Economic Impacts of Climate Change on Agriculture

ILSI/CIMSANS Conference
Bengaluru
16 November, 2013.

What should we study?

Some issues to keep in mind

- Impacts of climate change as a change from the baseline

- Important – the baseline is not a constant.

- Development is not only growth – involves many kinds of structural changes.

- Evolution of baseline must take into account development

- Limitations of modeling of development

What should we study (contd)?

- Characterising development

- Macro-economic issues important but do they capture the key issue?

- Local also important – biophysical, environmental, economic, social aspects

- Normative issues – putting people at the centre of the story

- Development as transforming the structure of economic, social and political inequalities (human development a part but not all)

Current situation in rural India

- High levels of inequality – Rich and poor
- Land – the key asset in terms of agriculture
- Other assets, especially livestock but linked to the above
- Social inequality (gender and caste)
- Unequal access to natural resources, mainly water
- Utter lack of basic amenities
- Issues of power

How do we study?

- Official statistics – important and significant

- But insufficient – Many gaps

- Often underestimate inequalities

- Needs to be supplemented by detailed village level data and information

- Village level studies – difficult, time-consuming

Inequality in land

Table 5 *Gini coefficients for the distribution of operational and ownership holdings of land, India, 1960-61 to 2003-04*

Type of holding	1960-61	1980-81	2003-04
Operational holdings	0.58	0.63	0.62
Ownership holdings	0.73	0.71	0.74

Note: These are official estimates of Gini coefficients. Ownership holdings in these estimates refer to ownership of any type of land including homestead land. Gini coefficient of ownership of agricultural land in 2003-04 was about 0.76 (Rawal 2008).

Source: Ramachandran and Rawal (2010).

Village level studies Inequality in land holdings

Table 6 *Share of agricultural land owned by the 5 per cent of households with the largest ownership holdings and the 50 per cent with the smallest ownership holdings, selected villages in per cent*

Serial number	Village	Year of survey	Share of agricultural land owned by	
			top 5 per cent	bottom 50 per cent
1	ANANTHAVARAM, Guntur District, south coastal Andhra Pradesh	2006	54	0
2	BUKKACHERLA, Anantapur district, Rayalaseema region, south-west Andhra Pradesh	2006	33	17
3	KOTHAPALLE, Karimnagar district, North Telangana region, north Andhra Pradesh	2006	41	1
4	HAREVLI, Bijnor district, Western Uttar Pradesh	2006	39	2
5	MAHATWAR, Ballia district, Eastern Uttar Pradesh	2006	40	6
6	WARWATKHANDERAO, Buldhana district, Vidarbha region, Maharashtra	2007	35	10
7	NIMSHIRGAON, Kolhapur district, Marathwada region, Maharashtra	2007	24	5
8	DUNGARIYA, Adivasi village, south Udaipur district, Rajasthan	2007	23	18
9	25 F GULABEWALA, Sri Ganganagar district, Gang Canal region, Rajasthan	2007	43	0
10	GHARSONDI, Gwalior district, Madhya Pradesh	2008	44	6
11	ALABUJANAHALI, Madhya district, Karnataka	2009	26	8
12	SIRESANDRA, Kolar district, Karnataka	2009	31	16
13	ZHAPUR, Gulbarga district, Karnataka	2009	49	2
14	DHAMAR, Rohtak district, Haryana	Dec 2001-Jan 2002	36	4
15	BIRDHANA, Fatehabad district, Haryana	May 2003	74	0
16	PALAKURICHI, Nagapattinam district, Tamil Nadu	2004	74	0
17	SATHANUR, Thanjavur district, Tamil Nadu	2004	39	0

Note: Agricultural land includes net sown area and current fallows.
Source: Survey data.

