

# G20 to G21

## One Earth, One Family, One Future

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## FROM THE DIRECTOR'S DESK



**Deepak Mishra**

In the face of global crises such as the COVID-19 pandemic, climate change, and geopolitical conflicts, progress toward the 2030 Agenda and its Sustainable Development Goals (SDGs) has been at risk. The recent surge in food prices has led major exporting nations to adopt protectionist trade policies, impacting global food security. At the same time, the world is grappling with widespread undernourishment with approximately 725 million undernourished people as well as 148 million stunted children under five, as of 2022.

In response to these pressing issues, the current issue of ICRIER's Agriculture Policy, Sustainability, and Innovation (APSI) quarterly publication, Agri-Food Trends and Analytics Bulletin (AF-TAB) focuses on "**G20 to G21: One Earth, One Family, One Future.**" This publication explores how India's G20 presidency can offer valuable lessons to the Global South in addressing global challenges related to sustainable agricultural development, escalating commodity prices, and food and nutritional insecurity in the face of climate change.

India's G20 presidency will be remembered for promoting inclusive development by bringing the voices of the Global South to the forefront. India's hallmark move of including African Union in the G20 acknowledges the significance and potential of Africa as a vital partner in global development and stability. Moreover, the consensus reached in the G20 New Delhi Leaders' Declaration aims to steer the world out of its current challenges and accelerate progress on the SDGs by 2030.

Notably, the momentum established during India's G20 presidency should be sustained as Brazil assumes the next presidency. This requires a strong political commitment to invest in building a safer, stronger, more resilient, inclusive, and healthier future for our people and the planet. I am delighted that ICRIER had the opportunity to contribute to the success of New Delhi G20 Summit through its role as the knowledge partner to the Ministry of Finance, Ministry of Commerce and Industry, Department of Telecom, and the Bureau of Energy Efficiency, along with its role as the Secretariat of the Independent Expert Group constituted under India's G20 Presidency.

**Deepak Mishra**  
Director & Chief Executive  
ICRIER

## FROM THE CHIEF EDITOR'S DESK



**Ashok Gulati**

India's journey within the G20 has been marked by remarkable success, positioning the nation as a prominent leader on the global stage. As the host of the G20 summit and at the helm of the G20 presidency, India has exhibited its commitment to inclusive leadership by advocating for the inclusion of the African Union, thereby becoming a strong voice for the Global South. In addition to its diplomatic achievements, India has been confronted with pressing issues like climate change, food security, nutrition security and food inflation. In light of these challenges, the current issue of AF-TAB titled “**G20 to G21: One Earth, One Family, One Future**” explores India's role on the global platform as a voice of the Global South and its efforts to attain sustainable agriculture addressing these major issues, and highlighting the complexities and nuances of these critical issues.

The first article of this issue titled “*G21 Agriculture Pathway*” discusses India's successful G20 presidency, focusing on global challenges such as rising greenhouse gas emissions, climate change, and food security. It also highlights India's investments in agricultural research and development, both public and private, suggesting the importance of increased funding to reduce emissions while ensuring food security.

The second piece, “*Is India Ready to Lead Carbon Farming Market?*” highlights the G20's commitment to reducing greenhouse gas emissions and the substantial funding required for climate action. India's large agricultural sector is identified as a prime opportunity for emission reduction and carbon credit generation. The article suggests incentivizing farmers to diversify crops, focusing on carbon credits, and creating markets for alternative crops. India's vast agricultural resources present a significant opportunity for leading the global carbon market and contributing to emissions reduction efforts.

The third piece “*G21: Pathway to Nutrition Security in India and Africa*” embarks on India's role in addressing nutrition security, especially in collaboration with Africa through the newly formed G21. It highlights the shared challenges of rapid population growth, poverty, and undernourishment in India and Africa, emphasizing their significant global burden in terms of undernourished populations and malnourished children. Based on India's experience, the article suggests lessons for both regions such as: investing in women's higher education, enhancing WASH initiatives, shifting food

safety nets toward more nutritious diets, scaling up bio-fortification in staple crops, and promoting south-south collaboration to eradicate malnutrition by 2030.

The fourth piece “*A Balancing Act in Pricing for Consumers and Producers*” addresses the government's actions to curb inflation through export restrictions and stocking limits. Such a policy to tame food prices has an in-built pro-consumer bias but leads to adverse consequences for farmers. The article concludes by suggesting policy implications, including judicious trade policies, strengthening the processing sector, investing in innovative farming practices, and improving crop data collection to manage market fluctuations effectively. Overall, it addresses the intricate balance required to address food inflation while ensuring fair prices for farmers and protecting consumers as well.

The lessons drawn from Indian experience have the potential to encourage knowledge-sharing among other developing nations in the Global South, promoting the development of a sustainable and climate-resilient agriculture and food system while advocating for rational and liberal trade policies.

**Ashok Gulati**

Distinguished Professor

ICRIER

## G21 AGRICULTURE PATHWAYS



*Ashok Gulati and Purvi Thangaraj*

The New Delhi G20 Summit was a successful event, showcasing India's presidency for its inclusiveness and comprehensiveness. After over 200 meetings held in more than 60 cities across the country, the consensus on the G20 New Delhi Leaders' Declaration is a significant step in advancing India's role in the G20. In the post-Covid era, G20 collaboration is vital in shaping the world's path towards global economic growth and stability.

In light of this, the G20 leaders commit to taking concrete actions through partnerships for accelerating sustainable and inclusive growth, fully implementing the 2030 Agenda. It includes promoting low-carbon development, improving health preparedness in developing countries, addressing debt vulnerability, increased financing for SDGs, and remaining committed to the Paris Agreement. They also aim to reform Multilateral Development Banks, facilitate digital access, promote quality employment, address gender disparities, and amplify the voices of developing countries in global decision-making. These efforts seek to establish a more people-centric system that promotes global prosperity and well-being (G20 New Delhi Leaders' Declaration, 2023).

India's Presidency has made significant strides; however, its biggest achievement has been

advocating for the Global South by making the African Union a permanent member and establishing a new G21. This new group will now represent 84 percent of the world's population, up from the previous 66 percent. With India and Africa accounting for 36 percent of the global population (Gulati and Jose, 2023), they will truly represent the voice of the Global South.

The high rates of population growth in India and Africa have raised concerns about food and nutrition security, which are further aggravated by the effects of climate change. Anthropogenic greenhouse gas (GHG) emissions have led to a 1.1°C rise in temperature since the pre-industrial era (IPCC, 2023a). The largest contributors accounting for 76 percent of GHG emissions are the electricity, heat, transport, and industrial sectors, while the rest of the emissions, 24 percent come from agriculture, food, and other land use (AFOLU) sectors (IPCC, 2023b). Among the G21, Sub-Saharan Africa region, comprising 48 countries, has the highest agriculture emissions of 993 MtCO<sub>2</sub>e followed by India with 742 MtCO<sub>2</sub>e in 2020 (Climate Watch, 2023). Transformative changes are needed in the agri-food sector to improve climate resilience, reduce emissions and protect natural resources while ensuring food and nutritional security.

The Delhi Declaration also stands dedicated to improving global food and nutrition security, endorsing the DECCAN High-Level Principles on Food Security and Nutrition, 2023, and an international research program on millets and other traditional grains (MAHARISHI) - two important initiatives of the G20 Agriculture Deputies Group. The declaration outlined the initiative to achieve the following targets (i) encouraging research cooperation to enhance climate-resilient and nutritious grains, including millets, quinoa, sorghum, and traditional crops like rice, wheat, and maize; (ii) emphasising the importance of increasing access to fertilizers while promoting their efficient use and boosting local production to enhance soil health; (iii) committing to driving innovation and investment to enhance agricultural productivity, minimize food loss, improve storage and marketing, and build sustainable, climate-resilient food systems. The focus is on supporting developing nations in addressing food security challenges, ensuring access to affordable, healthy diets, and realizing the right to adequate food. Finally, they also pledge to facilitate open and fair agriculture and food trade, adhering to WTO rules and avoiding export restrictions, while strengthening information systems for greater transparency and food price stability.

