Double-Digit Inclusive Growth

Not without Robust Agricultural Growth

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India aspires for a double-digit growth rate. For that, agriculture will have to grow at least 4% annually to support gross domestic product growth rates in excess of 8% if we are to constrain imports at slightly higher levels than at present. Such agricultural growth can be attained with a total factor productivity growth rate of 2%, along with developing the net irrigated area to 90 million hectares. But in the past two decades, agricultural growth has been less than 3% and productivity growth has been lower than 2%. Surface irrigation has not grown and groundwater is being overexploited in many parts of the country. Achieving the required agricultural growth for double-digit growth of the economy is a significant challenge.

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1 The Issues

Despite the current slowdown, the rapid economic growth attained over 2004-09 has raised high hopes that the Indian economy can grow at a double-digit rate. Here we explore the role of agricultural development in inclusive double-digit growth. What role will agricultural development play if the Indian economy is to grow in an inclusive and sustainable way at a double-digit rate for three decades as China's economy has done?

Continued population growth and double-digit economic growth that is inclusive will drive up food demand rapidly and change its composition. Supply will have to increase and it will have a different composition. Cultivable land has remained constant at around 140 million hectares (mha) for many years. Agricultural output can increase only through expansion of irrigation, investment, intensification of input use, and by way of technical progress. Since intensification of input use will run into diminishing returns, and since water availability is limited, technical progress will be the ultimate source of agricultural growth. What rate of total factor productivity growth (TFPG) in agriculture will be needed to sustain agricultural and economic growth?

In an open economy, rising food demand can be met by imports, but natural and political economy constraints limit the proportion of food that can be imported without putting the food security of the huge population of India at risk. Indian agriculture is also considered to be vulnerable to the threat of climate change, which is expected to lead to global price increases and make reliance on imports less acceptable. Will accelerating productivity growth and sustained expansion of irrigation support the higher agricultural growth needed? Will domestic agriculture be able to provide the required food in the long term, say over the next three decades? Or will limits to agriculture growth impose limits to economy-wide consumption and/or income growth? What will be the role of imports? These are the specific questions we address here.

2 The Approach

We explore these questions using a multi-sectoral, inter-temporal programming model that has the needed structure and features for addressing these issues. It has 28 sectors, of which 15 are agricultural (for details, see Parikh et al 2011). Crop production from irrigated and unirrigated land is distinguished so that there are 40 production activities. Land allocation to different crops is done within the constraint of 140 mha of net cultivated area and the available irrigation capacity.

The model covers the whole economy and captures macro feedback and ensures macro balances. It has 20 consumption classes, 10 rural and 10 urban. Of these, five classes in each sector are at much higher consumption levels than observed today and will be the ones into which the population will move as its income increases. Each class has its own expenditure system. Income distribution is determined for every period endogenously, depending on the level of aggregate consumption and prescribed parameters of the log normal income distributions for rural and urban consumption. Rural people migrate to urban areas depending on the relative gross domestic product (GDP) from agriculture and non-agriculture. A particularly important feature of the model is a demand system that can predict the consumption behaviour of classes at much higher income levels where income elasticities of demand for food will be much lower than today. We were able to estimate a non-linear demand system based on National Sample Survey (NSS) and Central Statistical Office (CSO) data without having to make ad hoc assumptions about consumer behaviour at very high income levels (Parikh 1992 shows the difficulties in projecting long-term food demand).[1] We then use these estimates to generate linear approximations of the demand system for each separate consumption class, which together approximate the non-linear demand system in a piece-wise manner.

The path that an economy takes depends on many choices. How much of its production is invested and how much of it is consumed determines the growth rates of GDP and consumption. The sectoral composition of production depends on demand, which is affected by income distribution. The possibilities of imports and exports provide some flexibility in sectoral composition. The scenario will be affected by whether consumption or GDP is maximised.

The model in most scenarios maximises the present discounted value (PDV) of private consumption over 10 time points four years apart. If growth is to be inclusive, we should maximise private consumption. The base year is 2007 and the last year is 2039. We develop various scenarios that provide alternative possible futures for the economy and its agriculture. They are not predictions, but tools to explore the economic consequences of alternative assumptions.

