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Outlook for Rice and Wheat to 2030-31

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Fueled by technological change and supported by investments in irrigation, markets, infrastructure and institutions, India experienced significant increase in productivity and production of rice and wheat. Between 1970-71 and 2020-21, production of rice increased from 42.2 to 124.4 million tonnes, and of wheat from 23.8 to 109.6 million tonnes. India is now a net exporter of both. Nevertheless, the need to produce more of rice and wheat remains as urgent as in the past. The scope for bringing additional area under cultivation is limited, as the country's net sown area has been stagnating at around 140 million hectares for the past two decades. Between 2000-01 and 2020-21, wheat area increased from 25.7 to 31.1 million hectares, and of rice it has been hovering around 43 million hectares.

The planning for future requires reliable projections of production and demand. Such information is essential for managing production risks, price volatility, participation in international trade, optimal use of resources, and reforming agricultural markets.

Several studies have projected supply and demand for agricultural commodities[1],[2]&[3] using simple econometric techniques without due consideration to the changes happening in other sectors of the economy. Accounting for these changes requires a sound econometric framework. Parappurathu *et al.*[4] using data for 1995-2011 and applying a version of the FAPRI (Food and Agricultural Policy Research Insitute)

Outlook Model projected supply and demand for rice, wheat and maize for 2025. This policy brief applies a similar framework to the updated data for 1995-2015 to project yield, area and production of rice and wheat, and their demands as food and other uses.

Description of the Outlook Model

The FAPRI outlook model is based on a dynamic spatial partial equilibrium modelling framework. It estimates a system of simultaneous equations considering linkages among several economic factors corresponding to the food balance sheet. Figure 1 provides a schematic representation of these linkages. A change in any of the components of the system (i.e., producer, consumer, and trade) can generate short-term and long-term effects on other systems[5]. The structural equations formulated here are solved by applying a linear programming framework. The equations are rewritten in a manner that the exogenous and predetermined variables appear on the right-hand side, while the endogenous variables are retained on the left-hand side.

Before proceeding to projections, we validate our model for its robustness, by making projections for 2016-17 to 2019-20; and matching these with their actual values. We estimted the mean absolute error (MAE) and the mean absolute percent error (MAPE) to know how closely the projected values match the actual values. Table 1 presents the deviation in the

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2. Kumar, P., Kumar, A., Parappurathu, S. & Raju, S.S. (2011). Estimation of demand elasticity for food commodities in India. *Agricultural Economics Research Review*, 24(1): 1-14.
3. Chand, R. (2009). Demand for foodgrains during 11th Five Year Plan and towards 2020. *Policy Brief 28*, ICAR-National Insitute of Agricultural Economics and Policy Research, New Delhi.
4. Parappurathu, S., Kumar, A., Kumar, S., & Jain, R. (2014a). Commodity outlook on major cereals in India, *Policy Paper 28,* ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi.
5. Parappurathu, S., Kumar, A., Kumar, S., & Jain, R., (2014b). A partial equilibrium model for future outlooks on major cereals in India, *The Journal of Applied Economic Research, 8* (2): 155–192.
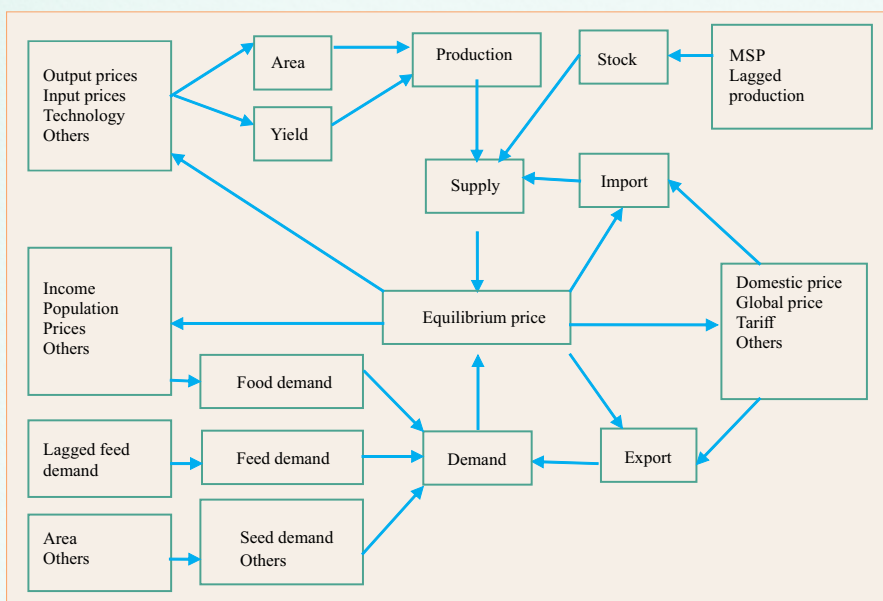
Figure 1. Modeling framework