## **R&D Landscape in India**

As repeatedly highlighted in the Agriculture Working Group (AWG) proceedings the way to achieve food and nutrition security is via higher investment in agri-R&D. India's total Gross

Expenditure on Research and Development (GERD) in all sectors (agri plus non-agri) has increased, from INR 1.39 billion (USD 0.18 billion) in 1970-1971 to INR 1274 billion (USD 17.19 billion) in 2020-21 (DST, 2023). Over the years, the proportion of R&D expenditure through Public<sup>1</sup> investments have decreased from 90 percent, accounting for only INR 1.25 billion (USD 0.16 billion) to 64 percent, accounting for INR 810 billion (USD 10.93 billion) between 1970-1971 and 2020-21. Meanwhile, Private<sup>2</sup> R&D investments have increased from 10 percent with only INR 0.14 billion (USD 0.019 billion) to 36 percent, equivalent to INR 464 billion (USD 6.26 billion) over the same period. While the absolute numbers provide a sense of scale, their percentage to the GDP provides the Research Intensity (RI). RI peaked at 0.81 percent in 2005-06 however, dropped to 0.64 percent in 2020-21 (DST, 2023). The average RI from 2014-15 to 2020-21 is 0.67 percent.

However, within agriculture, public spending on Agricultural Research and Development Expenditure (ARDE) has been consistently dominant, accounting for an average of 89 percent of the total ARDE budget between 2005-06 and 2020-21. The total ARDE budget has significantly grown over the years in absolute terms, from INR 45 billion (USD 1.03 billion) in 2005-06 to INR 160 billion (USD 2.16 billion) in 2020-21 (DST, 2023). However, RI is a crucial indicator of the commitment to research relative to the size of the agricultural sector. The ARDE RI

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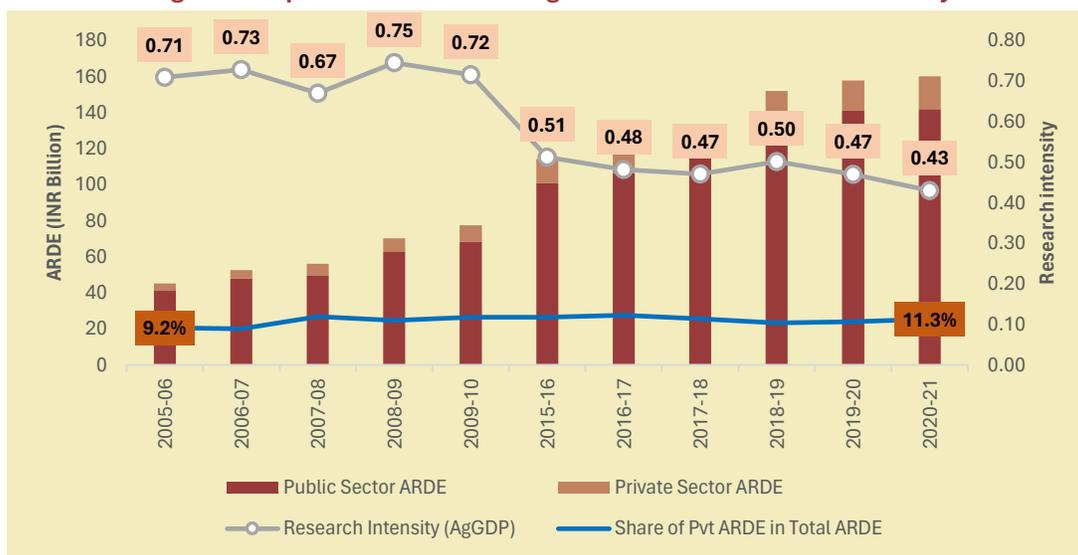
<sup>1</sup> Public Sector includes Central Government Ministries/Department + Public Sector/Joint sector industries + State Government + Higher Education.

<sup>2</sup> Private sector R&D reporting by DST is survey-based, which includes Private sector and Scientific & Industrial Research Organisations (SIRO).

peaked in 2008-09 at 0.75 percent, and currently stands at 0.43 in 2020-21 (Figure 1). The RI has fallen from an average of 0.71 percent during 2005-10 to 0.48 percent between 2015-21. While this trend should have been rising, keeping in line with Government of India as well as UN-FAO recommendations of having a RI of at least 1 percent of overall agriculture gross value

added, in recent years, India has not only been able to achieve this instead has fallen behind. This suggests the need for stepping up and increasing funding to match the potential growth of the agricultural sector while ensuring food and nutritional security in the face of climate change.

**Figure 1: Expenditure on R&D in Agriculture & its Research Intensity**



Source: DST, RBI.

Note: 1. Public Sector includes Central and State Governments, Public Sector and includes Higher Education only for 2005-2010 (as reported by DST).

2. Private Sector includes Scientific & Industrial Research Organisations (SIRO)

Private sector contribution in ARDE has increased marginally during this period (2005-06 to 2020-21) from 9.2 percent to 11.3 percent of the total investment in agri-R&D and agri-innovations. However, despite the share of Private Sector GERD in all sectors increasing to 36 percent, the share of Private sector in ARDE is not very significant. This indicates a very slow uptick in private sector interest and investment in agricultural research and development, and

scope for more incentives to invite private sector investments.

Within the private sector, the agricultural industry encompasses various sectors<sup>3</sup>, such as biotechnology, agricultural machinery, fertilizers, food processing, sugar, and vegetable oil, which are all substantially influenced by the private sector. In TE 2021, an average amount of INR 5900 million (USD 83.13 million), was

<sup>3</sup> As reported and compiled in R&D Statistics, DST 2023.

invested by the private sector industry groups in ARDE. However, in terms of their own sales, the RI (ARDE investments by industry groups as a share of their sales) accounted to be 1.17 percent of these industry groups for TE 2021 (DST, 2023).

## Way Forward

The question of whether India can realistically achieve the AWG goals with its current level of agricultural research is a pertinent one. It prompts us to consider the need for a comprehensive reassessment of agricultural policies that should prioritize both human welfare and environmental sustainability. At present, the policies in place, such as open-ended procurement, guaranteed Minimum Support Price (MSP), and high subsidies on fertilizers (INR 2.25 lakh crores, RE 2022-23 and INR 1.75 lakh crores, BE 2023-24), power, irrigation, food (INR 2.87 lakh crores, RE 2022-23 and INR 1.97 lakh crores, BE 2023-24) etc., not only take away much larger share of resources but also lead to significant damage to our natural resources, encompassing soil, water, air, and biodiversity (SWAB). This has happened despite enough research evidence that marginal returns on investment in ARDE are almost 5 to 10 times higher than most of these subsidies (fertilizer, power, canal irrigation, etc) (Gulati, Ferroni & Zhou, 2018).

Much like the G20 Sustainable Finance Roadmap outlined in the Delhi Declaration, which underscored the need for substantial financial commitments, approximately USD 5.8-5.9 trillion in the pre-2030 period for the specific needs of developing countries to implement

their NDCs, and an annual requirement of USD 4 trillion by 2030 for clean energy technologies to attain net-zero emissions by 2050, we should establish comparable financing targets on both global and local scales for agriculture R&D. While the private sector ARDE has been able to reach a RI of 1.17 percent in TE 2021, for few industry groups, public sector ARDE is performing poorly now, as compared to a decade ago.

