Post-2015 Development Agenda

India Perspectives

Food Security

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In 2013, the USDA estimates that there were 842 million people around the world suffering from food insecurity. Despite considerable progress in reducing poverty (a nearly 9% reduction was achieved between 2004 and 2010), 30% of these people live in India and about 190 million Indians remain undernourished. Food security remains a major problem for the country.

India is nearly self-sufficient in production of cereals, but a wider variety of foodstuffs is needed and there are real problems in terms of food distribution and storage. This is despite a number of efforts designed to improve storage and distribution systems, the regulatory framework and provision of subsidies, to make sure more food gets to the people who need it. There is also the 2014 National Food Security Act, aimed particularly at improving food distribution. However, increased agricultural productivity also has an important part to play in improving food security.

An important issue in India as elsewhere is the level of postharvest losses (PHL). In India, the best estimate is that 21% - one kilo of food out of every five harvested – is wasted. Most of this happens between the farm and the consumer, although there are also on-farm losses and a small amount of wastage by consumers. Consumer waste is a much smaller problem than in developed countries, though.

Reducing losses would benefit both the farmer, who would have more food to sell, and the consumer, who would pay lower prices and so have more to eat. More dramatic changes in the spread of new technologies could push prices down further so that farmers might actually lose out, but in realistic scenarios both groups would gain.

Reducing PHL can take considerable investment in infrastructure and storage facilities. For example, reducing losses by 5% would mean building 500,000 kilometres of paved road and increasing the amount of electricity available per head of population (although this would remain modest by emerging economy standards).

Looking at two scenarios for gradual reduction of losses, either concentrating on staple foods or cutting waste of both these and more perishable produce such as fruit, vegetables and animal products, an investment of up to about $100 billion could be needed for rural infrastructure, including paved roads, railways and electricity supply. But for every rupee invested, we can expect benefits to farmers and consumers worth at least three rupees, making PHL reduction a very worthwhile investment. It is also likely that better infrastructure would have wider benefits which are not accounted for in this study.

Another important contribution could be made by increasing agricultural productivity. Quite modest annual improvements in yield – 0.4% for crops and 0.2% for livestock products – would make a considerable difference, and could be achieved by spending just $10 billion more a year on agricultural research and development. The gains would be very large: at least R22 for every rupee invested.

But improved productivity is not the whole answer. The overall benefits for both farmers and consumers are greater if losses of food are reduced, so it is important to invest in both rural infrastructure and agricultural research to really improve food security for poor Indians.

White Paper Report by Mark Rosegrant et al.

Despite significant improvements over the last several years, food security remains a crucial global problem. As of 2013, 842 million people were food insecure in the world (USDA 2014). A sizeable 30 percent of these people live in India. Hence, thinking about food security necessarily involves thinking about India. By any measure, very important progress has taken place in India over the last 20 years. From 2004 to 2010, the number of poor people in India decreased by nearly nine percent. This reduction in poverty has had important implications on food security. Improved food security requires that governments invest in public goods to create an enabling environment for the agricultural sector. But choosing where to invest is far from trivial, particularly as resources are finite and often scarce. For India, we show that investing in the agricultural research offers the highest return for the Indian government and can be highly beneficial to cause of food security.

In 2009-2011, India was home to 190 million undernourished people (FAO, IFAD, and WFP 2014). India's food security issues are on both the demand and supply sides. On the demand side, while India has nearly attained self-sufficiency in the production of cereals, increased consumption of other food types suggest that India must diversify its agricultural production. Dev and Sharma (2010) highlight six supply-side issues that have hampered India's progress towards food security: insufficient levels of investments, infrastructure and credit services; insufficient and inefficient systems of land and water management; inefficient markets; lack of diversification; and lack of solid institutions. These issues are by no means new and have been impacting India's food security for some time (see for instance, Umali-Deininger and Deininger 2001). These studies suggest more targeted interventions from the government to address issues of food distribution, storage, management and prices.

To some extent, programs have become more targeted in recent years and a number of policy instruments have been in place. There have been increased efforts to boost agricultural research, improve input distribution systems, expand current infrastructure (including roads, storage facilities and access to cooperatives), improve the regulatory market framework, and provide subsidies to both consumers and producers (Acharya 2009). The National Food Security Act, enacted in 2014, also offers the possibility of improving food security in general, but particularly food distribution (Narayanan 2015). The ultimate goal, however, is to create conditions that will allow more people to become food secure. From a food production perspective, the most direct way to augment food security is by increasing productivity, or by investing in activities that help promote the growth of productivity.

While the need for increased productivity is perceived as a given, there is also debate about the potential gains that can be obtained by reducing postharvest losses (PHL). Estimates of how much food could be saved by reducing losses vary considerably in part due to the questionable quality of the data (see Rosegrant et al. 2015 for a review of the issues surrounding PHL). For India, the issue of PHL is significant – it is estimated that on average 21 percent of the total amount of food produced is wasted, most of the losses take place at the value-chain stage (i.e. the intermediary step between leaving the farm where it is produced and reaching the consumer), followed by on-farm losses. Consumer losses are very low at four percent, particularly compared to developed countries.