92% of the total demand. In 2030 India will be surplus in rice to the tune of 21.6 million tonnes and will export 18.1 million tonnes.

Rice is grown in different ecologies, and therefore, we need to look at its projections at regional[7] level (Table 3). As in the past, eastern and northern regions remain main contributors to the country's total rice production. In eastern region, rice production will increase from 46.5 million tonnes in 2020-21 to 53 million tons in 2030-31 despite a marginal decline in its area. Additional production will come from an increase in its yield. In northern region, rice area will increase marginally, but driven by yield improvements its production will increase to 38.7 million tonnes. Likewise, in southern region additional rice production will come from yield improvements despite a marginal decline in area. In northeastern and hill regions, area under rice is unlikely to expand much and its yield is also not expected to increase significantly.

estimated and actual values. Both MAE and MAPE values lie within the acceptable limits.[6]

Table 1. Robustness of projected quantities at national level

Particulars	Rice		Wheat	
	MAPE (%)	MAE	MAPE (%)	MAE
Area	1.19	0.52	3.39	1.02
Yield	1.91	0.05	3.60	0.12
Production	0.72	0.81	1.29	1.29

Outlook on Rice

Table 2 presents the supply and demand projections for rice upto 2030-31. At national level, rice area is expected to decline by 0.8 million hecatres, from 43 million hecatres in 2020-21 to 42.2 million hectares in 2030-31. *This means that there is very limited scope for raising production through area expansion.* Rice production, however, is projected to increase to 144.7 million tonnes in 2030-31 from 122 million tonnes in 2020-21, and the increase will be driven by yield improvements. *This implies that future growth in rice production will have to come from technological change.*

By 2030, India's demand for rice inclusive of its food and other uses is expected to be 20 million tonnes more than in 2020-21. Food demand will comprise

Table 2. Supply and demand outlook for rice at national level

Particulars	2020-21	2021-22	2025-26	2030-31
Area (million ha)	43.0	42.8	42.4	42.2
Yield (tonne/ha)	2.84	2.93	3.21	3.43
Production (million tonnes)	122.0	125.4	136.1	144.7
Demand (million tonnes)				
Food	95.2	96.9	104.3	113.8
Others	7.8	7.9	8.4	9.3
Total	103.0	104.8	112.7	123.1
Export (million tonnes)	12.9	14.6	15.4	18.1
End stock (million tonnes)	36.1	36.7	39.5	43.1

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[6] The calibration of the model was done as robust as possible, however, projections are subject to the risk of over or under estiamation due the extreme events such as heat weaves, floods, geopolitical instablility, etc.

[7] Based on rice and wheat production environment states are categorized into six regions, namely (i) Eastern region- Assam, Bihar, Odisha, West Bengal and Jharkhand; (ii) Western region- Gujarat, Madhya Pradesh, Maharashtra, Rajasthan and Chhattisgarh; (iii) Northern region- Haryana, Punjab, Uttar Pradesh and Uttarkhand; (iv) Southern region: Andhra Pradesh (erstwhile), Karnataka, Kerala and Tamil Nadu; (v) Hilly region- Himachal Pradesh and Jammu & Kashmir; and (vi) North Eastern region- Manipur, Meghalaya, Nagaland, Sikkim, Tirpura, Arunachal Pradesh and Mizoram.