Inequality in Land

Table 2. *Share of agricultural land owned by top 5 per cent and bottom 50 per cent households, selected villages* in percentage

Village	Year of survey	Share of agricultural land owned by	
		top 5 per cent	bottom 50 per cent
Ananthavaram (AP)	2006	54	0
Bukkacherla (AP)	2006	33	17
Kothapalle (AP)	2006	41	1
Harevli (UP)	2006	39	2
Mahatwar (UP)	2006	40	6
Warwat Khanderao (Mah)	2007	35	10
Nimshirgaon (Mah)	2007	24	5
25 F Gulabewala (Raj)	2007	43	0
Gharsondi (MP)	2008	44	6
Alabujanahalli (Kar)	2009	26	8
Zhapur (Kar)	2009	49	2

16

Inequality in all assets

Table 7 *Share of value of assets (land, and other productive assets, and all assets) owned by the 5 per cent of households with the largest assets holdings and the 50 per cent with the smallest assets holdings, selected village, (per cent)*

Serial number	Village	Year of survey	Share of land and other productive assets owned by		Share of total assets owned by	
			top 5 per cent	bottom 50 per cent	top 5 per cent	bottom 50 per cent
1	Ananthavaram (AP: south coastal)	2006	65	1	60	2
2	Bukkacherla (AP: Rayalaseema)	2006	46	8	42	10
3	Kothapalle (AP: north Telangana)	2006	54	5	45	9
4	Harevli (UP: western)	2006	45	2	43	3
5	Mahatwar (UP: eastern)	2006	43	6	38	9
6	Nimshirgaon (Mah: Kolhapur)	2007	41	7	41	9
7	Warwat Khanderao (Mah: Vidarbha)	2007	66	0	26	6
8	25 F Gulabewala (Raj: Sri Ganganagar)	2007	39	0	35	0.6

Note: Land includes all the agricultural, non-agricultural, and homestead land also.

Source: PARI Survey data.

Inequality in all assets

Table 1. *Share of value of assets (land, and other productive assets, and all assets) owned by top 5 per cent and bottom 50 per cent households, selected villages* in percentage

Village	Share of total assets owned by	
	top 5 per cent	top 5 per cent
Ananthavaram (AP)	59	3
Bukkacherla (AP)	42	10
Kothapalle (AP)	45	9
Harevli (UP)	44	3
Mahatwar (UP)	51	7
Warwat Khanderao (Mah)	41	8
Nimshirgaon (Mah)	34	6
25 F Gulabewala (Raj)	41	1
Rewasi (Raj)	33	16
Gharsondi (MP)	49	6
Alabujanahalli (Kar)	37	10
Zhapur (Kar)	51	7

14

Crop Production and Incomes

Table 17 *Average value of annual output from crop production per acre of operational holding, bottom 20 household, all households and top 20 households, PARI villages in 2008-09 prices*

Village	Bottom 20 households	Mean	Top 20 households
Ananthavaram*	14810	38886	66302
Bukkacherla*	3245	8637	13226
Kothapalle*	6188	12047	15653
Harevli	14849	27622	33576
Mahatwar	6152	11880	17567
Warwat Khanderao	3426	12025	23370
Nimshirgaon*	5933	22813	44227
25 F Gulabewala	10091	15430	20178
Gharsondi	3719	13178	30437

Notes: All incomes were converted to 2008-09 prices using State-level CPIAL

   * Figures for bottom and top 20 households of these villages are averages of sample households

Source: PARI Survey data.

Table 18 *Average annual net incomes from crop production per acre of operational holding, bottom 20 household, all households and top 20 households, PARI villages in 2008-09 prices*

Village	Bottom 20 households	Mean	Top 20 households
Ananthavaram*	-11712	5621	31232
Bukkacherla*	-5027	1049	6648
Kothapalle*	-1801	3091	8015
Harevli	-4965	6343	16350
Mahatwar	-3016	2665	9017
Warwat Khanderao	-782	6301	15893
Nimshirgaon*	-72	10598	26253
25 F Gulabewala	3553	7737	12024
Gharsondi	-5172	5338	20081

Notes: All incomes were converted to 2008-09 prices using State-level CPIAL.

* Figures for bottom and top 20 households of these villages are averages of sample households.

Source: PARI Survey data.

Gross output, Costs and Net Income

Table 3 *Gross value of output (GVO), Cost A2 and net income for kharif paddy, by class, Ananthavaram village, 2005–06 (Rs/ha)*

Socio-economic class	GVO	A2	Net Income
Peasant: poor	29,142	33,578	-4,436
Peasant: lower middle	30,230	27,625	2,606
Peasant: upper middle	30,466	21,875	8,591
Capitalist farmer/Rich peasant/Peasant: upper*	35,521	31,772	3,748
Landlord/Big capitalist farmer	30,374	19,065	11,308
All classes (average)	31,734	29,293	2,441

Note: * A significant proportion (40 per cent) of land cultivated by households in this class was leased in.

