Asia Water Forum 2022
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Focus Area: **Productive water in agriculture and the economy**
Session Title: **Enhancing the economic value of water**

Schedule: [Date | Time]
9 August 2022 (Tue), 11:00 a.m. - 12:30 p.m. (GMT+08)

Paper title: Trade-offs in virtual water trade and exports advantages for rice cultivation in India

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Rationale

- **Exports raising sustainability concerns**
- **A few studies on Indian virtual water (VW) import and export**
- **Rice, most important from VW trade perspective**
- **Studies on a complete virtual water ecosystem lacking**

Interventions for sustainable rice cultivation based on:

1) Rice surplus
2) Groundwater extraction
3) Rice productivity
4) Productivity potential

Research Approach

Virtual water trade

VW export (VWE) or virtual water import (VWI) = Traded volume (year) × VW content of traded product (m3)

NWT = VWE – VWI

Revealed comparative advantage (RCA) in food commodities

$$RCA_{ij} = \frac{\left(\frac{X_{ij}}{\sum_{j=1}^{k} X_{ij}}\right)}{\left(\frac{X_{wj}}{\sum_{j=1}^{k} X_{wj}}\right)}$$

where,

RCA_{ij} = Revealed Comparative Advantage for i^{th} country in j^{th} commodity

X_{ij} = Value of export of j^{th} agricultural commodity from i^{th} country

$\sum_{j=1}^{k} X_{ij}$ = Value of agricultural export of i^{th} country

X_{wj} = Value of world export of j^{th} product

$\sum_{j=1}^{k} X_{wj}$ = Value of agricultural export for world

Research Approach

Rice Surplus Zones

i. Deficit zone (<10 % surplus)
ii. Surplus zone (10 to 50 % surplus)
iii. Major surplus zone (more than 50 % surplus)

Groundwater exploitation (GE)

i. Safe zone (GE less than 70 per cent)
ii. Semi-critical zone (GE between 70 to 90 percent)
iii. Critical zone (GE more than 90 per cent)

Productivity Growth

i. Negative productivity growth (less than 0 percent growth)
ii. Average productivity growth (0 to 1.20 percent growth)
iii. High productivity growth (more than 1.20 percent growth)

Productivity Potential

i. Low productivity potential zone (below 15 per cent)
ii. Moderate productivity potential zone (between 16 to 30 percent)
iii. High productivity potential zone (above 31 per cent)