3 The Results

3.1 The Reference Scenario

In the reference scenario (RS), we take trend values of critical variables. An important concern is how fast technical progress increases productivity. Technical progress is widely recognised as an important driver of economic growth. Output can be increased by investing more capital, employing more labour, cultivating more land, or by using more inputs. TFPG measures the increase in the productivity of factors such as land, labour, and capital. It indicates that output will increase by TFPG with the same levels of factors. In the model, TFPG is incorporated as the rate at which capital/output ratio goes down and the rate at which yield per hectare increases for the same levels of inputs. A TFPG of 1.5% would in 20 years reduce the factor requirement by nearly 20% to 81%, and a TFPG of 3% will reduce it to 55%.

TFPG in the agriculture sector is set at 2%, a rate that was achieved in the 1980s (Fuglie forthcoming) and from 2003 to 2007, but that may be a bit on the optimistic side. In the non-agricultural sector, TFPG is set at 3.0%. It may be noted that over and above the prescribed TFPGs, we have a fuel use efficiency growth of 1.5%, an electricity use efficiency growth of 1.0%, and a use of wheat, rice, and other agricultural commodities as intermediate inputs efficiency growth of 1.5%. Thus the overall productivity growth will be significantly higher than the weighted average of the TFPG of 2% for agriculture and 3.0% for non-agriculture assumed in many of the scenarios. Together, these assumptions imply that the reference run is a slightly optimistic scenario.

Another critical assumption is that the net irrigated area will increase to 90 mha by 2039 from 63 mha in 2007-08. This is also a bit optimistic, considering the virtual stagnation, or even reduction, in the area of surface irrigation since 1990-91 and the overexploitation of groundwater in many parts of the country. The country added only 20 mha of irrigated area from 1980 to 2007.

Finally, the permissible levels of imports critically affect the scenarios. For example, in the reference run, the imports of wheat and rice are limited to 3.0% of domestic availability (or 3.1% of domestic production), close to self-sufficiency. From 1990 to 2010, India was a net importer of cereals only in two years and the maximum import was 2.6 million tonnes in 1993, constituting less than 2% of domestic production. This reflects the strong policy preferences of India's policymakers for national food security that are consistent with the large size of the population. In the reference scenario, coarse cereals imports are limited to 10%, milk and milk products imports to 6%, animal products and forestry products to 30%, and all other agricultural commodities to 15% of availability (17.6% of production). The import constraints imposed on other sectors of the economy are also much wider than what is seen historically.

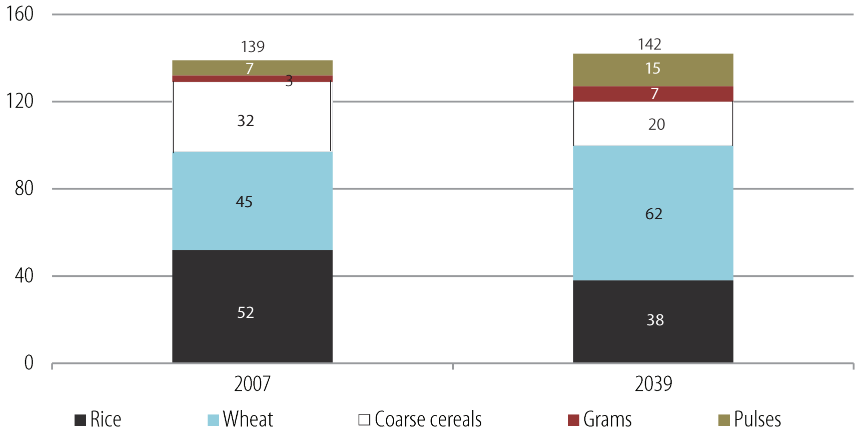
The reference scenario (Table 1) shows a per capita private consumption growth rate of 7.70% an agricultural growth rate of 4.25%, and a growth rate of GDP of 8.40%. At these rates of growth, GDP rises more than 13-fold between 2007 and 2039 while per capita consumption rises nearly 11-fold. The reference run implies that a per capita consumption growth rate of 7.7% and a GDP growth rate of 8.4% require an agriculture growth rate exceeding 4%, slightly higher than the target rate for agricultural growth generally assumed in India's five-year plans. The higher rate of increase of rural per capita consumption compared to urban consumption is the outcome of an assumed fall in urban-rural consumption parity. Though per capita rural consumption increases at a higher rate, it is still much below urban consumption even in 2039.