Table 3. Regional outlook on rice production

Regions	Particulars	2020-21	2021-22	2025-26	2030-31
Eastern	Area	17.1	17.1	16.7	16.4
	Yield	2.71	2.80	3.05	3.24
	Production	46.5	47.8	51.0	53.0
Western	Area	7.6	7.5	7.4	7.4
	Yield	2.27	2.41	2.85	3.20
	Production	17.3	18.1	21.1	23.7
Northern	Area	10.7	10.7	10.9	10.9
	Yield	3.16	3.22	3.41	3.55
	Production	33.6	34.5	37.3	38.7
Southern	Area	6.21	6.14	6.00	5.99
	Yield	3.4	3.5	3.9	4.2
	Production	21.4	21.8	23.3	25.0
Hilly	Area	0.3	0.3	0.3	0.3
	Yield	2.20	2.25	2.45	2.60
	Production	0.7	0.7	0.8	0.8
North Eastern	Area	1.0	1.0	1.1	1.1
	Yield	2.39	2.44	2.60	2.73
	Production	2.4	2.5	2.7	2.9

Note: Area in million ha, yield in tonne/ha, production in million tonnes

Outlook on Wheat

By 2030, India's wheat production is likely to reach 136 million tonnes, about 25 million tonnes more than in 2020-21. Its area is projected to increase by one million hectare and yield by 0.7 tonne/ha. Additional increase in wheat production will come largely from yield improvements.

Demand for wheat is expected to increase to 108 million tonnes, about 18 million tonnes more than in 2020-21. Food demand will comprise 95% of it. Its demand for other uses will also increase. India will remain surplus in wheat, yet, its export may not increase drastically because of its lack of competitiveness in the global market.

Table 4. Supply and demand outlook for wheat at national level

Particulars	2020-21	2021-22	2025-26	2030-31
Area (million ha)	31.6	31.7	32.0	32.5
Yield (tonne/ha)	3.5	3.6	3.9	4.2
Production (million tonnes)	110.8	114.5	126.1	135.8
Demand (million tonnes)				
Food	85.4	87.0	93.8	101.8
Other uses	4.6	4.7	5.1	5.7
Total	90.0	91.7	98.9	107.5
Export[8] +End stock (million tonnes)	28.8	29.4	31.9	34.9

Table 5. Regional outlook on wheat production

Regions	Particulars	2020-21	2021-22	2025-26	2030-31
Eastern	Area	2.8	2.8	2.8	2.9
	Yield	2.72	2.78	2.94	3.07
	Production	7.5	7.7	8.3	8.8
Western	Area	11.6	11.7	11.9	12.2
	Yield	3.18	3.32	3.74	4.07
	Production	36.8	38.7	44.7	49.7
Northern	Area	16.4	16.4	16.4	16.5
	Yield	3.96	4.06	4.34	4.56
	Production	64.9	66.5	71.3	75.2
Southern	Area	0.2	0.2	0.2	0.2
	Yield	1.47	1.57	1.87	2.11
	Production	0.3	0.3	0.4	0.5
Hilly	Area	0.6	0.6	0.6	0.7
	Yield	1.99	2.07	2.31	2.49
	Production	1.3	1.3	1.5	1.6
North Eastern	Area	0.01	0.01	0.02	0.02
	Yield	1.98	2.03	2.20	2.33
	Production	0.02	0.03	0.03	0.04

Note: Area in million ha, yield in tonne/ha, production in million tonnes

Wheat production in India is concentrated in its north-western region. Northern region contributes 59% and western region one-third to the total wheat production. In northern region, wheat area is unlikely to change much, but yield improvements will drive most of the increase in wheat production (Table 5). Wheat production will increase to 75.2 million tonnes in 2030-31, from 64.9 million tonnes in 2020-21. In western region, wheat area may expand marginally. Nonetheless, additional increase in production will come from yield improvements.

Eastern region accounts for 6.8% of the total wheat production, which is projected to decline to 6.5% by 2030-31 because of little change in area and slow improvement in yield. In northeastern region wheat area will expand considerably, which together with yield improvement will lead to doubling of wheat production from 0.02 million tonnes in 2020-21 to 0.04 million tonnes in 2030-31.