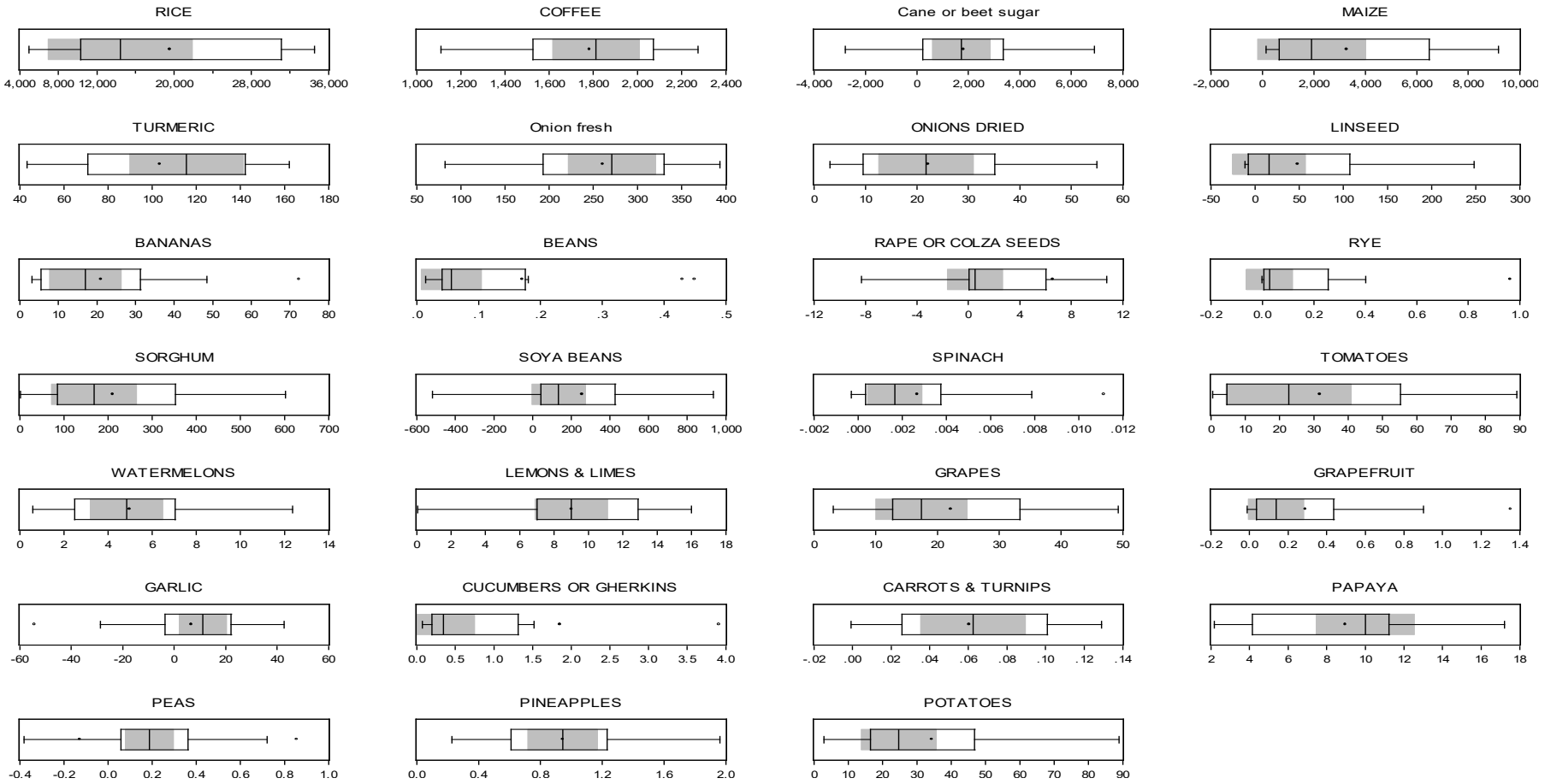
Trends in export and import of selected commodities

Products	Export quantity (Thousand tonnes)			Import quantity (Thousand tonnes)			Share in global exports (%, 2019)
	TE 2003	TE 2010	TE 2019	TE 2003	TE 2010	TE 2019	
Rice	3485.6	2731.2	11201.9	2.0	0.1	4.7	29.44
Maize	135.4	2910.9	655.9	1.6	11.3	141.9	0.40
Potatoes, fresh	36.5	113.1	364.5	0.8	0.0	0.3	1.55
Coffee	168.9	140.6	241.7	4.8	35.3	81.2	2.83
Grapes fresh	20.2	96.8	190.7	0.4	2.8	6.7	3.63
Bananas	9.1	43.8	127.9	0.0	0.0	-	0.54
Turmeric	32.5	74.3	120.4	1.3	4.2	25.1	63.93
Onions dried	11.3	21.1	67.7	0.0	0.1	0.2	32.10
Grain sorghum	2.0	58.1	60.1	-	-	-	2.55
Tomatoes	7.8	105.6	59.8	0.0	0.1	0.0	0.32
Water melons	7.2	8.7	29.1	0.1	0.0	0.0	0.47
Garlic fresh	1.0	9.0	16.9	29.9	0.2	0.7	0.22
Lemons	7.2	20.5	14.4	0.0	0.0	0.1	0.19
Linseed	0.1	1.7	10.7	1.0	0.4	0.6	1.32
Papayas	3.0	11.5	9.8	0.0	-	-	1.52
Pineapples	0.9	2.5	5.2	0.0	0.0	0.0	0.18
Cane sugar	1.4	2.3	3.2	0.0	1.3	1.8	8.41
Onions	0.5	1.5	1.6	0.1	0.2	0.7	8.80
Peas	1.8	1.4	0.6	21.3	0.1	0.0	0.10
Cucumbers/gherkins	23.9	1.8	0.5	0.0	0.0	0.0	0.02
Grapefruit	0.2	2.4	0.5	0.0	0.0	0.5	0.04
Rape or colza seeds	9.3	1.2	0.1	1.9	0.7	0.0	0.00
Rye	4.0	2.3	0.1	-	-	-	0.03
Beans	0.2	0.1	0.1	0.0	0.0	0.0	0.01