Gross value of output, costs and incomes

Table 13: Average GVO, Cost A2 and net income per acre of operational holding by class, Nimshirgaon Class	GVO per acre	Cost A2 per acre	Net income per acre
Landlord	52692	21363	31329
Peasant: 1 (rich)	36192	22852	13340
Peasant: 2 (middle)	23987	10740	13247
Peasant: 3 (small)	17309	9597	7712
Hired manual workers	10010	6912	3099
Business activity/self-employed	28542	16763	11779
Salaries, pensions and remittances	11141	5260	5882

Another case study

Table 17: Average GVO, Cost A2 and net income per acre of operational holding by class, Warwat Khanderao Class	GVO per acre	Cost A2 per acre	Net income per acre
Landlord	17647	9198	8449
Peasant: 1 (rich)	15224	6660	8564
Peasant: 2 (middle)	11123	5273	5850
Peasant: 3 (small)	10749	4574	6175
Hired manual workers+cultivation	6258	4173	2085
Hired manual workers	7518	2293	5225
Business activity/self-employed	10152	6349	3804
Salaried person/s	10582	6019	4564

Absence of Basic Amenities

Table 7. *Proportion of households that live in pucca homes with at least two rooms, with an electricity connection, and access to a lavatory and a source of water within the house or at the doorstep, survey villages, 2005-09* in per cent

Village and State	Adivasi	Dalit	Muslim	Other castes
Ananthavaram (Andhra Pradesh)	0	8	12	44
Bukkacherla (Andhra Pradesh)	--	0	0	2
Kothapalle (Andhra Pradesh)	0	9	0	14
Warwat Khanderao (Maharashtra)	--	0	2	3
Nimshirgaon (Maharashtra)	--	11	17	39
Harevli (Uttar Pradesh)	--	0	0	15
Mahatwar (Uttar Pradesh)	--	1	--	0
25F Gulabewala (Rajasthan)	--	3	--	76
Rewasi (Rajasthan)	--	14	--	23
Dungariya (Rajasthan)	0	--	0	0
Gharsondi (Madhya Pradesh)	0	12	0	18
Badhar (Madhya Pradesh)	0	0	--	0
Alabujanahalli (Karnataka)	--	3	--	32
Siresandra (Karnataka)	--	0	--	2
Zhapur (Karnataka)	0	0	0	0
All	0	6	4	22

Source: PARI survey data in Shamsher Singh, "Access to Basic Amenities: A Sociological Study of Villages in Selected States of India."

What does this imply?

- Conditions of production and correspondingly output and incomes vary sharply across socio-economic categories.

- Consequences of climate or weather shock will be non-uniformly distributed across categories of farmers

- Any spatial averaging will miss substantial aspects of inequalities and their consequences.

- Consequences of climate shock need to be studied similarly at the household level.

Is vulnerability enough?

- Theoretical conceptions of vulnerability useful.

- Most conceptions of vulnerability have a general view of empowerment. Miss out local political and social hierarchy.

- Choice of particular type of shock sharply defines the vulnerability ranking

- Relevance of choice of indicators rarely tested against actual outcomes of climate shocks.

One study – Impact of Cyclone Thane (Dec 29-30, 2011)

- Damage to Standing Crops

(Govt of TN estimates)

S.No	Crops	Total Area cultivated (Ha)	Area damaged (Ha)	Percentage	Remarks
1	Paddy	96391	70271	72.9	Flowering and harvesting stage
2	Groundnut	9394	2274	24.21	Sown and vegetative stage
3	Black Gram	14132	7000	49.53	Sown and vegetative stage
4	Sugar cane	29700	6833	23.01	Planting and growth stage
5	Coconut	2363	939	39.74	20 years of yielding stage
6	Cotton	7452	110	1.48	Boll stage
7	Oil Palm	1100	46	4.18	4 years old and yielding palm
	Total	160532	87473	54.49	

house

S.No	Name of the Taluka	Huts		Tiled Houses
		Fully Damaged	Partially Damaged	
1	Cuddalore (rural)	49511		26835
2	Cuddalore (town)	302	16094	15833
3	Panruti	18545	50650	26153
4	Kurinjipadi	3058	39799	10916
5	Chidambaram	1362	82556	16458
6	Viridachalam	413	6883	
7	Kattumannarkoi	101	175	10
8	Thittagudi		228	
	Total	73292	196385	96205