The projections for rice and wheat are compared with FAO-OECD and NITI Aayog estimates for 2030-31 (Table 6). Our estimates are closer to the estimates of NITI Aayog.

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[8] Due to India's inconsistent export policy, and prevailing cheap prices in international markets, India's wheat exports have been low. Hence, projecting its export is a challenge. We included exports and endstock to estimate surplus. The endstock is defined as the stock of wheat available in the central pool at the end of the reporting year.

Table 6. Comparison of projections for 2030-31(million tonnes)

Crop	Particular	FAO-OECD	NITI Aayog#	ICAR-NIAP	Deviation from FAO-OECD (%)	Deviation from NITI Aayog (%)
Rice	Production	139.2	145.9	144.7	4.0	0.8
	Demand	121.3	118.6	123.1	1.5	-3.7
Wheat	Production	121.8	132.9	135.8	11.5	-2.1
	Demand	120.1	110.2	107.5	-10.5	2.5

#NITI Aayog Projections to 2030-31 are arrived at using $P_{2030-31} = P_{2029-30}\left[\left(\frac{P_{2032-33}}{P_{2029-30}}\right)^{1/3}\right]^{(2030-2029)}$
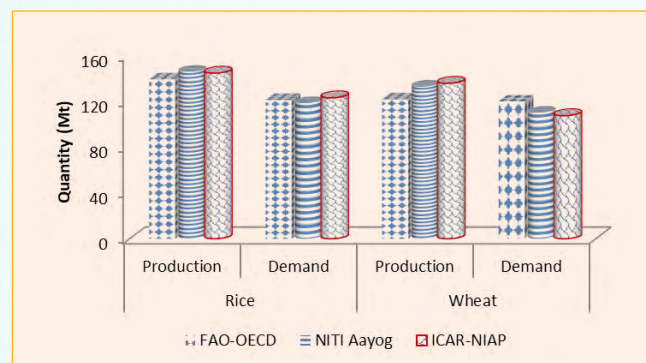

Figure 2: Projection of production and consumtion of rice and wheat by 2030-31

Policy Implications

There are two key findings of this analysis. One, there is a limited scope of raising production through area expansion and the production in future will come from yield improvments, which may come from bridging the yield gaps and/or raising yield frontiers or both. Hence, increased attention on research investment, appropriate public policies are imperative to raise yield frontiers sustainably. Two, the country will remain surplus in both rice and wheat.

These findings have some important policy implications. *One*, the surplus in both the commodities suggest a need to diversify some area under these crops towards oilseeds and pulses in which the country is deficit, and relies on imports to meet the domestic demand.

Two, area from these crops may also be diversified towards high-value crops including fruits, vegetables, spices, aromatic and medicinal plants as the demand for these commodities is expected to grow faster than of staple food cereals. It will ease pressure on natural resources, especially, groundwater, which is exteremly limited and is overextracted to irrigate water-guzzling crops like rice. Diversification in general will help improve effeiciency and sustainability of agricultural production system.

Three, Food Corporation of India (FCI) procures huge quantities of both the grains for public distribution system. FCI incurs huge operational costs, called "*buffer carrying cost*" on warehousing and stock maintenance, and these have increased considerably, from Rs. 205 in 2001-02 to Rs 540 per 100 kg in 2020-21 (https://www.fci.gov.in). Besides, on average 1.6 thousand tonnes of these grains is wasted in FCI godowns due to one or another reasons (https://www.indiatoday.in/india/). If planned properly based on demand and production projections, these costs and wastages can be reduced.

Four, projections of excess supply of rice and wheat also indicate the need for development of the mechanism for value addition, agro-processing and export promotion. There is a need for a long-term strategy for their exports to improve competitiveness in global market, focusing on improving their quality, safety and conformity to the specific requirements of importing countries. Hence, there is a need for strengthening private sector participation in marketing, food processing, and value chains to improve international competitiveness. Besides, integrating the principles of low-input scientific farming gradually will help in reducing cost of agricultural production and thereby making India competitive in the long term.

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