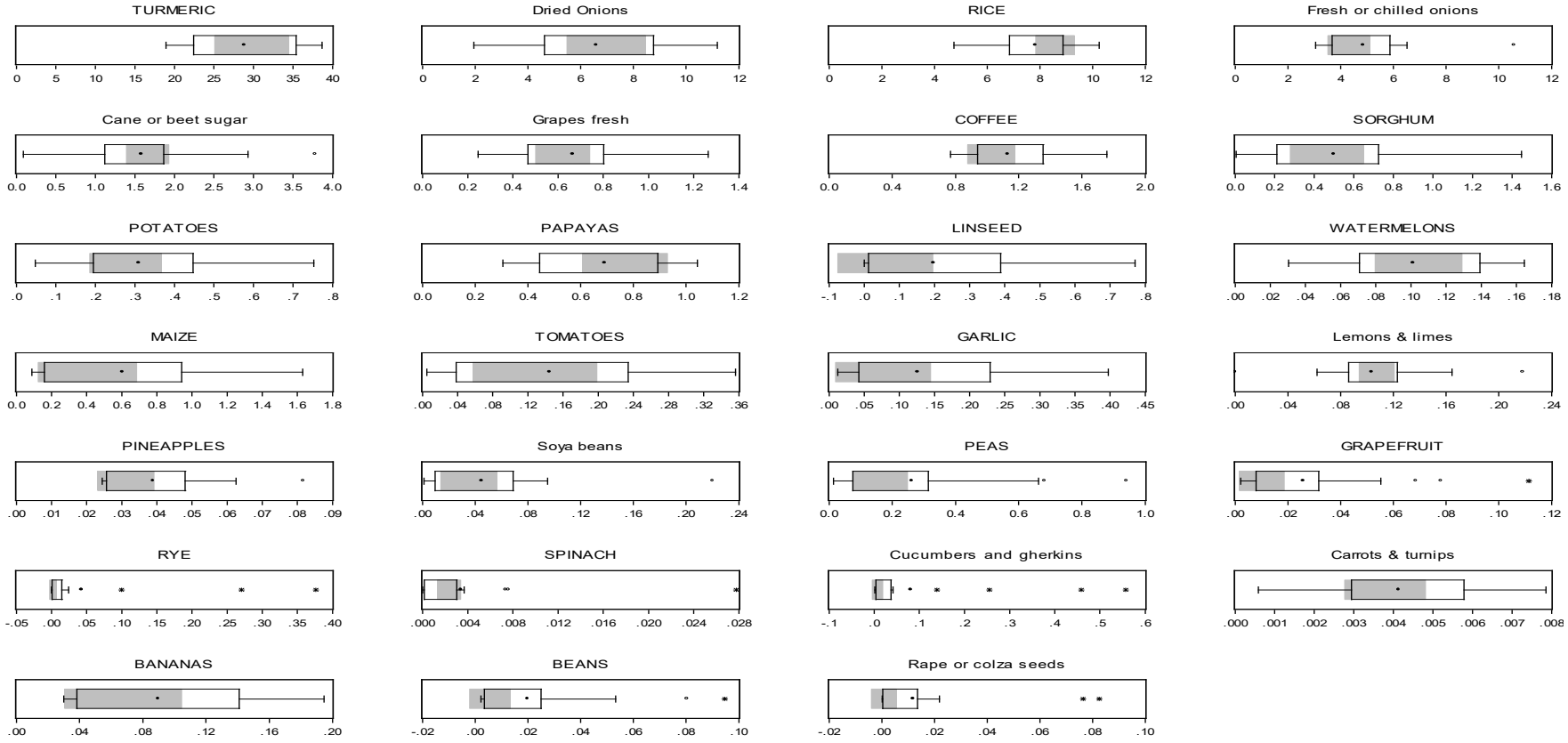
Virtual water trade in selected commodities