Land holding charactertistics of Melanjipattu village

Total population	1144
Total household	296
Land owning households	62
Land owning household to total households	21%
Cultivating households	94
Cultivating households to total households	31.8%
Tenants households	55
Percentage of tenants to cultivating HH	58.5%

Land ownership – distribution by size class

■

Size class of landholding(Acre)	No of ownership holding		Area under ownership holding	
	No of hh	Share to total number of hh(%)	Extent(Acre)	Share of holding(%)
Landless	235	80.1		
0.01-0.099	26	8.8	10.04	9.3
1-1.99	16	4.7	16.09	14.9
2-2.99	5	1.4	8.97	8.3
3-3.99	6	2	18.96	17.5
4-4.99	4	1.4	16	14.8
5-5.99	1	0.3	5	4.6
6-6.99	1	0.3	6	5.6
7-7.99	1	0.3	7	6.5
8-8.99	1	0.7	20.05	18.5
Total	296	100	108.1	100

Income from Cultivation - 2010-11

Land holding size	No of houses	Areas of cultivation	Gross Income/acre	Net Income/acre
0.01-0.099	57	89.08	10802	2935
1-1.99	25	65.93	9873	4142
2-2.99	10	42.56	12876	8211
3-3.99	6	36	8255	8088
4-4.99	2	12	16271	6696
5-5.99	1	10	6780	5265
6-6.99	1	6.5	63846	12523
7-7.99	1	7	14857	8324
8-8.99	1	8.25	34667	24200
Total	104	277.32	12716	5941

Agricultural income 2011-2012

No of houses	Areas of cultivation	Gross Income/acre	Net income/acre
43	37.58	7171	-9716
20	30.31	1554	-7629
5	10.97	1067	-8295
7	21	612	-10977
3	12	0	-4650
1	5	0	-4800
1	6.5	0	-9754
1	7	0	-11857
1	8.25	0	-10697
82	138.61	2461	-8891

Damage

	Damage to the crop			
Land holding	No of houses	Affected area	Total Loss	Loss per household
0.01-0.099	45	23.47	530685	12061
1-1.99	18	21.21	408400	22689
2-2.99	5	12.64	297900	49650
3-3.99	7	21.00	435850	62264
4-4.99	3	12.00	254900	84967
5-5.99	1	5.00	77000	77000
6-6.99	1	6.50	139000	139000
7-7.99	2	14.00	246200	123100

Different Forms of climate extremes

- Climate extremes that are not visible as a shock

- Role of variability of temperature (and precipitation) beyond the optimal

- Lobell et al (Wheat senescence)