Table 1: Key Variables at 2003-04 Prices and Growth Rates over 2007-39 in Reference Scenario

Name	2007	2011	2031	2039	Growth Rates
GDP (Rs billion)	28,321	41,185	2,36,106	3,74,063	8.4
Agriculture GDP	4,472	4,698	12,740	16,923	4.25
Per capita consumption (Rs)	16,517	23,315	1,16,866	1,77,481	7.7
Rural (Rs)	12,433	17,250	90,432	1,39,806	7.86
Urban (Rs)	28,174	37,852	1,68,991	2,44,998	6.99

With these growth rates, the share of agriculture in GDP goes down to 5% by 2039, and the share of GDP from the foodgrains sector to 1%. Even then agriculture constrains the growth of GDP. The investment rate fluctuates between 19% and 8%, well below what would have been possible given the upper bound of 35% on the marginal savings rate. As it is possible to increase investment, higher growth rates of the economy would be possible. Why was the growth rate of GDP only 8.9% in the reference scenario? The reason is we maximise consumption in it and given the limited land, irrigation capacity and import restrictions, agricultural supply is limited and consumption cannot be increased any further. The import bounds and land constraints for both irrigated and unirrigated land become binding in the beginning of 2023. This means that our model projects the

Figure 1: Per Capita Foodgrains Consumption in Reference Scenario (kg/year)



economy being constrained by the availability of agricultural commodities from 2023 onwards.

This raises the question of whether the demand for food projected is too high. We next look at this.

3.2 Changing Structure of Food Consumption

The rapid growth in consumption is accompanied by a change in consumption patterns in the reference scenario. Figure 1 shows the per capita consumptions of foodgrains. In calculating the physical quantities of foodgrains from monetary expenditure, we have accounted for quality differences in the consumption of different classes. Total foodgrains consumption increases only marginally from 139 kilograms/year to 142 kg/year. In total foodgrains, rice and coarse cereals consumption decreases over time, while the consumption of wheat increases, and that of gram and pulses rises more significantly. This is similar to the trend seen internationally in many Asian economies. Our new consumer demand system therefore is able to reproduce these trends even over the enormous income changes that are associated with nearly 35 years of rapid growth.

The change in the consumption pattern, while not unexpected, is even more striking when we look at other food items. The expenditure share of foodgrains (cereals and pulses) goes down by more than half, from 29% to 12% and that of oils from 11% to 7%. The agricultural economy will be even less dominated by foodgrains than today. The share of sugar remains more or less constant. The shares of all high-value commodities rise – from 12% to 13% for meat, fish, and eggs, from 18% to 21% for horticulture, and from 17% to 31% for milk and milk products. These high-value products will therefore constitute almost two-thirds of the total food consumption expenditure.

The increase in the share of animal products is striking. By 2039, milk and milk products will account for most of this increase, as it alone constitutes 31% of the total food expenditure. The share of meat, eggs, fish, and animal services rises by 1%. The high increase in consumer expenditure on animal products is consistent with the differences in consumption across expenditure classes in the NSS data of 2007-08, which shows that the richest decile in rural areas consume 16 times and in urban area nine times as much milk as the respective poorest decile.

While the shares of many items in food consumption show a decline or small increase, the per capita consumption of most items is increasing, as can be seen in Table 2.

Table 2: Per Capita Consumption of Selected Agricultural Items in Reference Scenario (Rs per person)

Year	Sugar	Oilseeds	Plantations	Fruits	Vegetables	Other Crops	Milk and Milk Products	Animal Services, Poultry	Forestry
2007	191	476	14	282	458	232	726	537	207
2011	236	564	23	372	601	307	1,046	689	218
2031	544	1,076	171	1,111	1,677	930	3,915	1,850	355
2039	609	1,186	320	1,391	1,966	1,182	4,952	2,148	481

Thus it is not the demand system that leads to agricultural growth being critical for inclusive growth. To illustrate this point further, we develop a scenario in which GDP is maximised.

3.3 Maximising Growth

In the growth first scenario (GF), the present discounted value of GDP is maximised and a minimum growth rate of per capita consumption of 3% is stipulated. A much higher economic growth rate is achieved with exactly the same assumptions as in the reference scenario on land, TFPG, irrigation, and import bounds. The broad characteristics of this scenario are summarised in Table 3.