Products	Virtual Water Content (m^3/tonne)	Virtual Water Export (million m^3/year)			Virtual Water Import (million m^3/year)		
		TE 2003	TE 2010	TE 2019	TE 2003	TE 2010	TE 2019
Rice	3702	12903.7	10110.9	41469.4	7.3	0.3	17.5
Cane sugar	1391	1985.2	3182.9	4487.7	46.5	1829.1	2490.8
Coffee	12180	2057.7	1712.4	2943.5	57.9	429.5	989.3
Maize	1937	262.3	5638.5	1270.6	3.2	21.9	274.9
Onions fresh	214	117.4	328.2	340.3	0	0.4	6.4
Grain sorghum	4053	8.2	235.3	243.7	0	0	0
Turmeric	1556	50.6	115.5	187.4	2.1	6.5	39.1
Linseed	11080	0.8	19.2	118.4	11.5	4.6	6.7
Potatoes, fresh	213	7.8	24.1	77.6	0.2	0	0.1
Bananas	415	3.8	18.2	53.1	0	0	0
Grapes fresh	238	4.8	23	45.4	0.1	0.7	1.6
Onions dried	538	6.1	11.3	36.4	0	0.1	0.1
Garlic fresh	1268	1.3	11.5	21.4	37.9	0.3	1
Tomatoes	302	2.4	31.9	18	0	0	0
Water melons	362	2.6	3.2	10.6	0	0	0
papayas fresh	922	2.8	10.6	9.1	0	0	0
Lemons	611	1.5	12.5	8.8	0	0	0
Pineapples	305	0.3	0.8	1.6	0	0	0
Grapefruit	411	0.1	1	0.2	0	0	0.2
Cucumbers or gherkins	357	8.5	0.6	0.2	0	0	0
Rape or colza seeds	2618	24.5	3	0.1	5	1.8	0
Rye	901	3.6	2.1	0.1	0	0	0
Peas, fresh	178	0.3	0.3	0.1	3.8	0	0
Beans, fresh	487	0.1	0.1	0	0	0	0

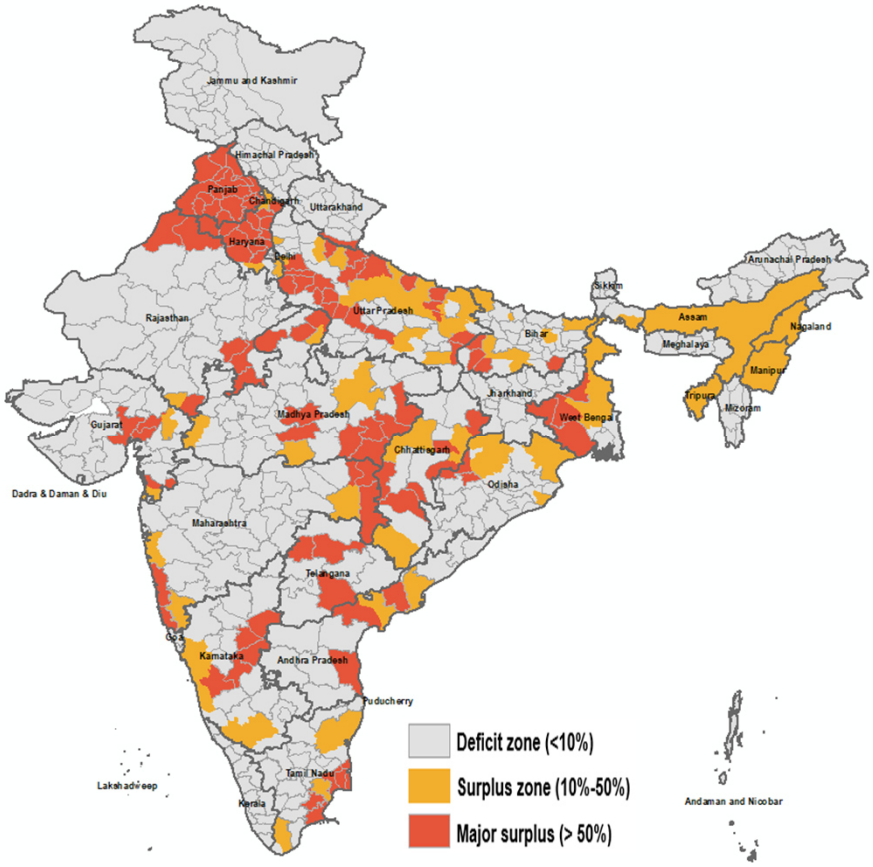
Net virtual water trade in selected commodities



