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What India wants

Analysis of India's food demand to 2050

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Foreword

Strong economic growth in India over the past twenty years is expected to continue in the coming decades. Economic reforms have shifted India toward a more market-oriented economy with increased openness to foreign investment and trade.

India's economic growth, population growth and urbanisation trends have contributed to fundamental changes in the demand for food. Not only has total food consumption increased over the past two decades but diets have become more diverse, with households consuming more vegetables, fruit and dairy products. While most of these foods are produced domestically, food imports have also risen.

Current Indian agrifood policies are directed at protecting producers and consumers from uncertainties arising from market movements. The cost of this policy approach to India's Union and state governments is high. This report develops three hypothetical policy environments that move from the existing policy settings for rice and wheat to ones that place smaller demands on government budgets and that lead to improved potential for economic growth. India's growing potential as a market for Australian agricultural exports under these alternative policy settings is assessed.

This report is part of the *What Asia wants* series, which analyses future food consumption and trade trends in Asian countries over the long term. Previous reports in this series are *What Asia wants* and *What China wants*.

Karen Schneider
Executive Director
November 2014

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Summary

India has been one of the world's fastest growing economies over the past twenty years. That growth mainly reflects government reforms to support economic activity and increase the openness of the economy to global markets. It has brought with it rising household incomes and a gradual increase in the proportion of the population living in urban centres, trends that are projected to continue to 2050. As a result, consumption of agrifood products has been rising, and is projected to more than double between 2009 and 2050.

Indian consumers are not only demanding more food but a wider variety of foods. To meet increased demand the Indian agrifood sector needs to contend with the challenges of increasing its production and productivity growth. Some of the existing production challenges are being addressed by significant and ongoing investment in the sector, investment which nearly doubled productivity in the 2000s compared with the previous decade. The Indian Government's continued commitment to agricultural investment will be required to further mitigate or overcome the persistent challenges of a deteriorating resource base, and rising costs of intermediate inputs and transport.

On the consumer side, the significant projected increase in agrifood demand also poses challenges for India where, despite rising incomes, poverty continues to be widespread and access to food for many is dependent on existing agricultural policies. India's agricultural and food policies have three broad objectives: food security, food self-sufficiency and income support for farmers (USITC 2009). Among the many policies employed to meet these objectives are the subsidised prices of staple grains paid by consumers and the guaranteed minimum support prices (MSP) received by farmers for their grain. These policies insulate consumers and producers from market price movements. However, their financial cost to the Indian Government is significant and increasing.

With the population of India expected to increase from 1.2 billion in 2010 to about 1.6 billion in 2050, the nature of food demand will depend on a number of factors, including income growth, urbanisation and the policy direction taken by the Indian Government. Using an updated version of the ABARES agrifood model (Linehan et al. 2012a), this study analyses potential changes in agrifood consumption, production and trade to 2050 stemming from three hypothetical changes to existing agrifood policies. These hypothetical policy environments progressively move the existing policy settings for rice and wheat to ones that are more market oriented, reduce government expenditure and improve the sector's potential for growth. While these policy changes are not currently on the agenda of the Indian Government, they are not inconsistent with the overall approach to reform.

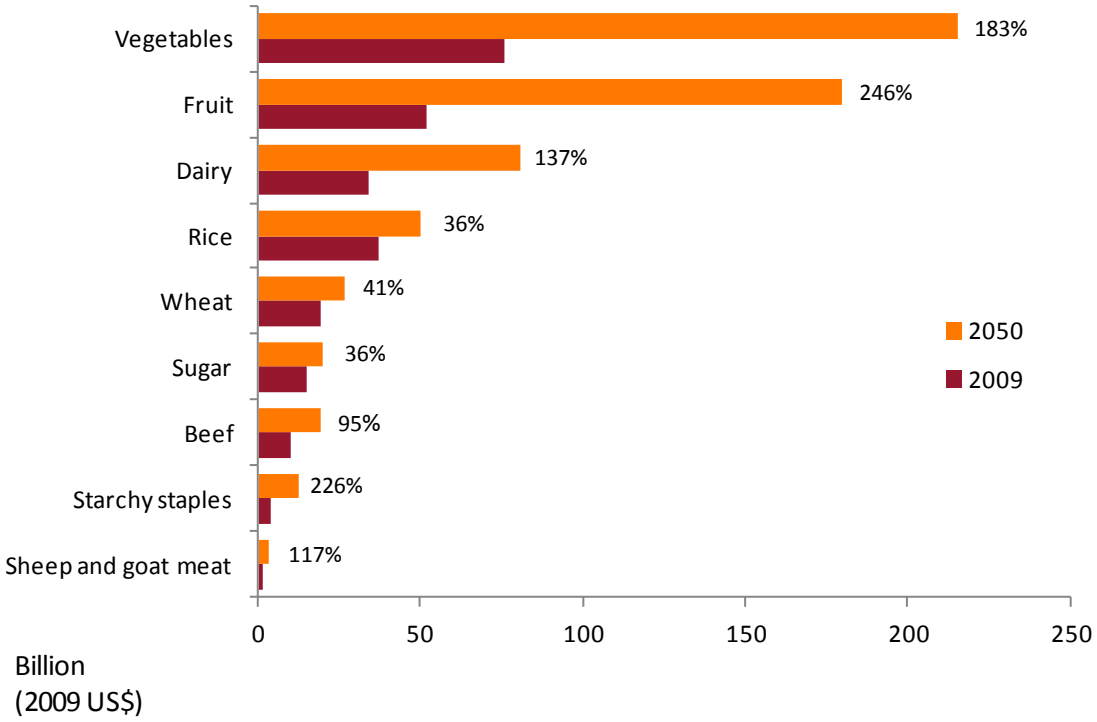
The agrifood model is an economic simulation model of global agricultural production, consumption and trade. In this report, agrifood products include primary agricultural products and lightly transformed agricultural products, such as flour and meat. Highly processed food items, such as beverages and packaged food, are not included.