Table 3: Maximising Consumption (Reference Scenario) and Maximising Growth (Growth first)

	Reference Run (RS)	Growth First (GF)
Growth rates of 2007-39		
GDP	8.4	15.25
GDP agriculture	4.25	4.42
Per capita consumption	7.7	3
Persons poor in 2039 (millions)		
Rural	4	79
Urban	0	32

It is seen that with an emphasis on growth a much larger GDP growth rate of 15.25% is realised at the cost of private consumption. The growth rate of private consumption is merely the minimum stipulated 3% in growth first, compared to the 7.70% in the reference scenario. Of course an economic growth rate of more than 15% over 30 years is highly unrealistic as other resource constraints may become binding, but the scenario illustrates the point that the consumption growth rate has to be much higher for inclusive growth. This is seen from the number of persons in poverty in the two scenarios. Whereas in the reference scenario poverty is virtually eliminated by 2039, in growth first, 111 million people remain below the poverty line even in 2039. Since India's policymakers aim at inclusive growth in all other scenarios, we maximise the present discounted value of private consumption.

3.4 Double-Digit Inclusive Growth

In the reference scenario, with the maximisation of consumption, limits on the availability of agricultural commodities due to constraints on land irrigation and imports curtail the growth rate. The availability of agricultural commodities needs to be stepped up to attain double-digit inclusive growth. This can be done by increasing the TFPG in agriculture and/or expanding irrigation and/or by permitting larger imports of agricultural commodities. We now examine these options.

Agricultural Productivity Growth

In a scenario of high productivity (TH), a higher TFPG in agriculture of 3.0% (from 2011 onwards) is used, compared to the reference run level of 2.0%. China has achieved close to 3% or more for the last three decades in a row, an achievement unprecedented in the world.

In this scenario, the GDP growth rate reaches the double-digit level of 10.43%, per capita consumption 10.19%, and agricultural GDP 5.64%. The changes compared with the reference scenario show increases of 2.03, 2.49, and 1.39 percentage points respectively in the growth rates of GDP, per capita consumption, and agricultural GDP. These scenarios suggest that when consumption is maximised, the growth of the economy is limited by the rate of agricultural growth at a pace technical change permits.

Table 4: Impact of Total Factor Productivity Growth

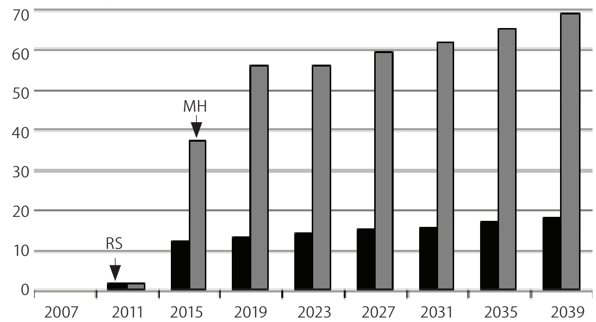
Growth Rate 2007-39	Reference Run (RS)	High TFPG (TH)
GDP	8.4	10.43
GDP agriculture	4.25	5.64
Consumption per capita	7.7	10.19
Foodgrain expenditure per capita	1.21	1.41
Rural foodgrain expenditure per capita	1.38	1.57
Urban foodgrain expenditure per capita	0.99	1.28
2039 per capita consumption as a multiple of 2007 level	11	22

We can conclude that given the somewhat optimistic irrigation scenario and the moderate levels of food imports, a growth rate of agricultural TFPG of at least 3% is needed in both sectors to achieve an agricultural GDP growth rate over 5.6%, which would be consistent with an inclusive aggregate GDP growth rate of more than 10%.

Water Use Efficiency and Irrigation

In the reference run, we assumed that net irrigated area will be 90 mha by 2039. In a scenario of high irrigation (IH), we use a higher growth rate so that the total net irrigated area in 2039 will be 108 mha.

Figure 2: Projected Imports of Foodgrains (Adjusted for quality, million tonnes)



In this scenario with a larger irrigated area, the growth rates of GDP agriculture, GDP, and consumption will be 4.92%, 9.42%, and 8.97% respectively (Table 5). The importance of expanding irrigation through improving water use efficiency and spreading the benefits of irrigation widely, such as through watershed development and groundwater recharge, is underlined by this scenario. When compared to the reference scenario, the increases in the growth rates of GDP agriculture, GDP, and consumption by 0.67, 1.02 and 1.27 percentage points respectively in the high irrigation scenario are due to the expansion of irrigation to near full potential.

Even with an agricultural TFP growth rate of 2%, which has been achieved in India in the past, an economic growth rate of nearly 10% is attainable if irrigation can be expanded to 108 mha.