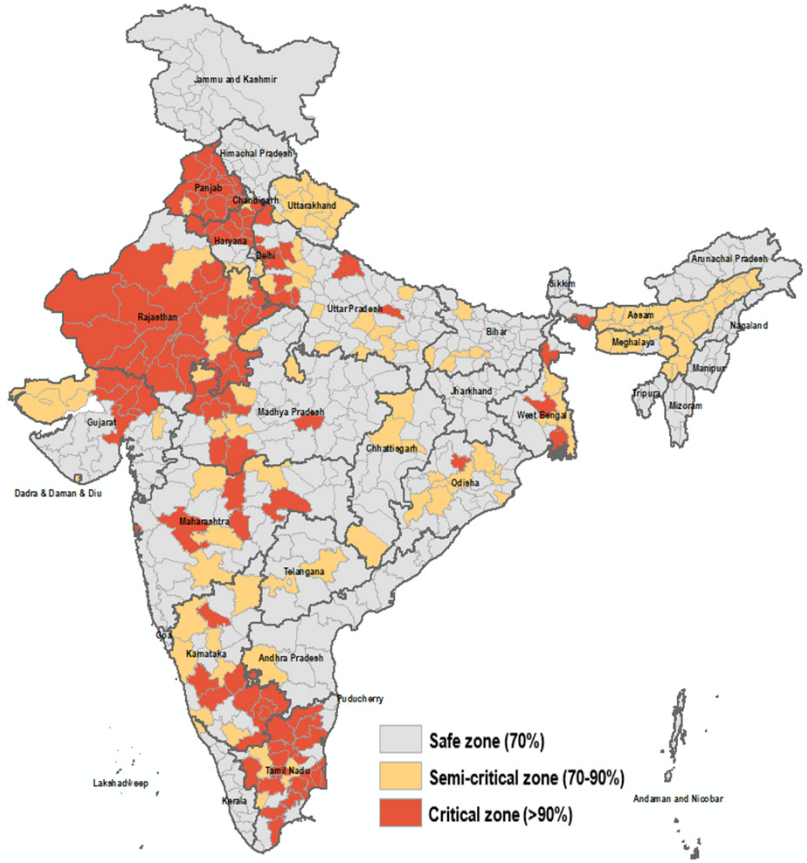
Revealed comparative advantage in selected commodities