Given that they make up the largest portion of subsidies, food and fertilizer should actually be rationalized by the government to fund ARDE, which has been shown to yield higher marginal returns. Agri-R&D should be the focus of PLI programs and CSR initiatives in order to attract more private investment. Offering business tax incentives is one way to extend invitations, and private enterprises should be open to audits to guarantee accountability and openness in this process.

To lead the pathway for robust and sustainable agriculture growth, there is an urgent need to re-align and rationalise these input subsidies while inviting higher investments from both the public and private sectors in agri-R&D.

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# IS INDIA READY TO LEAD CARBON FARMING MARKET?

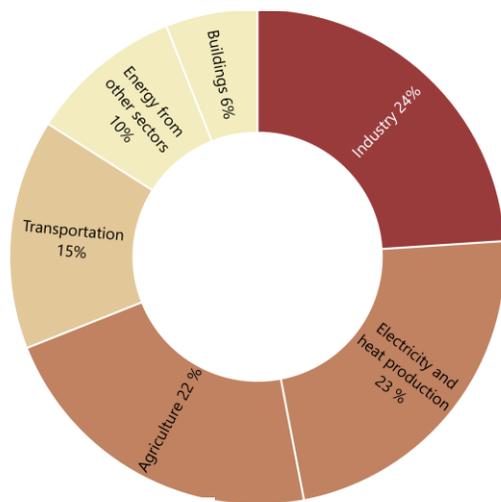


**Reena Singh and Ashok Gulati**

Climate change is a prime focus of the G20 Leader’s Declaration adopted in New Delhi on 10<sup>th</sup> September 2023. The “Green Development Pact for a Sustainable Future” section reaffirms G20’s commitment to hold the global average temperature well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. The G20 nations recognize the need for rapid and sustained reductions in global GHG emissions of 43 percent by 2030 relative to the 2019 levels. During the Summit, the G20 leaders also “encourages tripling of renewable energy capacity by 2030, and voluntary doubling the rate of energy efficiency improvement by 2030” (G20 New Delhi’s Declaration, 2023 p.14).

The declaration noted the “need of USD 5.8-5.9 trillion in the pre-2030 period required for developing countries, in particular for their needs to implement their NDCs, as well as the need of USD 4 trillion per year for clean energy technologies by 2030 to reach net zero emissions by 2050” (G20 New Delhi’s Declaration, 2023 p.16). One of the key ways to address the rising environmental crisis is through climate financing, a fund specifically meant to address the challenges of climate change through mitigation and climate action. At CoP15 (Copenhagen 2009), the developed countries had collectively committed to mobilising \$100 billion per year by 2020, and at COP 21 (Paris 2015), it was re-emphasized and extended to 2025. The International Monetary Fund (IMF) has so far secured \$40 billion through the Resilience and Sustainability Trust to support vulnerable countries (IMF 2023). Thus, there is a huge gap between the requirement and the availability of climate funds. In this climate change crisis, the new G21 with the inclusion of the African Union has a bigger role to be on the solution side. India cannot commit to climate financing but can pave the way for carbon markets. Being an agricultural country, India has the advantage and expertise to lead carbon farming.

**Figure 1: Global GHGs (percent) by economic sectors**



Source: IPCC 2023

While Energy Transition is the focus on achieving net-zero targets, it must be noted that agriculture emissions (if left, unchecked) can also pose significant challenges in achieving the targets. Agricultural production is strongly affected by and a major contributor to climate change. Globally, it contributes to approximately 22 percent (13 Gt CO<sub>2</sub> eq) of the total anthropogenic GHG Emissions (IPCC 2023).

## Potential of India-to turn climate crisis into opportunities

India has the world's largest crop-land area and, also produces the highest agriculture emissions (Table 1), thus has significant room for reduction of global emissions and generating carbon credits.

**Table 1: Cropland Area and Green-house emissions (GHGs) from agriculture sector of the G20 countries, 2019-20**

G20 Countries	Cropland area (Mha)	Global share (%)	Agriculture Emission, Mt CO <sub>2</sub> eq)	Global share (%)
<b>Argentina</b>	33.7	2.16	134.6	2.29
<b>Australia</b>	30.99	1.98	104.09	1.77
<b>Brazil</b>	63.52	4.07	518.86	8.85
<b>Canada</b>	38.4	2.46	63.28	1.08
<b>China</b>	134.88	8.64	653.97	11.15
<b>France</b>	18.97	1.21	71.34	1.22
<b>Germany</b>	11.86	0.76	58	0.99
<b>India</b>	168.66	10.8	741.92	12.65
<b>Indonesia</b>	51.3	3.28	154.3	2.63
<b>Italy</b>	9.26	0.59	33.24	0.57
<b>Japan</b>	4.37	0.28	21.86	0.37
<b>Republic of Korea</b>	1.56	0.1	14.45	0.25
<b>Mexico</b>	22.87	1.46	99.25	1.69
<b>Russia</b>	123.44	7.9	104.13	1.78
<b>Saudi Arabia</b>	3.59	0.23	7.36	0.13
<b>South Africa</b>	12.41	0.79	28.59	0.49
<b>Turkey</b>	23.14	1.48	57.93	0.99
<b>United Kingdom</b>	6.02	0.38	50.03	0.85
<b>United States</b>	160.44	10.27	382.01	6.51
<b>European Union</b>	157.4	10.08	391.94	6.68
<b>African Union</b>	293.05	18.77	1,062.42	18.11
<b>Others</b>	231.93	14.85	1,274.48	21.73
<b>World</b>	1,561.67	100	5,865.47	100

Source: FAO, Rome, and Climate Watch (data accessed on 20<sup>th</sup> September, 2023)

Note: Cropland includes Arable land and permanent crops

GHG emissions from Indian agriculture dominantly comprise of crop and livestock production. Using IPCC Tier 2 methodology<sup>4</sup>, we have estimated Indian agriculture non-CO<sub>2</sub> GHG emissions to be ~500 Mt CO<sub>2</sub> eq (excluding Land-Use, Land Use Change and Forestry) in 2021-22 (Singh & Gulati, Forthcoming Publication). Our estimates show that 54 percent of India’s agriculture GHG emissions correspond to enteric fermentation, followed by 21 percent from rice cultivation, 17 percent from agricultural soils, 6 percent from manure management and 2 percent corresponding to field burning of agricultural residues.

### Mitigation opportunities available for India

As the country has the world's largest bovine population (303 million), it also produces the

world's largest amount of methane emissions (such as burping) from enteric fermentation (263 MtCO<sub>2</sub> eq), (Singh & Gulati 2023). This offers a significant scope for reduction in this area. Furthermore, with the largest rice cultivation area in the world (45 Mha), India’s rice paddy fields (besides China) generate the largest sources of emissions (produced 144 MtCO<sub>2</sub>eq in 2021-22, which includes methane emissions from flooding, nitrous oxide emissions from fertilizers, carbon-dioxide emissions from energy sources used in rice cultivation and non-CO<sub>2</sub> emissions from burning of rice residues), suggesting there is scope for reduction efforts. With the largest crop-land area in the world, the country offers immense scope to lead the carbon markets in the agriculture sector. A few of the technological mitigation opportunities for the agriculture sector in India are presented in Table 2.