- Importance of studying current climate variability

GROWING SEASON LENGTH DECREASES AS AVERAGE TEMPERATURES AND EXTREME HEAT DAYS INCREASE
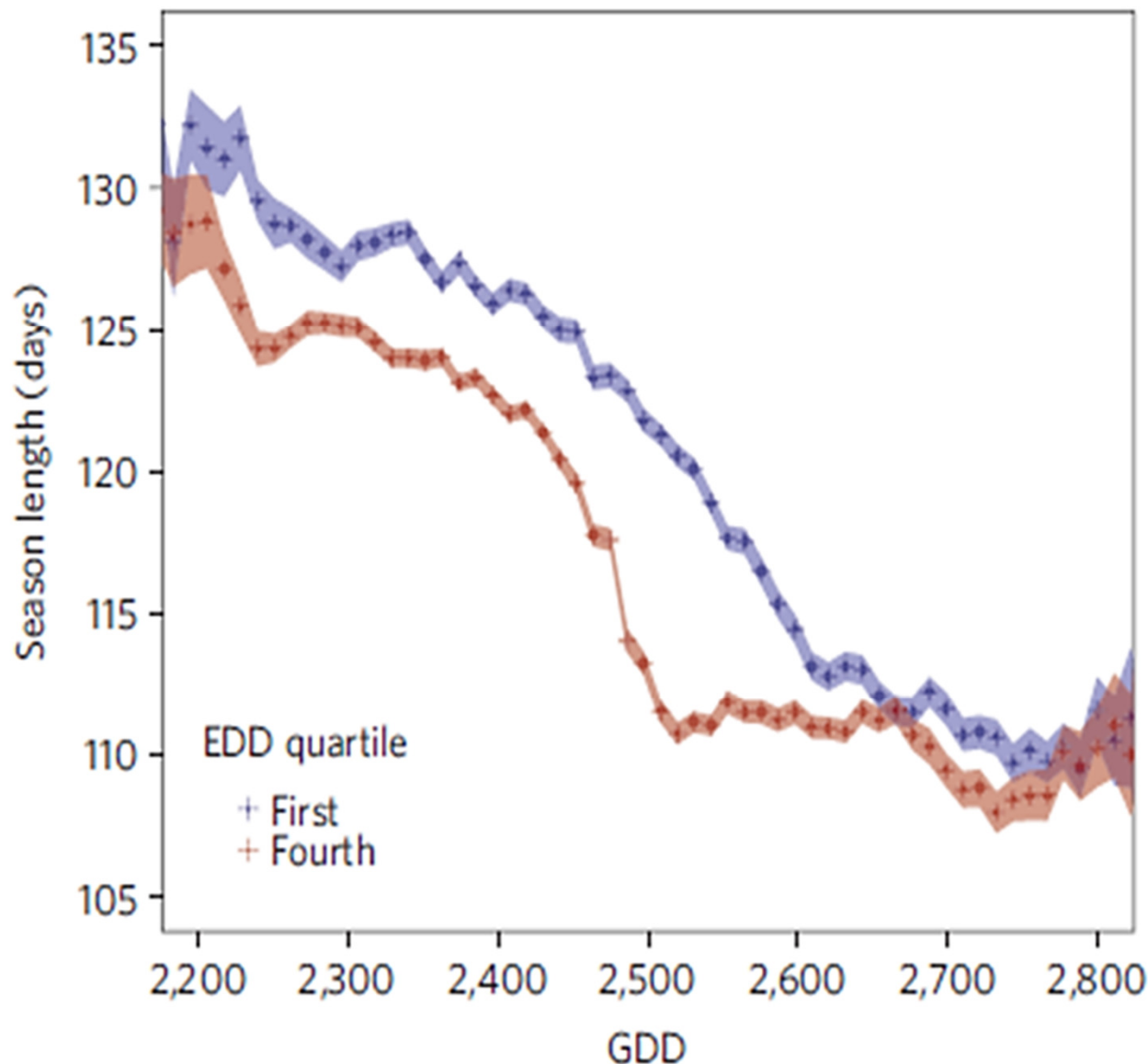(from remote sensing data for wheat production in the Indo-Gangetic plain for 2000-2009)


GDD (Growing Degree Days) – measure of average temperatures and their duration.

EDD (Extreme Degree Days) – measure of extreme temperatures and their duration.

Blue curve – lower EDD
Red Curve – higher EDD

38

GROWING SEASON LENGTH DECREASES AS AVERAGE TEMPERATURES AND EXTREME HEAT DAYS INCREASE
(from remote sensing data for wheat production in the Indo-Gangetic plain for 2000-2009)

GDD (Growing Degree Days) – measure of average temperatures and their duration.

EDD (Extreme Degree Days) – measure of extreme temperatures and their duration.