The impact of PHL reduction on food security is also the subject of much debate. Part of what spawns this debate is the costs associated with reducing PHL, which can be quite substantial, particularly in light of scarce resources. An additional component of this debate is whether the adoption of technologies or strategies to reduce PHL require investments in infrastructure, both in terms of physical and human capital. In Rosegrant et al. (2015), we explored the role of infrastructure in reducing PHL. Our work points

to important gains that can be made in the reduction of PHL by improving infrastructure. More importantly, however, we estimate alternative investment scenarios which allow us to compare the returns of investments to reduce PHL with other yield-enhancing alternatives, particularly agricultural research and development (R&D). Enhancing agricultural R&D is crucial and more beneficial as this directly targets food security in developing countries than investing in infrastructure.

In this paper, we have drawn from Rosegrant et al. (2015) to estimate similar scenarios for India. Our methodological approach, analysis and results are presented in the next sections. In particular, section 2 outlines the methodology used to measure and quantify the impacts of different investments. Section 3 discusses the results of our simulations and is followed by a brief conclusion.

Methodological Approach

The investment simulations were conducted using IFPRI's International Model for Policy Analysis of Agricultural Commodity and Trade (IMPACT). IMPACT provides long-term projections of food supply, demand, trade and prices, which, in turn, can provide trends in global food security between 2010 and 2050. Two key food security indicators are also provided: number of malnourished children under the age of five and number of people at risk of hunger[1].

The model[2] assesses the economic and food security impacts of investments to reduce PHL by treating the reduction in PHL as effective increases in commodity yields (productivity). A similar approach is taken to compute the impact of investment in agricultural research. Three different scenarios were analyzed, based on different assumptions about the rates of return of investments and the amount of investments effectively allocated to PHL reduction and agricultural research. By doing so, the model allows for a direct comparison of the potential gains from these two different kinds of investments (PHL reduction through investments in infrastructure and agricultural R&D) across four different scenarios. In the next section, we present a brief overview of the socioeconomic assumptions, as well as the baseline scenario and the alternative four scenarios.

Scenarios Description

All scenarios were run using the Intergovernmental Panel on Climate Change (IPCC) medium projection on shared socioeconomic pathways (SSP2), and assuming a constant 2005 climate. Table 1 summarizes the assumptions on socioeconomics for SSP2.

The following scenarios shown in Table 2 were then implemented to test the effects of potential decreases in PHL (through investments in infrastructure) as well as yield gains caused by agricultural research. Scenarios 1-2 follow the same specifications as the baseline, except where described below. Additionally, an increase in incremental investment in agricultural R&D from an additional US$ 5 billion/year to US$ 8 billion/year was included to allow for comparability of the benefits of investments decreasing PHL to the benefits of increasing agricultural R&D (Scenario 3). For the final scenario, we follow the assumptions made by Hoddinott, Rosegrant, and Torero (2013), where the effects of agricultural R&D would increase the yield growth for crops by 0.4 percent per year and livestock by 0.2 percent per year.

[1] For more details on the specifics of the IMPACT model, please see Rosegrant and the IMPACT team (2012); and Hoddinott, Rosegrant, and Torero (2013).
[2] IMPACT Version 3, newly updated in 2014.

Table 1. Average annual growth rates (%) to 2050 for GDP, population, and per capita GDP by region under SSP2.

Region	GDP[a]	Population[b]	Per capita GDP[c]
East Asia and Pacific	2.9	0.1	2.8
Europe and Central Asia	1.9	0.1	1.8
Latin America and Caribbean (LAC)	2.4	0.5	1.9
Middle East and North Africa (MENA)	3.6	1.1	2.4
North America	1.5	0.5	0.9
South Asia (including India)	4.1	0.7	3.3
India	4.2	0.7	3.4
Sub-Saharan Africa (SSA)	5.4	1.8	3.5
World	2.5	0.6	1.9

Notes:
[a] OECD GDP projections
[b] IIASA Population projections
[c] Calculated in IFPRI's IMPACT model
Source: SSP Database (https://secure.iiasa.ac.at/web-pps/ene/SspDb/dsd?Action=htmlpage&page=about)

Table 2. Scenario summary.