**Table 2: GHG mitigation options for crop and livestock sector in India**

GHG Abatement Option	Mitigation Potential (Kg CO <sub>2</sub> e/ha/year for crops and Kg CO <sub>2</sub> /head/year for livestock)
<b>Crops</b>	
Improved Water Management in Rice	2,760
Adoption of zero tillage	518 to 1,796
Stop residue burning	-3 to 522
Fertilizer production	57 to 529
Fertilizer consumption	48 to 198
Laser Land levelling	1,284 to 3,055
Increase NUE through fertigation	170 to 4,999
Sprinkler/micro-sprinkler	163 to 1,276
<b>Livestock</b>	
Green fodder supplement for large ruminants	32 to 39

<sup>4</sup> Emission Factor used for methane was 27.2 and 273 for nitrous oxide (as per IPPC AR6 Report 2022) and for residue burning estimates, MoEFCC 2021 data was taken

GHG Abatement Option	Mitigation Potential (Kg CO <sub>2</sub> e/ha/year for crops and Kg CO <sub>2</sub> /head/year for livestock)
Increased concentrate feeding for large ruminants	117 to 140
Monensin pre-mix for large ruminants	32 to 39
Molasses Urea Product (MUP) for large ruminants	117 to 140
High fibre diet for pigs	122
Improved diet management for small ruminants	21
Improved manure management for large ruminants	31
Biogas from large ruminants' manure	500

Source: Sapkota et al. 2019

### Challenges for adoption of GHG mitigation

Presently, agriculture receives substantial government budgetary support from central as well as state governments in the form of various schemes for fertilizer, irrigation, power, equipment, and credit, which was in the range of Rs. 300,000 crores in 2021-22. This support is provided with an overall objective of achieving food security for the country. But sometimes agricultural policies incentivise inputs and production practices that might be harmful to

agriculture sustainability and climate. Notably, our study found that Punjab emitted the highest GHG (5 t CO<sub>2</sub> eq/ha) from rice cultivation on a per hectare basis in 2021-22. We further estimated the total agriculture subsidies that Punjab received for rice cultivation. Fertilizer subsidy was provided by the centre and power & irrigation subsidy was provided by the state government and together they accounted for Rs. 30,804 per hectare, which is 56 percent of the total agriculture subsidy for Punjab farmers (Table 3).

**Table 3: Agri subsidies provided to Punjab (Central & State Govts) and for rice cultivation in Punjab**

	Punjab	Rice Cultivation in Punjab
Total Grossed Crop Area (Million Hectares)	7.8	3.1
Electricity Consumption for agriculture (GWh)	12,533	8,409
Power Subsidy for Farmers (Rs. Crores)	6,745	4,526
Power Subsidy for Farmers (Rs. per hectare)	8,628	14,599
Irrigation Subsidy (Rs. Crores)	791	679
Irrigation Subsidy (Rs. per hectare)	1,012	2,190
NPK Consumption (Million Tonnes)	1.99	0.84
Fertilizer Subsidy (Rs. Crores)	10,292	4,345
Fertilizer Subsidy (Rs. per hectare)	13,165	14,015
Total Subsidy (Rs. Crores)	17,828	9,549
Total Subsidy (Rs. per hectare)	22,804	30,804

Source: Union Budget, Punjab State Budget, Punjab State Electricity Corp. Ltd, Fertilizer Statistics 2021-22, Punjab Statistics 2021-22, DES 2021-22

Since rice is the major Kharif crop in Punjab, which takes 20-25 irrigations as compared to 4-5 irrigation in other crops, approximately 67 percent of the power subsidy is getting diverted to rice cultivation. Free electricity and the assured paddy procurement are discouraging farmers in Punjab not to diversifying from rice cultivation, which is a major GHG-intensive crop. If we compare the net profit (over A2 cost) of paddy and maize – which is Rs. 89,454 per ha from paddy and Rs 22,789 per ha from maize in the same year (2021-22), this explains why crop diversification targets are not achieved despite all policy measures. If farmers are given incentives in the form of carbon credits, then they can switch to carbon farming to reduce or sequester emissions.

### **Way Forward-Carbon Trading Scheme in Agriculture**

Carbon is a tradable good in a carbon credit system where one carbon credit unit is equivalent to one tonne of carbon dioxide emissions. Carbon credits in sustainable agriculture are attracting worldwide attention as a climate change mitigation strategy. This system provides financial incentives to farmers by allowing them to sell the carbon credits generated through the reduction of GHG emissions in their farmlands and is developed mainly in Europe and the US. The private sector is also developing credit certification systems for carbon farming. There are signs indicating that the market for carbon farming credits will spread into India as well. This is evidenced by a couple of private industries (Grow Indigo Private Ltd, Boomitra Inc, Varaha ClimateAg Private Ltd etc) taking up pilot projects on carbon farming.

The carbon credit mechanism needs to be worked out by the policy makers for the agriculture sector so that the farmers can earn 3-5 credits or more per hectare. Similarly, by reducing emissions from the livestock sector, ranchers can also earn credits per livestock head. Carbon credit has the support of the Central government as well as a few state governments. Gujarat, in May 2022, announced the creation of the country's first carbon credit trading market, and in July 2022, the central government adopted a bill to amend the Energy Conservation Act of 2001 to establish a nationwide voluntary carbon credit trading scheme, aiming to create the market within 2023. National Steering Committee for the Indian carbon market and other authorities shall develop the detailed procedure for operationalising the Indian carbon market, in accordance with this Scheme.

Protocols are required to be developed for measurement, reporting, and verification systems for GHG emission and mitigation. Mitigation practices are required to be coupled with remote sensing, GIS, and web-enabled tools so that accurate accounting of emissions and mitigation can be done, reported, and verified. Such verification tools are also required if carbon pricing for mitigation practices is to be arrived at for developing carbon markets in India. Companies such as fertilizer producers, mining, oil companies etc. who have higher carbon footprints should have mandatory emission reduction targets, which they can offset by purchasing carbon credits from farmers. National as well as international companies can pitch in to offset their emissions

from Indian croplands and livestock sector and can contribute to the global mission of achieving net zero.

If we have to encourage farmers to diversify, then triple measures need to be taken. First, total paddy subsidy (power subsidy and fertilizer subsidy) provided to farmers, needs to be diverted from rice to other crops, such as maize. Second, farmers to be incentivized through carbon credits. As we estimated, rice cultivation in Punjab generates 5t CO<sub>2</sub> eq per hectare, thus farmers are eligible to get 3-4 net credits if they shift from paddy to other crops. Alternatively, the farmers could also be given carbon credits for better water management by shifting to wetting and drying (AWD), direct-seeded rice (DSR) etc. Similarly, ranchers are eligible to get credits if they reduce emissions through ration balanced diet or other measures. Third, markets and incentives for alternate crops need to be worked out. For example, industries that are procuring maize for their bio-diesel plant can be given Performance-Linked Incentives (PLIs).

Adopting these practices in the vast farm sector with the involvement of millions of farmers is an uphill task and would require complete revamping of the agriculture sector while fulfilling the agenda of food security and farmers' livelihoods. Policymakers should help improve policy coherence and intensify interventions to reduce environmental health and GHG emissions while achieving other development goals. For example, (i) linking agri-input subsidies with GHG's mitigation targets, (ii) introducing "procurement of produce with low GHG foot-prints at premium minimum

support price (MSP)" at the state and national levels, and (iii) crop diversification for regions with high GHG per unit area and per kg of crop produced. Awareness generation and capacity building for best management practices and GHG mitigation in agriculture will also be required.

While these practices can be cost-beneficial for farmers or ranchers and have important additional benefits, uptake of new approaches can be slow and may require significant incentives, outreach and education coupled with a more robust regulatory requirement. Whether agriculture will ultimately achieve carbon neutrality will depend on whether policies with that goal are adopted—and that is a question of political will, not a scientific one.

