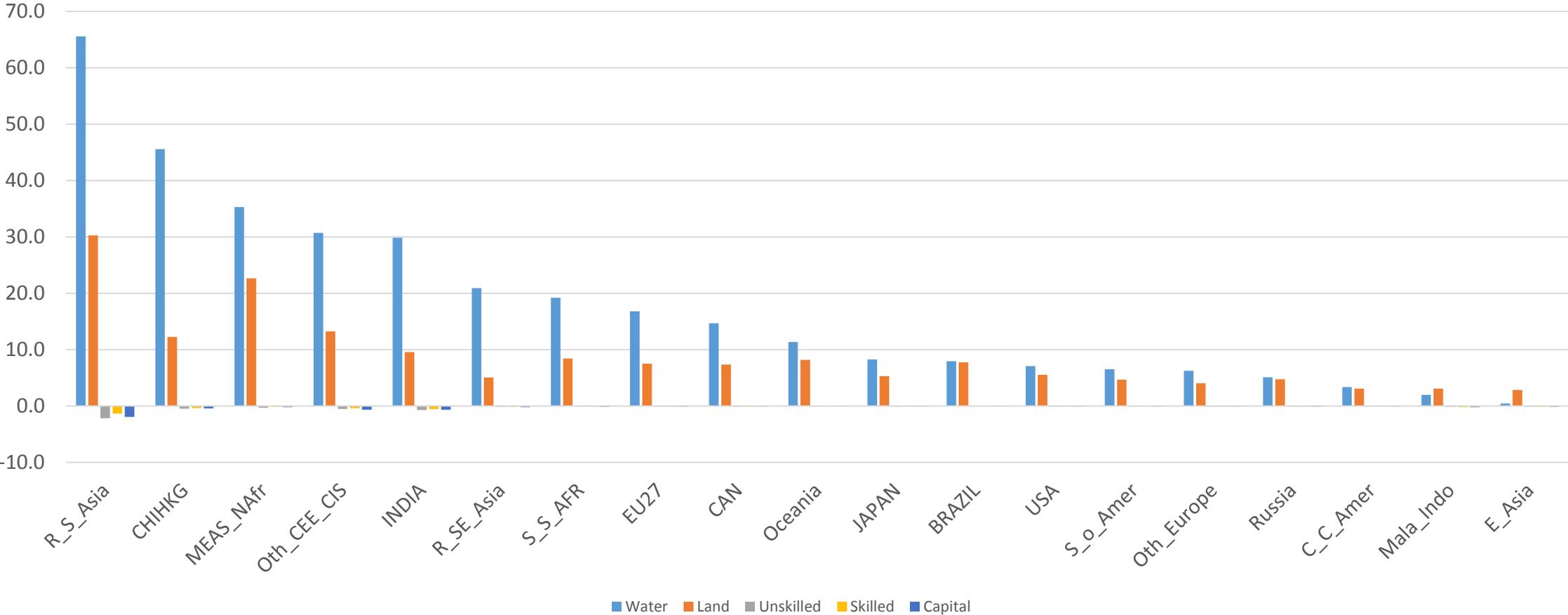
Share of irrigation in aggregate crop production