In addition to improving TFPG and water availability and efficiency of its use, we can increase domestic agricultural supply if we permit larger imports, which we now explore.

Impact of Higher Trade Bounds

In the above runs, we have seen that GDP growth is constrained by limits on imports, irrigation and technical change. Many people believe that India should be able to import more agricultural products from world markets with long-term agreements. In a scenario of high imports (MH), all the import bounds are significantly relaxed compared to the reference run and high productivity and irrigation scenarios by increasing them to 10% of foodgrain availability and to more for other agricultural commodities. The results given in Table 5 show that the growth rate of GDP increases by only 0.59 percentage point and the growth rate of agriculture increases by 0.18 percentage point. The agricultural growth rate increases due to the flexibility provided in the allocation of land by higher import bounds to commodities that India can produce more efficiently.

However, the level of foodgrain imports rise dramatically. Figure 2 shows the level of foodgrain imports in the reference and high import scenarios. In the latter, it rises to 69 million tonnes by 2039 compared to 18 million tonnes in the reference run. Even by 2015, total foodgrain imports of 37 million tonnes will be needed. Despite such large increases in imports, the growth rate of GDP increases by a modest amount. Agriculture still remains a constraint on the growth of GDP. Of course, if we had no constraint on agricultural trade, agricultural output would not be a constraint. The levels of imports will be even higher, which the world market might not be able to easily supply. That would most likely be considered unacceptable to India's policymakers. The import quantities in Figure 2 are adjusted for quality.

Table 5: Macroeconomic Aggregates of Different Scenarios

	Rate of Growth 2007-39				
	Reference Run (RS)	High TFPG (TH)	High Irrigation (108 mha) (IH)	High Food Import (MH)	All Together (AT)
GDP	8.4	10.43	9.42	8.99	11.71
GDP agriculture	4.25	5.64	4.92	4.43	6.28
Consumption per capita	7.7	10.19	8.97	8.47	11.55

Should India limit imports when it has the capacity to pay for it? India's past experience of large imports of foodgrains makes it wary of excessive dependence on imports for food. Most countries' policies, including China's, imply a target level of self-sufficiency in cereals. When the domestic relative price is regressed against the world market price and the self-sufficiency level, the latter shows a significant coefficient, indicating that the pricing policies of countries do account for domestic self-sufficiency (Fisher et al 1988).

Impact of High Irrigation, High TFPG, and Larger Imports

The all together (AT) scenario considers all measures as a whole. It is an optimistic scenario with full development of irrigation, higher import bounds, and a higher TFPG of 3% in both agriculture and non-agriculture. This leads to a growth of agriculture of 6.28% (Table 6), and to double-digit growth of 11.55% for per capita consumption, and 11.71% for GDP. An inclusive growth rate of nearly 12% therefore requires an agricultural TFPG of 3% and full development of irrigation that results in an agricultural growth of more than 6%, and imports of foodgrain at 69 million tonnes. The required agricultural and TFPG can of course be reduced modestly by allowing for even larger imports. However, as can be inferred from the high productivity and irrigation scenarios, even with a much more modest import constraint, a TFPG of 3%, and full development of irrigation to 108 mha, a growth rate of 11% plus is realisable.

Table 6: Persons in Poverty in Different Scenarios in 2039 (millions)

Year	RS	TH	IH	MH	AT	GF
2007	359	375	365	359	385	336
2011	247	231	238	240	227	316
2023	43	23	32	36	17	242
2031	12	3	6	7	2	174
2039	4	0	1	2	0	111

RS: reference scenario; TH: high technology; IH: high irrigation; MH: high imports; AT: all together; GF: growth first.

3.5 Impact on Poverty

The poverty line for rural areas at 2003-04 prices is Rs 6,800/person/per year and for urban areas Rs 10,800/person/per year. With growth over time, poverty decreases in both rural and urban areas in all the scenarios. However, urban poverty decreases at a faster rate than rural poverty. If we continue with policies as usual, that is, the reference scenario, then we would end up with four million people in rural areas below the poverty line and no person below it in urban areas. Poverty is virtually wiped out in all the scenarios. The scenarios that reach or exceed double-digit growth are high technology, high irrigation, high imports, and all together, all showing virtually no poverty by 2039. However, in the growth first scenario, we will end up with 111 million poor people even with a GDP growth rate of 15.25%. Thus inclusive double-digit growth is a must for rapid and near total eradication of poverty.