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## G21: PATHWAY TO NUTRITION SECURITY IN INDIA AND AFRICA



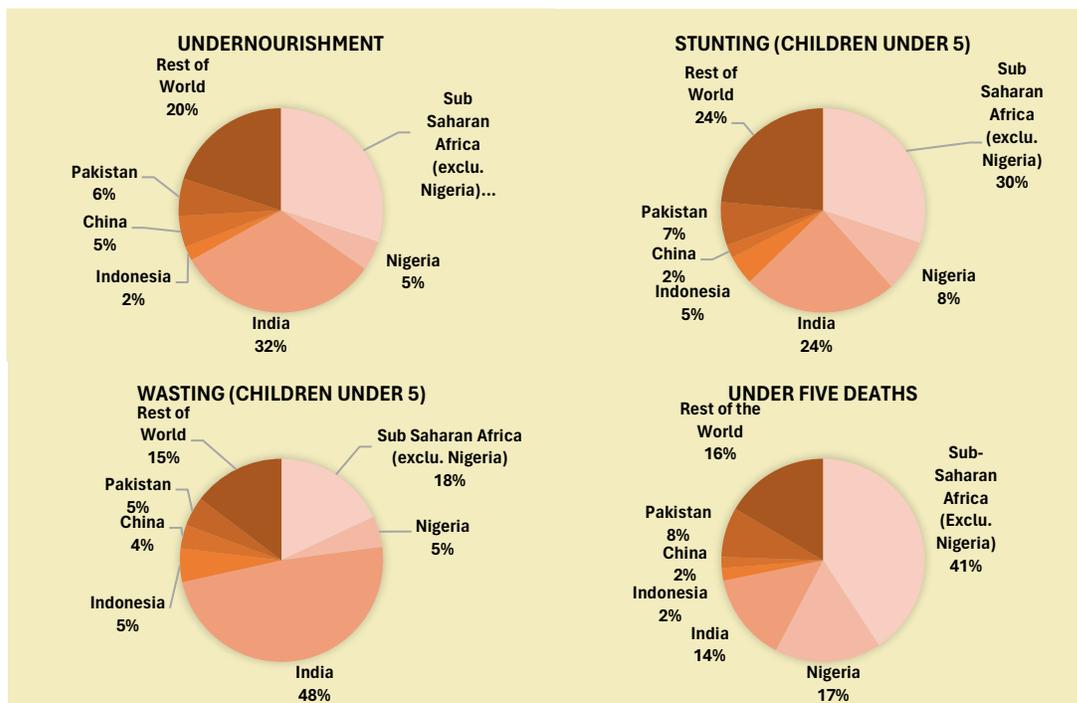
**Shyma Jose and Ashok Gulati**

India's G20 Presidency achieved a historic milestone by including the African Union as a permanent member in the G20. The newly formed G21 ensures that the voice of Global South is brought to the mainstream, aligning with the overarching motto of 'One Earth, One Family, One Future'.

India and Africa face shared challenges including high population growth, low per capita income, persistent poverty, and widespread undernourishment. According to the latest 'The

State of Food Security and Nutrition in the World' report for 2023 published by FAO, IFAD, UNICEF, WFP and WHO, India and Africa accounted for 69.4 percent (503 million out of 725.1 million) of the world's undernourished population in 2020-22. At the same time, these regions also had 67.0 percent of the world's stunted children and 75.8 percent of wasted children under five years of age in 2022 (Figure 1). Furthermore, India and Sub-Saharan Africa together represented 71.8 percent (3.6 million) of global under-five deaths in 2022 (UNICEF, 2022).

**Figure 1: India's position globally in nutrition and child mortality, 2022 (% share)**



Source: FAO, IFAD, UNICEF, WFP and WHO, 2023; UNICEF 2023  
 Note: China's undernourished population estimated using WPP 2022.

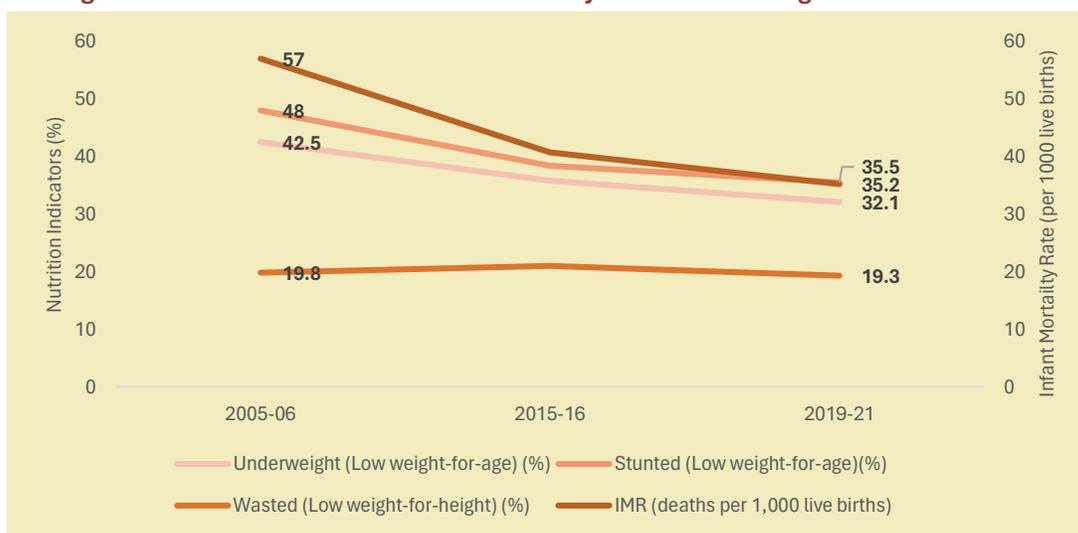
Evidently, both the regions have the largest number of undernourished population and malnourished children globally. In this regard, exploring Indian experience in tackling nutrition security and mortality rates can help in identifying focused interventions for the Global South.

### Trend of malnutrition and mortality rates among children in India

India's progress in improving nutrition security and mortality rates can help in identifying the factors that need focused interventions. India has made remarkable progress in reducing its infant mortality rate (IMR) from 57 to 35.2 deaths per 1000 live births during the period from 2005-06 to 2019-21 as per the latest National Family Health Survey (NFHS) (Figure 2). Yet, in spite of the progress made in reducing the child

mortality rate, malnutrition indicators have not improved as substantially. The nutrition indicators for children under 5 years of age over the last 15 years have been as follows: Stunting (low height-for-age) reduced significantly from 48.0 to 35.5 percent, wasting (low weight-for-height) reduced marginally from 19.8 to 19.3 percent and underweight (low weight-for-age) prevalence also reduced considerably from 42.5 to 32.1 percent during 2005-06 and 2019-21. Moreover, if the current trend continues business as usual, our estimated linear projection of malnutrition indicators for children under five years of age (underweight, stunting and wasting) are expected to lag far behind the SDG targets. With only 7 years remaining to the SDG Agenda, this alarming situation necessitates a comprehensive approach that integrates targeted multipronged short-term and long-term strategies.

**Figure 2: Trends in the nutrition and mortality indicators among children under five**



Source: NFHS- III, IV, V.

### Causes of malnutrition among children in India

Based on our extensive research using logistic regression analysis on the unit-level data of

NFHS (2019-21) (with a sample of 205,641 children under five) (also published in [ICRIER Policy Brief No.16](#)), we found mothers' education, particularly higher education, has the strongest association with undernutrition.