Blue curve – lower EDD
Red Curve – higher EDD

38

ESTIMATED NET IMPACT OF CLIMATE TRENDS FOR 1980–2008 ON CROP YIELDS FOR MAJOR PRODUCERS AND FOR GLOBAL PRODUCTION
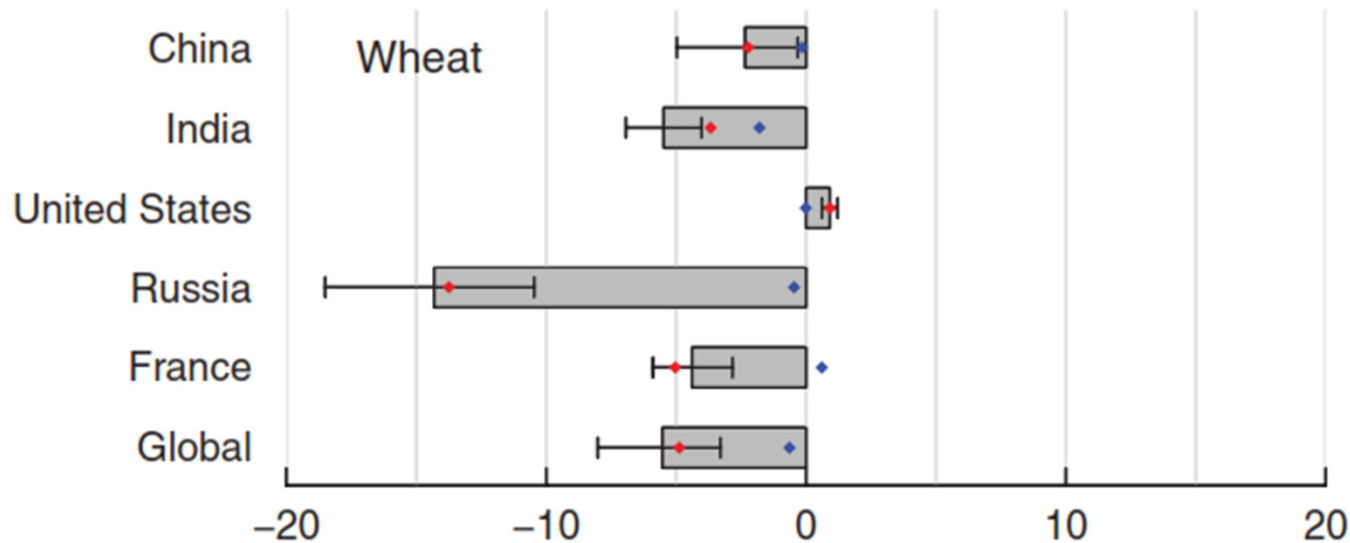
Red and blue dots show median estimate of impact for temperature and precipitation trends, respectively.
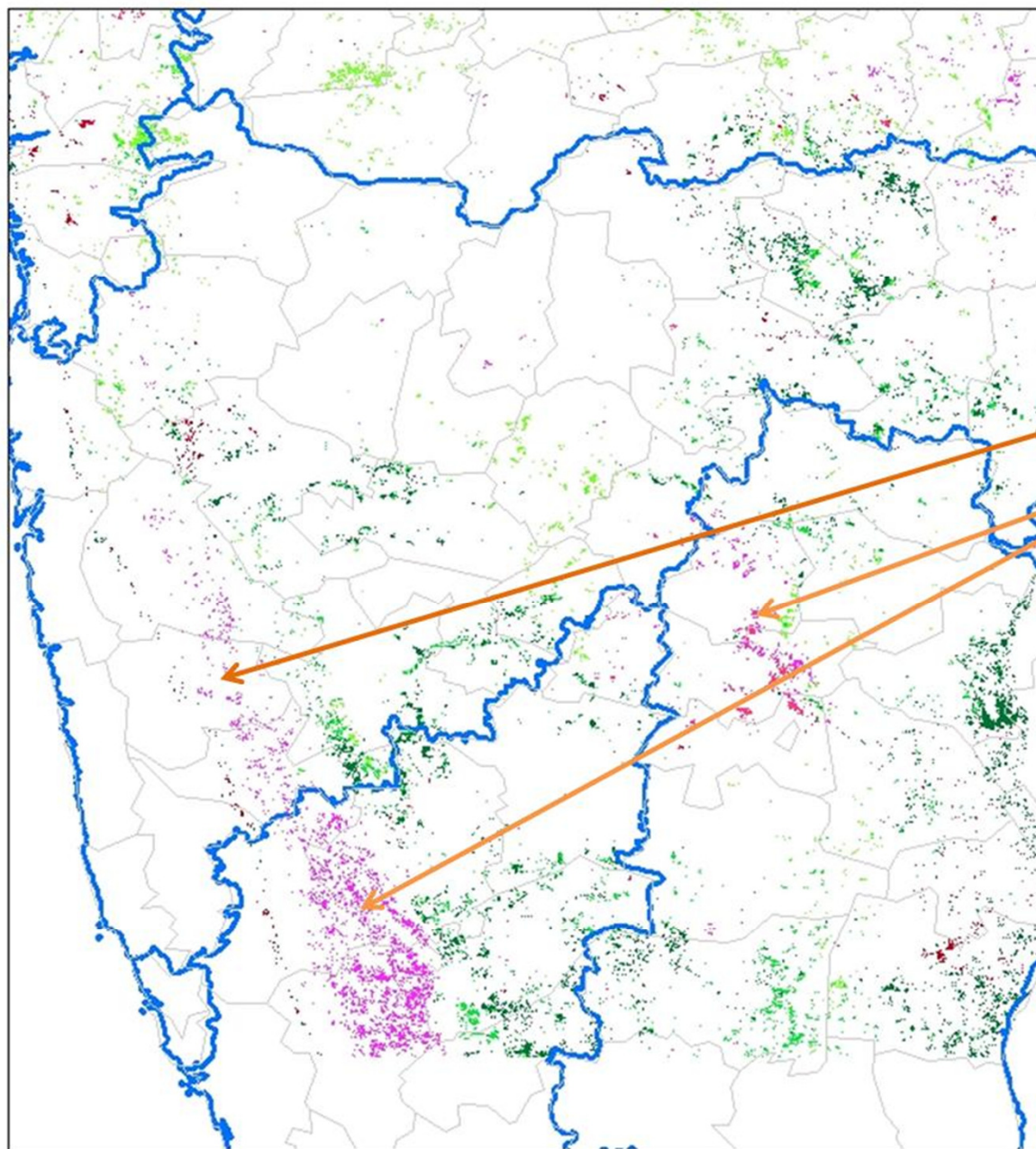