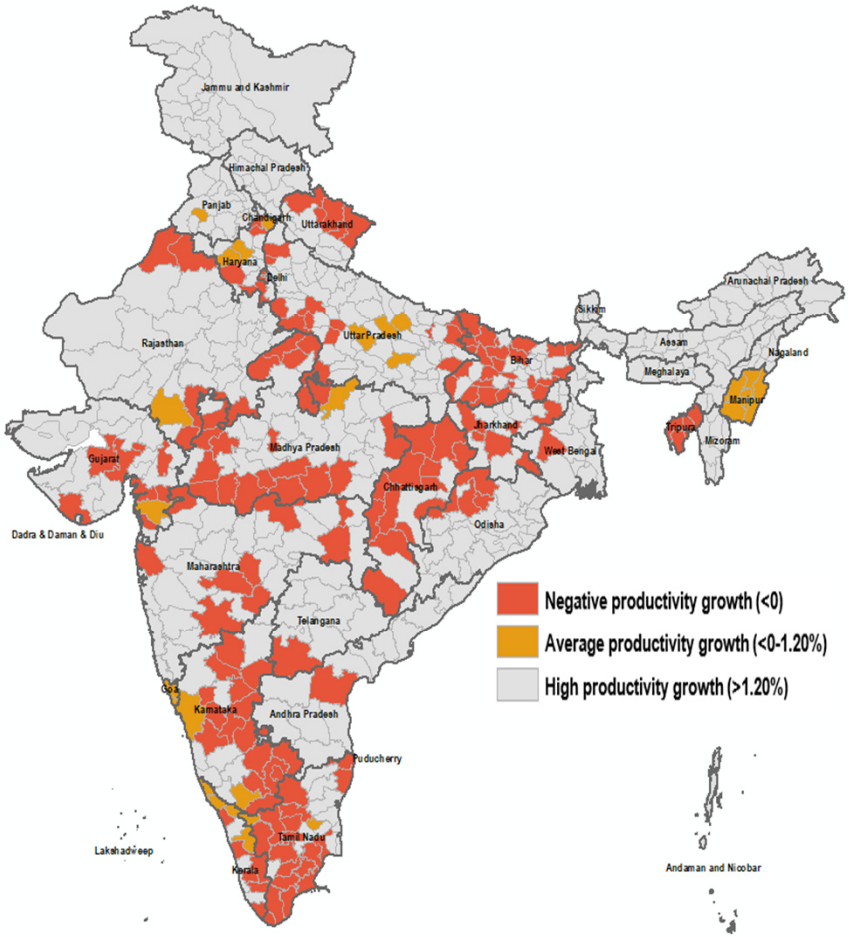
Rice Surplus Regions



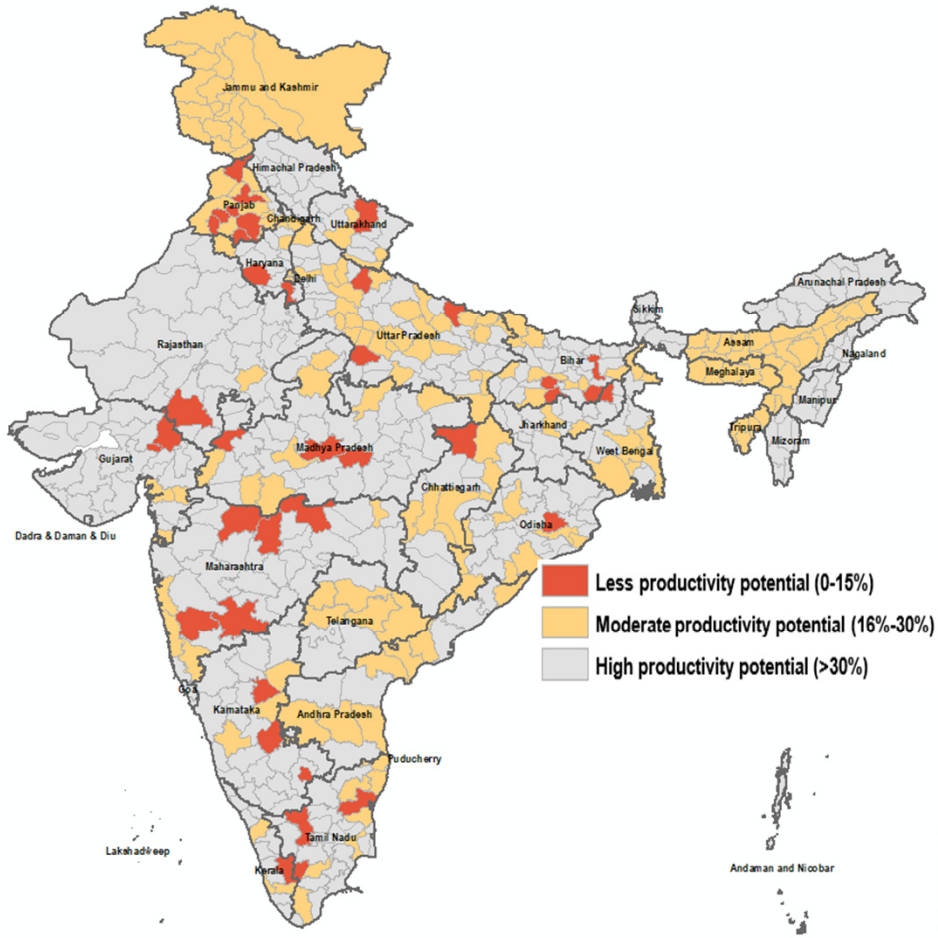
Status of Groundwater Extraction



Status of Crop Growth rate



Status of Productivity Potential



Identified technological solutions for sustainable rice cultivation

Improved cultivars	• Quality seed, enhancing seed replacement rate & varietal replacement rate, and high-yielding varieties • Addressing yield gaps as the inter-district variation, improved dissemination • Stress tolerant rice varieties, • Nutrient rich and aromatic rice (Basmati)
Cropping systems and resource use efficiency	• Increasing cropping intensity in rice-fallows • Input use efficiency, plant protection • Improved nutrient management and site-specific crop management • Promoting farm mechanization and solar energy
Irrigation systems	• Enhancing water use efficiency--promoting water harvesting and micro-irrigation
Management options	• Advanced technologies such as e-surveillance, drones etc., for precision rice farming • Crop insurance for risk management • Weather services and forecasting system • Market intelligence and improved logistics

- **Shifting non-basmati rice production to potential eastern and central states**
- **DSR, AWD technique, SRI may be upscaled**

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THANK YOU!!

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