Women's education has a multiplier effect not only on household food security but also on the child's feeding practices and sanitation facility. Despite India's considerable improvement in female literacy, only 25.9 percent of women have higher education level (12 or more years) in 2019-21.

The second most important variable that had a significant impact on child malnutrition indicators is the mother's nutritional status measured by the BMI index. Low birth weight during pregnancy and lactating period results in low duration of breastfeeding causing undernutrition among children (Black et al., 2013). The first 1000 days between a woman's pregnancy and her child's second birthday affect a child's cognitive and physical development. The number of underweight women (as per the BMI index <18 kg/m<sup>2</sup>) has reduced significantly from 35.5 to 18.7 percent in the period between 2005-06 and 2019-21.

Another underlying factor that impacts malnutrition among children is household characteristics like the type of sanitation facility, and sources of drinking water which have a significant impact on nutritional outcomes and mortality rates (Jose et al. 2020). WASH initiatives i.e., safe drinking water, sanitation and hygiene can be critical for child nutrition outcomes and are key to the success of nutritional interventions. According to data from the National Family Health Survey (NFHS), there has been concurrent progress in the coverage of

improved sanitation facilities. The number of households with access to improved sanitation facility<sup>5</sup> increased from 48.5 percent in 2015-16 to 70 percent in 2019-21.

Similarly, child care practices especially the duration of breastfeeding affects both the malnutrition rates as well as mortality rates among infants. The WHO recommends exclusive breastfeeding for children in the first six months. In India, there has been considerable progress in exclusive breastfeeding among children under six months of age which increased from 46.4 percent in 2005-06 to 63.7 percent in 2019-21. At the same time, the introduction of complementary and nutritious food and a diverse diet after the first six months is just as essential to meet the nutritious needs of infants and ensure their growth and development. The lack of a diverse diet and frequent meals lead to undernutrition, especially stunting and deficiency of micronutrients which can also result in morbidity and mortality. In 2019-21, around 11.3 percent of children (aged 6-23 months) were reported to have been given an adequate diet.

Several studies find nutritional interventions such as access to prenatal and postnatal health care services play a pivotal role in the mother's health and the well-being of the child. The risk of infant mortality decreases when mothers, regardless of their age, have received proper prenatal check-ups. Antenatal care (ANC) and

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<sup>5</sup> Improved sanitation facility include: Flush to piped sewer system, flush to septic tank, flush to pit latrine, flush to don't know where, ventilated improved pit (VIP)/biogas latrine, pit latrine with slab, twin

pit/composting toilet, which is not shared with any other household (NFHS-5)

delivery with skilled assistance at a health facility are major determinants of malnutrition (Jose et al. 2020) as well as infant and child mortality rates. As per the NFHS data, the number of institutional deliveries shot up, from 38.7 percent in 2005-06 to 88.6 percent in 2019-21. Similarly, the coverage of nutritional interventions especially among women who have at least four ANC during their pregnancy as recommended by WHO, has improved from 37 to 58.1 percent between 2005-06 and 2019-21. Still, even after the improvement in antenatal coverage during the last decade, strong focused support is needed to utilize antenatal care and increase awareness about pregnancy complications from healthcare providers. In India, although 87.6 percent of women with a birth in the last five years were provided iron and folic acid (IFA) during their pregnancy, the number that actually reported taking the IFA tablets for at least 100 days was as low as 44.4 percent in 2019-21.

### **What lessons can we draw from the Indian experience to help the Global South, especially Africa, achieve nutrition security by 2030?**

Based on our extensive research on India, we put forth the key areas to address nutritional insecurity and eradicate malnutrition in India and Africa by 2030.

First, in India, our analysis highlights a strong connection between a mother's higher education and her nutritional status with the well-being of her children. Investing in women's higher education can significantly increase

female labour force participation and, in turn, foster long-term economic growth. State governments should promote women's higher education through targeted scholarship programs. For example, introducing a monthly scholarship of Rs. 500 from the 9th standard, gradually increasing it to Rs. 1000 until graduation, and further raising it to Rs. 2000 per month for post-graduation can effectively reduce dropout rates among female students in secondary and higher education.

Second, the implementation of WASH (Water, Sanitation, and Hygiene) initiatives has a substantial impact on nutrition outcomes. India has made remarkable progress with initiatives like Swachh Bharat Abhiyan and Jal Jeevan Mission, which aim to improve sanitation and provide access to clean drinking water. While there has been significant improvement, there is still work to be done, as access to sanitation and clean water remains a challenge for some households. The success of these initiatives depends on comprehensive awareness programs, empowering Anganwadi workers, and fostering community participation to drive meaningful behavioural change.

Third, despite large-scale food safety nets including programs like the mid-day meal scheme, the Anganwadi system, and subsidized food grains through the public distribution system (PDS), improvement in the nutritional status of the population has been sluggish. Even today there is significant reliance on the PDS by around 800 million Indians. The budget allocation for food subsidy in the Union Budget for 2023-24 was Rs. 1.97 lakh crore under the

Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY). To address this, food safety nets should shift their focus from staples to providing a more nutritious diet. The National Food Security Act (2013) has an in-built provision that can be leveraged to offer households a choice between subsidized food grains or conditional cash transfers. Alternatively, a centralized system could issue inflation-indexed cash entitlement vouchers through the existing PDS network, giving beneficiaries the freedom to choose according to their dietary preferences and needs.

Fourth, scaling up bio-fortification in staple crops, an innovative and cost-effective technique can ensure the availability of nutritious diets in regions grappling with chronic malnutrition in India and Africa. Initiatives like the Harvest-Plus program by the Consultative Group on International Agricultural Research (CGIAR) have made significant progress in developing nutrient-rich staple food varieties in several African countries and India. These innovations can be expanded on a large scale in Indian states and African nations to combat malnutrition effectively.

Lastly, a mutual exchange of best practices between regions of the Global South can foster south-south collaboration in formulating strategies aimed at eradicating hunger and malnutrition by 2030.

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## A BALANCING ACT IN PRICING FOR CONSUMERS AND PRODUCERS



*Raya Das, Sanchit Gupta, and Ashok Gulati*

In the past three years, India exported approximately 85 MMT of cereals during the Financial Year (FY) 2020-21 to FY'23. This record-breaking export volume signifies an unprecedented achievement in India's history, highlighting the nation's significant role as a major player in the global cereal trade landscape, in alignment with the G-20 agenda of promoting global food security. One of the significant hurdles that G-20 countries face regarding food security is the existence of trade barriers, including tariffs, import restrictions, and the levying of export duties. This kind of restrictive policies distorts the market on one hand, and impacts farmers' price realization on the other.

To tame domestic food inflation Government of India (GOI) has taken multiple stringent measures of export ban on rice, wheat and imposition of export duties of 40 percent on onion, 20 percent on parboiled rice, and export restrictions on sugar trade.<sup>6</sup> Additionally, the government has been actively managing domestic inflation by releasing stocks under the Open Market Sale Scheme (OMSS) for both rice and wheat since February 2023 at prices that are significantly lower than their respective economic costs. However, these policy

measures took a toll on farmers. The [ICRIER policy brief No.15](#) estimates that wheat farmers bore a staggering Rs. 40,000 crores of loss due to dumping of wheat in the domestic market (Gulati et al.,2023). Onion farmers of Lasalgaon—the largest onion market in India, are also agitating against the recent imposition of a 40 percent export duty from August 2023. In this context, this article delves into the policy choices to curb inflation without impacting farmers' price realization.