Potentially good for land owners

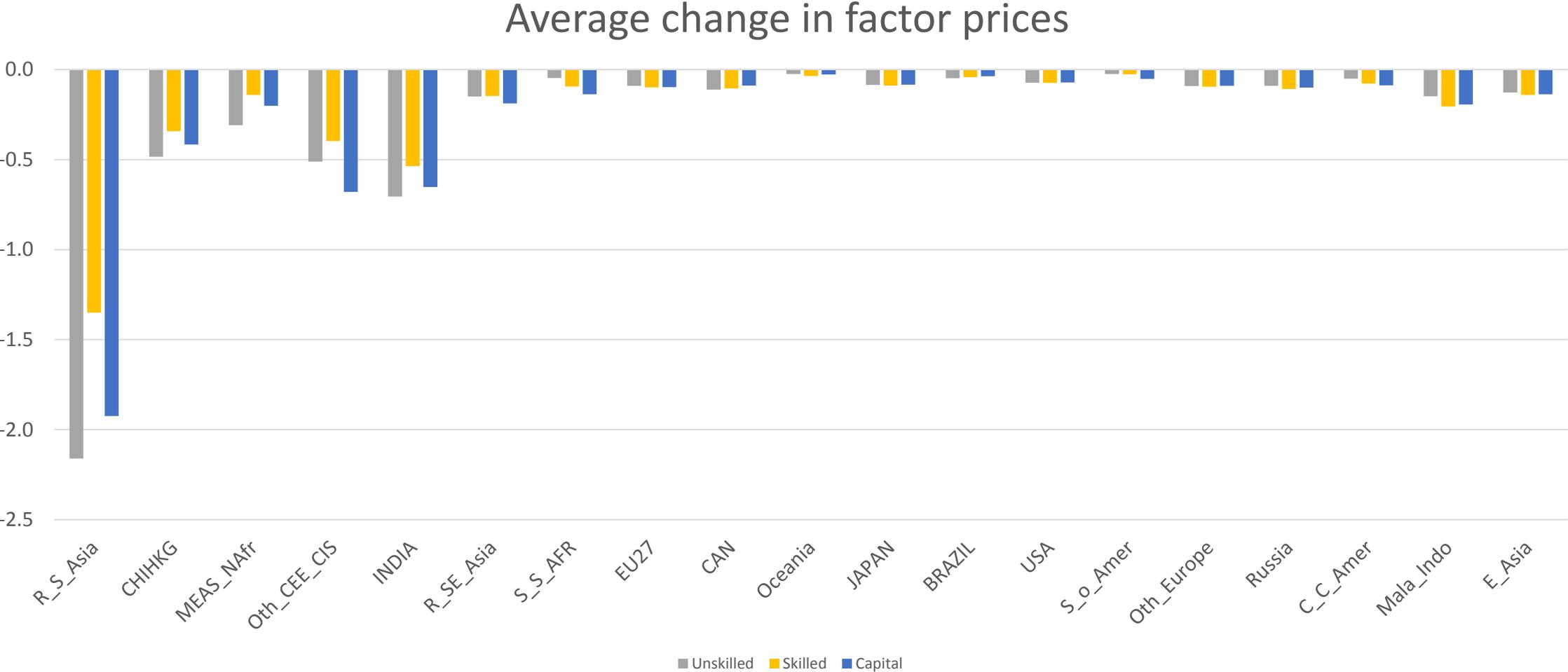
Percent change in factor prices, aggregated over all demand