Grey bar show median estimate.
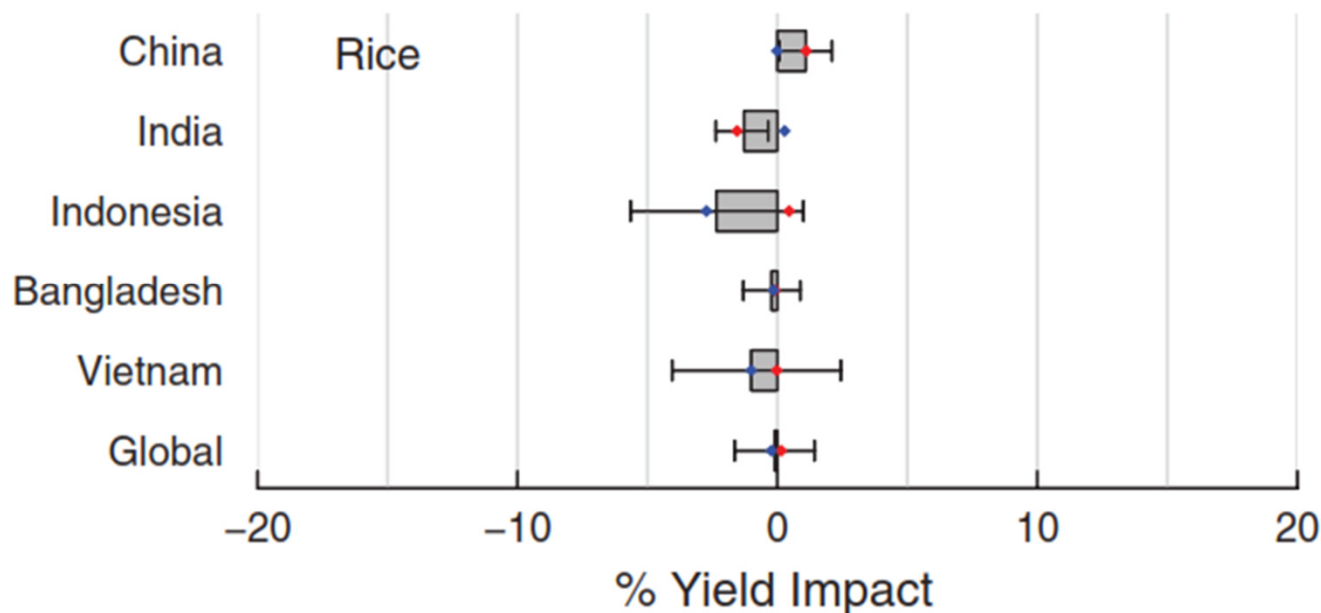
Note: These estimates do not refer to trends in actual yields, but only to the contribution of the climate component.

30

Green season length Trends

- GSL trends for the period 1999-2012

GSL trend (days/year)

	india_disrict
	india_state
	<-15
	-15 to -10
	-10 to -5
	-5 to 0
	0 - 5
	5-10
	>10