### **Export duty to tame inflation in onion take a toll on farmers**

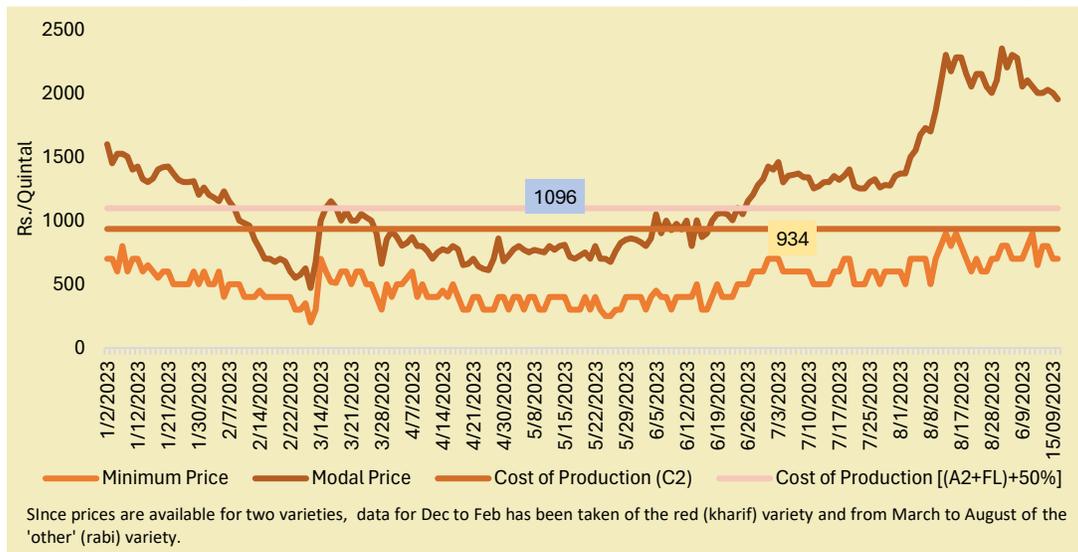
India is the largest exporter of onion accounting for 22 percent of the global trade of onion FY'23. Hence, abrupt export bans or high export duties exert a significant influence on onion prices in major importing nations, particularly in South Asia, where countries like Sri Lanka, Nepal, Malaysia, and Bangladesh rely heavily on Indian onion imports. Such restrictions not only depress the market rates domestically but also erode the country's reputation as a reliable exporter. The unit value of export onion was Rs. 3600 per quintal for rose onion (mostly goes to Middle Eastern countries), and Rs. 1600 per quintal for other kinds of fresh onion in July 2023.

<sup>6</sup> In August 2023, food inflation stood at 9.94 percent CPI YoY.

In March 2023, the domestic onion market experienced a glut due to a large overlapping of late kharif and early rabi arrivals with mandi prices plummeting to as low as Rs. 200 per quintal (Figure 1). Between February and June 2023, approximately 28 percent of the total onion production, adjusted for marketed

surplus and amounting to 7.92 MMT entered the market (Agmarknet 2023). Our estimates show that this influx of onions resulted in a cumulative loss of Rs. 8962 crores for onion farmers in reference to the A2+FL+50% at Rs. 1096 per quintal.<sup>7</sup>

**Figure 1: Wholesale price movement of onion at Lasalgaon, Maharashtra Jan., 23 to Sept., 23**



Source: DES, Agmarknet

However, following the harvest season and the period of market glut, a surge in export demand emerged, with a notable 18 percent year-on-year (YoY) increase in export quantities in July 2023. This surge in demand caused domestic onion prices to rebound, rising from Rs. 1200 per quintal on August 1 to Rs. 2250 per quintal on August 17. This increase in price, driven by export demand, provided an opportunity for farmers to potentially offset the total losses of Rs. 8962 crores they had incurred.

Along with export restrictions, the government employed market interventions such as untimely procurement and unloading of onions to manage inflation. Initially, the National Agricultural Cooperative Marketing Federation of India (NAFED) and the National Cooperative Consumers Federation of India (NCCF) each acquired one lakh tonnes of onions from seven selected districts in Maharashtra at a rate of Rs. 2410 per quintal, thereby increasing the buffer stocks from 3 to 5 lakh tonnes. However, the government had the opportunity to procure more onions at a lower cost, around Rs. 1500

<sup>7</sup> 1096 calculated as 50 percent over the production weighted average of cost of production for 2021-22 (A2+FL, defined by MoAFW as the total cost of labour, machinery, irrigation, rent, fertilizers, manure, etc. and

includes cost of family labour) for Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu i.e., 696+5%+50%. Five percent inflation assumed.

per quintal, during March when market prices were substantially lower (ranging from Rs. 500 to Rs. 600 per quintal). This could have aided in achieving the intended goal of price stabilization for farmers through the Price Stabilization Fund (PSF). Additionally, NCCF initiated the sale of onions at Rs. 25 per kg in retail markets (PIB, 2023) as a measure to subside inflation expectations. Furthermore, on the e-National Agriculture Market (e-NAM) platform, NCCF released 1300.75 tonnes of onions at a rate of Rs. 17 per kg, well below the procurement rate, as a strategy to combat inflation. The adoption of such policy measures indicates “urban consumer bias” of the price policy and transfer of resources from farmers to consumers.

### Tomato turbulence

To take the case of tomato, in June 2023, there was significant concern and outcry as tomato prices surged to Rs. 190 per kg in the retail market, but as of September 23<sup>rd</sup> 2023, the price has drastically fallen to Rs. 20 per kg in Delhi, while farmers in Kolar mandi are receiving distressingly low rates as low as Rs. 4.70 per kg.

At the same time, retail inflation plummeted from 201 percent CPI YoY in July 2023, to a negative -21.48 percent in September 2023 (Figure 2.1). Tomato farmers faced two kinds of risks: production risk and price risk. The variability in tomato price is caused by stochastic characteristics of weather and pest infestation. Tomato is a two-month crop, as the market price increased, more farmers sowed tomato plants, resulting in a glut situation in the market for the next cycle. Even tomatoes of a quality level comparable to the locally referred 'McDonald slice' are fetching prices equivalent to the transportation costs from Mumbai to Delhi, as low as Rs. 4-5 per kg.

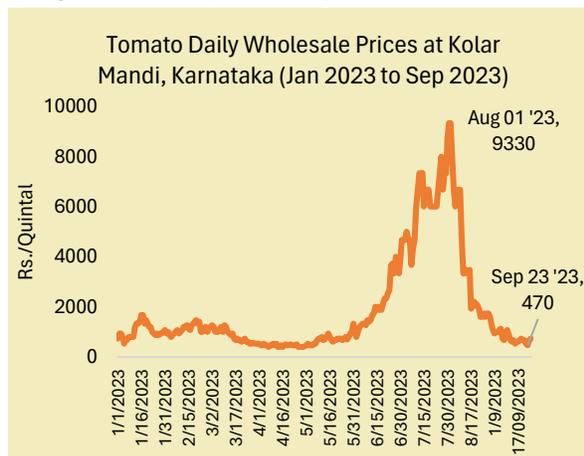
This turbulence in tomato prices can be explained by the farmers’ acreage response theory and cob-web pattern of price, where output prices impact the area allocation by the farmers, particularly in short term (Robert and Schelenker, 2009). In response to the surging prices of tomatoes, farmers opted to increase the area dedicated to tomato cultivation during the planting season, leading to oversupply and resultant fall in tomato prices (Figure 2.2).