Average change in factor prices

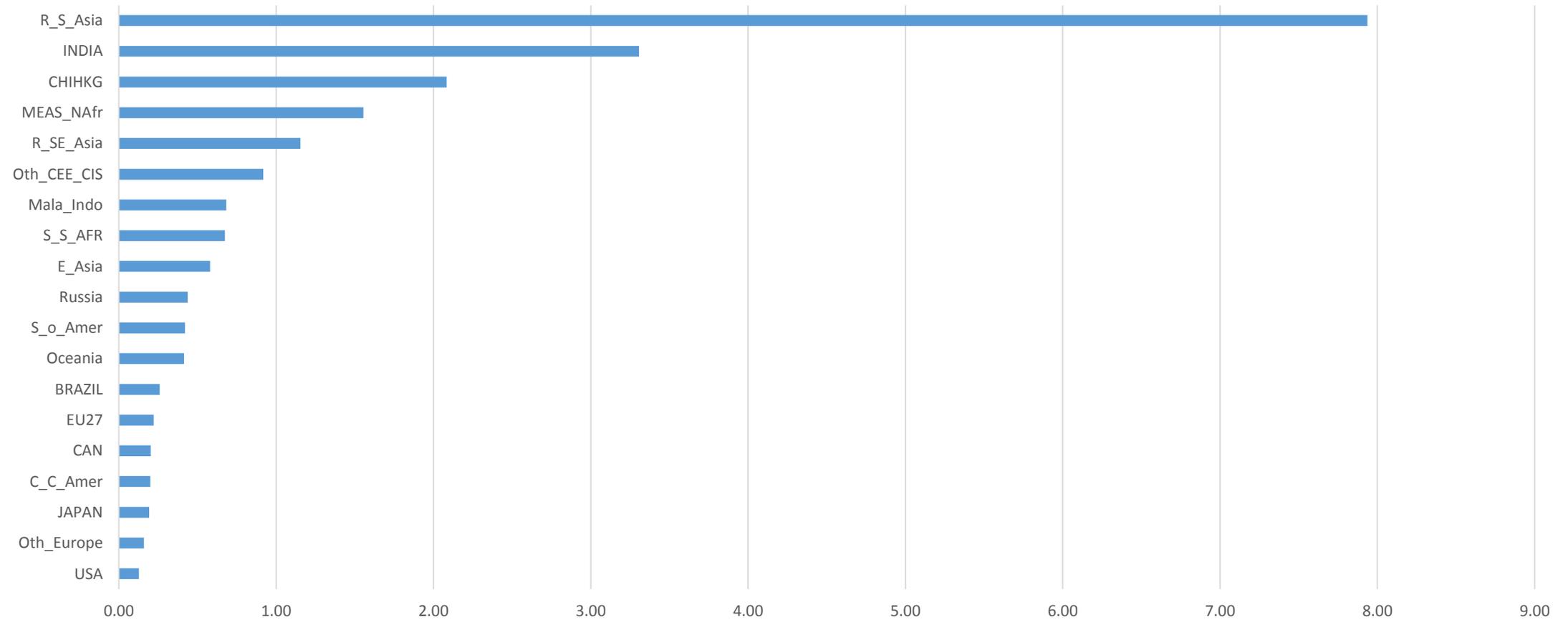


Potentially good for land owners

Percent change in factor prices, aggregated over all demand



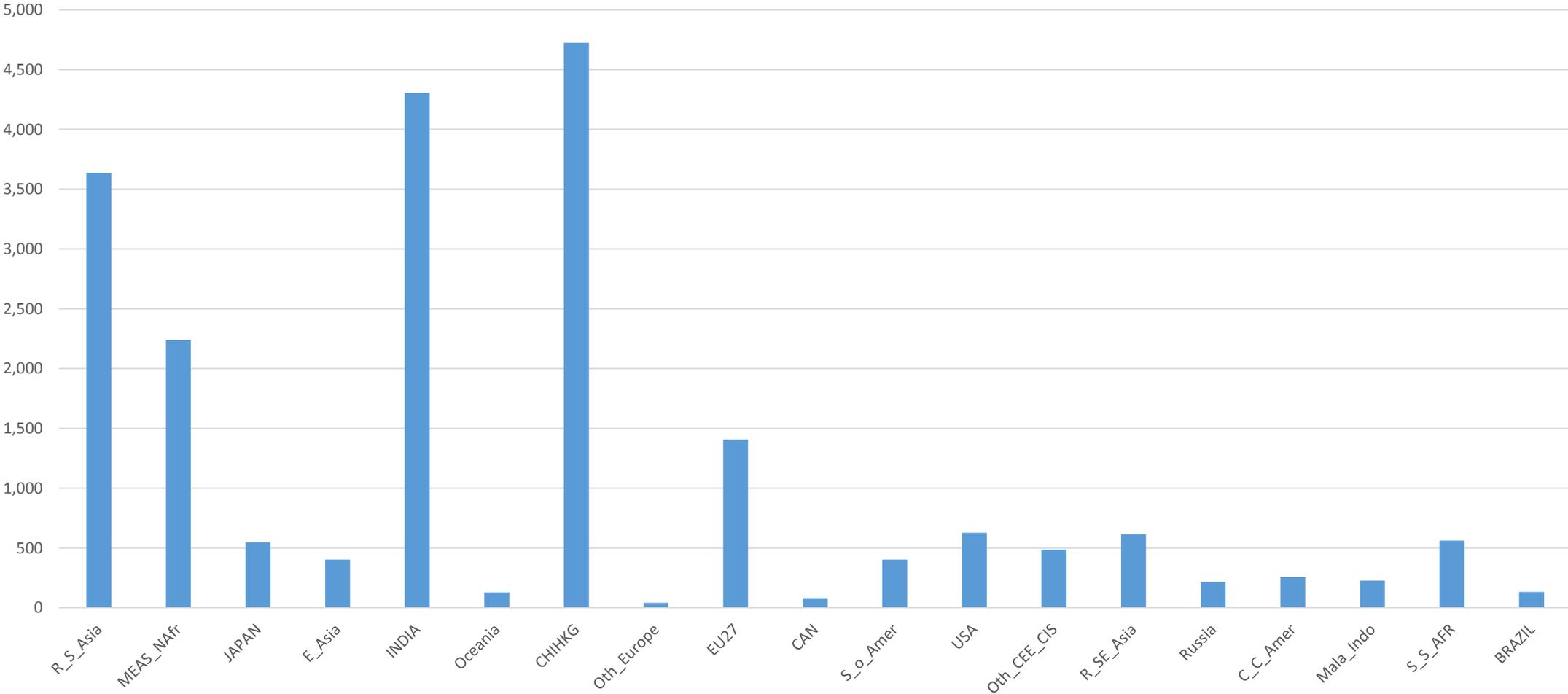
Knock-on Impact on Food Price, %



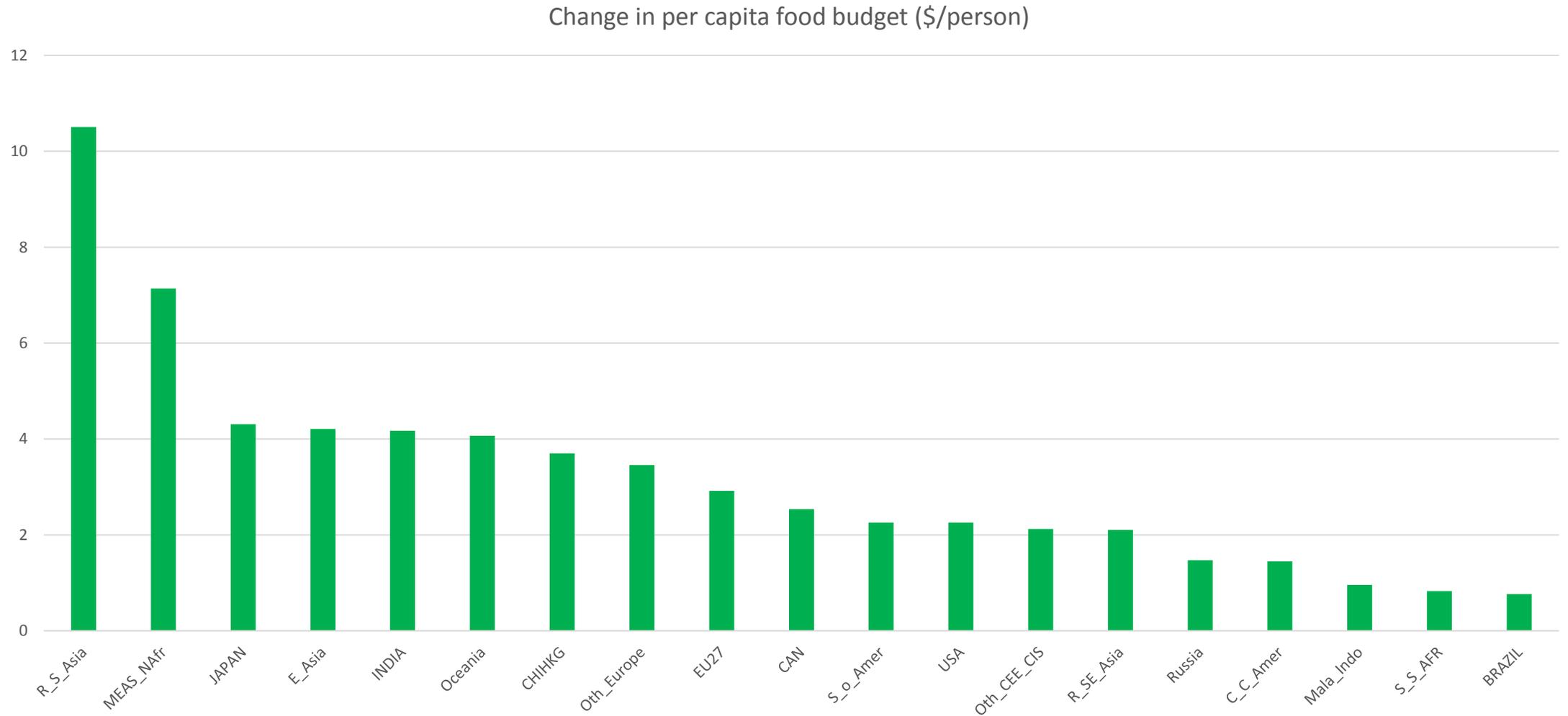
Compensation for food price changes could represent some 10% of ODA

\$million

Food budget compensation



Compare with poverty lines of \$1 and \$2/day



Take away messages

- Water shock large for (irrigated) crop production in some countries
- Land owners likely to benefit
- Closure effects potentially important
 - Countries facing large shocks see an increase in net imports of food leading to real depreciation
- Poor likely to be hit hardest
 - Reduction in unskilled wages, and even more relative to price of food