Scenario	Region	Commodities Groups and Postharvest Loss Assumptions	
		Less perishable commodities[a]	**More perishable commodities[b]**
Baseline (BSL)	Global	Standard IMPACT 3 yield projections	
Scenario1 (PLIn1)	India only	By 2020: postharvest losses decline by 3% By 2025: postharvest losses decline by 6% By 2030: postharvest losses decline by 10%	
Scenario2 (PLIn2)	India only	By 2020: postharvest losses decline by 1% By 2025: postharvest losses decline by 3% By 2030: postharvest losses decline by 5%	By 2020: postharvest losses decline by 4% By 2025: postharvest losses decline by 9% By 2030: postharvest losses decline by 15%
		Yield Assumptions from Investments in Agricultural R&D	
Scenario3 (ARIn1)	India only	Starting in 2015 All crops: exogenous yield growth increases by 0.4 percent per year All livestock products: exogenous yield growth increases by 0.2 percent per year	

Notes
[a] Cereals, Pulses, Roots and Tubers, Oilseeds, and Other Crops
[b] Fruits, Vegetables, and Livestock products
Source: Authors

Required increases in infrastructure investment in these scenarios are large. For example, the investments in paved roads required to reduce PHL by 5 percent translates into building about 500,000 kilometers of paved roads. Average electricity consumption would rise from 649 kwh/person in 2011 to 1096 kwh/person in 2025. Although this is a big increase, the India consumption figure will be in 2025 would be comparable to that of Vietnam in 2010.

Model Results and Analysis

Reductions in PHL and increased agricultural R&D increases food supply, which in turn reduces food prices and boosts food consumption by making food more affordable. As a result, an increase in agricultural R&D investments for India also leads to improvements in food security. Indeed, people at risk of hunger in India decline by 3.8 percent under the scenario focused on less perishable commodities (PLIn1); by 2.8 percent under the scenario targeting both less and more perishable commodities (PLIn2), and by 4.8 percent under agricultural R&D investment scenario (ARIn1).

Price reductions under the various scenarios provide obvious benefits to consumers by making food more affordable. However, because price reductions also affect producers, a detailed welfare analysis is required to understand how society as a whole benefit from investments to reduce PHL and increase agricultural research efforts. We have, therefore, estimated the changes in welfare under two different discount rates for each scenario, relative to the baseline.

1. Low discount rate = 3 percent
2. Medium discount rate = 5 percent

Table 3 summarizes the results across the two different discount rates for India. Starting with the medium discount rate, we note that total welfare is improved under all scenarios. In some scenarios producers witness a loss in welfare caused by the drop in prices. These losses, however, only take place if technologies are adopted extensively so that commodity prices will be reduced beyond the productivity gains for Indian farmers. The gains in welfare for India are more pronounced than global gains described in Rosegrant et al. (2015). Under a lower discount rate, gains are much larger.

Table 3. Change in Indian producer surplus, consumer surplus, and welfare by 2050 under different discount rates.

Description	Discount Rate Scenario	
	Low (3 percent) (US$ billion)	Medium (5 percent) (US$ billion)
PLIn1 (less perishable commodities)		
Producer Surplus Change	288	163
Consumer Surplus Change	58	32
Welfare Change	346	196
PLIn2 (less and more perishable commodities)		
Producer Surplus Change	404	228
Consumer Surplus Change	59	33
Welfare Change	462	261
ARIn1 (agricultural R&D investment)		
Producer Surplus Change	197	108
Consumer Surplus Change	44	24
Welfare Change	240	132

Source: IFPRI IMPACT Model version 3.1 (2014)

Benefit-Cost Analysis

Policymakers base their investment choices on the net gains from a given investment – how much is received for each dollar invested. To understand the impact of the different possible decisions regarding reductions in PHL and agricultural research, we now consider the benefit-cost ratios (BCRs) of different scenarios of investment for India.

The BCRs for India are presented in Table 4. Increased agricultural investment in India is highly beneficial, with benefit-cost ratios above 20. PHL investments for India-only scenarios are also profitable, although substantially less so than agricultural research investment.

Table 4. Benefit-Cost Analysis under 100 percent cost allocation for India.

	Discount Rate	PLIn1	PLIn2	ARIn1
Benefits derived from investments (US$ billion)	3 percent	346	462	240
	5 percent	196	261	132
Costs (US$ billion)	3 percent	89	104	10
	5 percent	66	77	6
BCR	3 percent	3.9	4.4	24.0
	5 percent	3.0	3.4	22.0

Source: IFPRI IMPACT Model version 3.1 (2014).

India is home to more than one-fifth of the undernourished people in the world, posing a major challenge for food security policy. It has made major strides in agricultural development over the past decades, but still faces significant challenges. Increased investments in public goods to support agricultural development is a key to future growth. In this note we assessed the rates of return to two essential public goods: investment in rural infrastructure, including electricity, roads, particularly paved roads, and railways to reduce post-harvest losses; and investment in agricultural research and development to boost productivity growth. The analysis shows that investment in infrastructure for PHL reduction contributes to lower food prices, higher food availability, and improved food security, and has positive economic rates of return. However, increased investments in agricultural research has considerably higher BCRs and greater improvement in food security. Both types of investments are essential for future agricultural development. The benefits of infrastructure investments may be underestimate here, since these investments would likely have large benefits in other sectors of the economy as well.

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