4 Conclusions

Our analysis suggests that if imports of food are constrained to levels slightly higher than at present, at least a 4% growth rate of agricultural GDP is needed to support GDP growth rates in excess of 8%. This can be attained with a slightly optimistic agriculture TFPG rate of 2%, along with a slightly optimistic development of irrigation potential to 90 mha (net).[2] But in the past two decades, agricultural growth has been less than 3%, and productivity growth has been lower than 2%. Limits on total water availability in the country, competition for water from urban areas, and slow improvements in water-use efficiency have reduced the irrigation growth rate and could continue to do so in the future. Achieving the required agricultural growth is therefore a significant challenge. Global warming will make it even more formidable.

Very high gains result from higher TFPG in agriculture. Raising it to 3%, similar to China's level, raises agricultural growth to 5.6% and allows for a GDP growth rate of 10.4%. Increasing irrigation growth that would lead to a net irrigated area of 108 mha by 2039 raises the agricultural growth rate to 4.9% and would allow a GDP growth rate of 9.4%, even with a TFP growth rate of 2.0%. Again, global warming will increase the need for water harvesting and improving water-use efficiency in irrigation. Double-digit growth therefore requires the high growth of agriculture and for that we need to increase the TFPG in agriculture and water-use efficiency so that as large an area as possible is irrigated with the available water.

While permitting much larger food imports can lead to higher growth, the country is unlikely to accept such a level of import dependence. Agricultural import policy could therefore become relevant for economy-wide growth, even at a time the agricultural sector has become a smaller part of the economy as a whole.

A growth rate of nearly 12% is feasible via full development of irrigation, a higher TFPG of 3% both in agriculture and non-agriculture, and higher import bounds. It appears odd that constraints on the growth of the shrinking agricultural sector should limit the overall growth of the economy. This happens because large food imports are not likely to be acceptable and because the non-agricultural sector requires agricultural inputs, such as cotton in textiles, food in the services sector, and many more.

Would this mechanism linking agricultural growth to economy-wide growth survive a change to an alternative modelling strategy? In a non-linear general equilibrium model with endogenous commodity and factor prices, but without import constraints, food and agricultural prices would rise as scarcity increases. Agricultural commodities would have to be imported at higher and higher prices from global markets. These higher prices would reduce non-agricultural demand, via the loss of purchasing power of consumers and higher production costs in sectors that use agricultural inputs. The mechanism for constraining overall growth would still be operating, although the quantitative impact might be less severe.

With high levels of per capita consumption, the demand for better quality and more processed agricultural commodities will increase. If better quality has lower yield per hectare, more land will be needed. On the other hand, if more processing reduces the demand for commodities, it can reduce the need for land. In the latter case, which is similar to technical progress in agriculture, the agricultural growth rate can increase a bit more, with consequences for the economy as a whole.

Growth and migration lead to a shift in the food consumption pattern in the economy. The share of foodgrains in total consumption of agricultural commodities declines, while that of fruits and vegetables, vegetable oils and oilseeds, plantation products, milk and milk products, egg, meat and fish, and other crops increases. The most significant increase is seen in horticulture and milk and milk products.

With economic growth, poverty decreases over time. The decrease in poverty is particularly rapid in a growth scenario with higher irrigation, higher food import limits, and Chinese-level productivity. Rural areas show a higher incidence of poverty than urban areas and it can be brought down to negligible levels only in the near double-digit growth scenarios.

Finally, we have to factor in climate change, though its threat is likely to be small in the next three decades. However, studies have shown that Indian agriculture is highly vulnerable to changes in climate – a two-degree Celsius rise could lead to a 15% to 20% reduction in yields of wheat and rice, and will lead to domestic price increases. Also, in the International Food Policy Research Institute's (IFPRI) IMPACT model, which projects increases in global food prices up to 2050, 50% or more are due to climate change. All this strengthens the conclusion of our analysis – increase TFPG in agriculture, expand irrigation, and be cautious about relying too much on imports if you want the Indian economy to achieve double-digit growth rate.

NOTES

1 We used the translog consumer demand system developed by Swami and Binswanger (1983).

2 India achieved similar rates of TFP growth during the 1980s and between 2003 and 2007. Past growth rates of irrigation have exceeded what is needed to reach 108 mha, though in recent years it has slowed down to 1% per year, which can reach the 90 mha targeted in the reference run.

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