**Figure 2.1: Tomato CPI YoY Inflation**



Source: MoSPI, AgMarknet

**Figure 2.2: Daily tomato prices at Kolar Mandi**



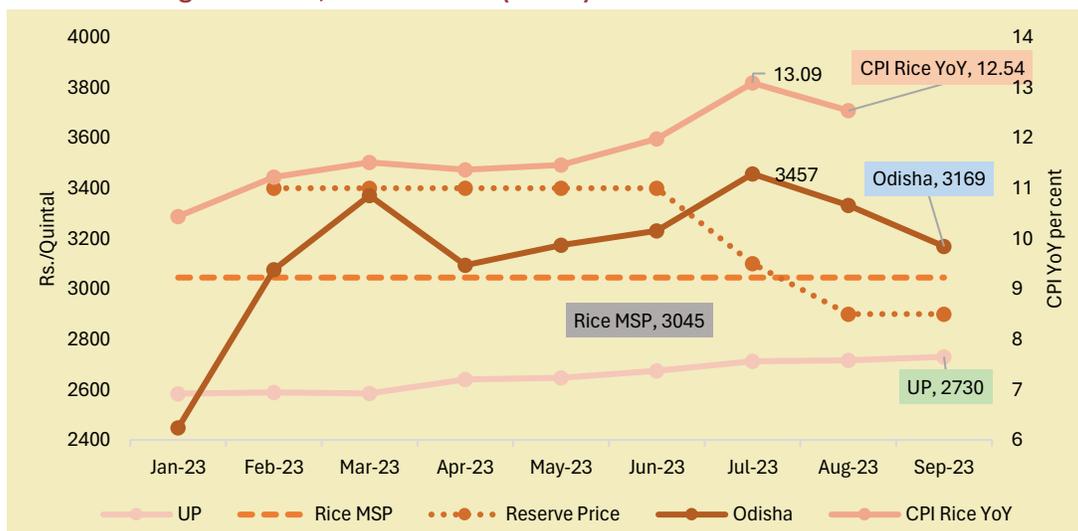
## Government Cuts Rice Prices for Open Market Sales Below MSP

Fearing price pressure on rice<sup>8</sup>, GOI banned the export of non-basmati rice in July 2023. As a result of India's rice export ban, global rice markets went in a turmoil, with Indica rice price (FAO's rice price index) spiking to its highest peak in the last 15 years, registering a 40.31 percent increase (YoY) in August 2023. Countries such as Benin, Madagascar, Kenya, Cameroon, Cote d'Ivoire, Mozambique, Vietnam, Angola, Togo, and Nepal felt the tremor, as these countries account for 62 percent of total exports from India.

Similar to wheat, GOI also commenced the release of rice stock under OMSS since February 2023 to cool down the prices. The reserve price for rice initially commenced at Rs. 3400 per quintal in February, was subsequently reduced

to Rs. 3100 per quintal starting from July 5th, and has now dipped below the Minimum Support Price (MSP) threshold, reaching Rs. 2900 per quintal as of August 9th<sup>9</sup>. However, selling rice below MSP just before the kharif harvest would surely impact the price realization of farmers in the coming KMS, particularly in Eastern states, where price assurance is already low. The latest unit-level data from the Situation Assessment Survey (SAS) 2018-19 shows that at the all-India level, only 7.64 percent of paddy farmers directly sold to public procurement agencies at MSP. If we look at the price pattern across states, currently there are spatial variations in the case of rice prices across states (Figure 3). The wholesale price data indicates, even during pre-harvest period (before the start of KMS), the modal price in many Eastern states including Uttar Pradesh is hovering below MSP, at Rs. 2651 per quintal.

Figure 3: MSP, Reserve Price (OMSS) and Wholesale Prices of Rice



Source: Agmarknet, DFPD, Gol

<sup>8</sup> India's rising inflation in rice commodity led to 12.54 percent CPI YoY in August 2023 and remained double digit despite the ban at 10.05.

<sup>9</sup> The MSP for the 2022-23 Kharif Marketing Season (KMS) was officially set at Rs. 3,045 per quintal, with an associated economic cost of Rs. 3,562 per quintal.

There was no need for immediate panic regarding rice inflation or the imposition of export bans, as there is a favourable trend in the expansion of rice cultivation in the kharif cropping area, with a growth of 2.7 percent compared to the previous year. At all India level, the cumulative negative deviation of rainfall is at 5.6 percent, just a notch lower than the normal range (96 to 104 percent of LPA). However, UP and Bihar (11.8 percent and 6 percent of India's paddy production share respectively) have received deficient rainfall at -16 percent and at -22 percent, respectively for the current monsoon season. Notably, the government maintains substantial rice stocks, exceeding three times the buffer stock norms as of July 1<sup>st</sup>, 2023, which should help mitigate any immediate supply concerns.

### Policy implications

In short run, it is essential to exercise trade policies judiciously as well as import at a low duty in case of supply shortages. Additionally, a critical measure is to strengthen export chain for perishable commodities like tomato. Many traders cum farmers in our field studies in Nashik highlighted that open and functioning trade routes can stabilise market prices. To ensure price realization during the glut period of onion, and tomato, it is pertinent to strengthen the processing sector in the medium term through institutional reform. In times of price pressure on fresh produce, consumers can turn to processed products as a cost-effective alternative.

Importantly, improving the crop data collection to provide the right signal to farmers about the

market arrival to control the glut situation is also crucial. The G-20 has undertaken significant initiatives, including the implementation of the Agricultural Market Information System (AMIS), aimed at controlling food price volatility, a critical challenge for small farmers in the Global South. By synergizing these strategies, India has the potential to pave the way for effective measures to tame inflation, promote cross-border agricultural trade, and simultaneously ensure fair price realization for the farmers.

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## Conferences/Workshops

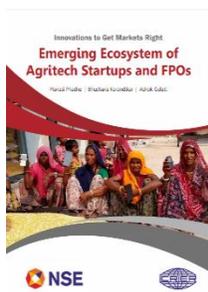


Reena Singh was invited as Jury member for the final round of the **PRISM Policy Championship** organized by **Centre for Civil Society** on 4<sup>th</sup> September 2023.



The "**Project Inception Workshop on Re-purposing Public Policies and Programs in Agriculture for Protecting Biodiversity**" organised by ICRIER on 24 August, 2023. The workshop featured distinguished speakers, from UNDP, National Biodiversity Authority (NBA), and ICRIER.

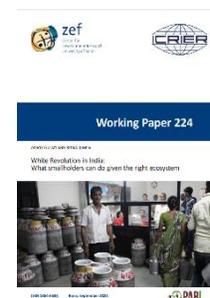
## Publications



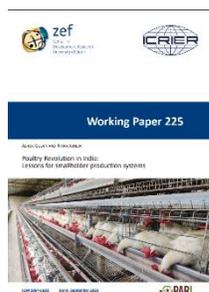
Report on "**Innovations to Get Markets Right: Emerging Ecosystem of Agritech Startups and FPOs**" by *Manasi Phadke, Bhushana Karandikar, Ashok Gulati*



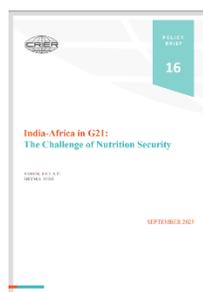
Policy Brief on "**Tackling Food Inflation: Is restricting exports and imposing stocking limits the optimal policy?**" by *Ashok Gulati, Raya Das, Sanchit Gupta, Manish Kr. Prasad*



ZEF Discussion Paper No. 224 on "**White Revolution in India: What smallholders can do given the right ecosystem**" by *Ashok Gulati, Ritika Juneja*



ZEF Discussion Paper No. 225 on "**Poultry Revolution in India: Lessons for smallholder production systems**" by *Ashok Gulati, Ritika Juneja*



Policy Brief on "**India-Africa in G21: The Challenge of Nutrition Security**" by *Ashok Gulati, Shyma Jose*

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