Business-as-usual

Under the assumptions established in the business-as-usual policy environment (policy environment 1), in which no changes to India's existing policy settings are assumed, the rise in the real value of food consumption in India will be characterised by a move toward more diverse diets, with higher intake of vegetables, fruit and dairy products. Between 2009 and 2050, the real value of vegetable consumption is projected to rise by 183 per cent, fruit by 246 per cent,

dairy by 137 per cent and wheat by 41 per cent (in 2009 US dollars; Figure S1). These value increases are driven by greater quantities demanded and not because of any significant projected rise in real prices.

Figure S1 Agrifood consumption under a business-as-usual policy environment



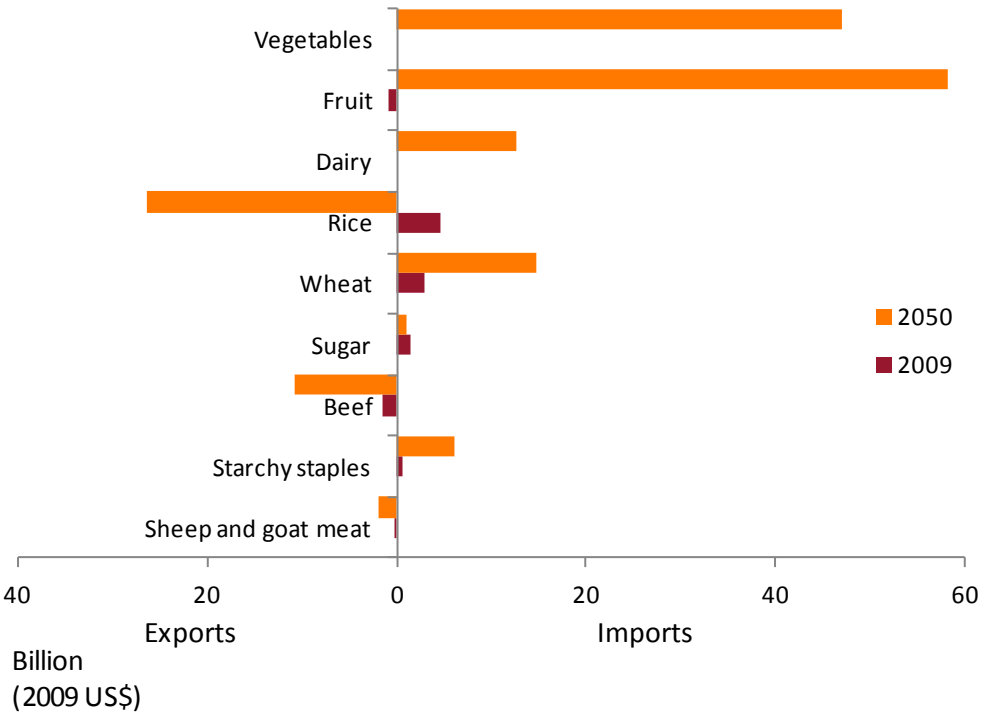
Note: starchy staples include pulses and yams.
Source: ABARES model output

The upward demand trend is most pronounced among urban households, where income growth is assumed to be greater than rural households. In rural households, slowing rural population growth and relatively lower incomes will result in slower total food consumption growth compared with the urban population. For traditionally important staple food in India, namely rice, the real value of consumption is expected to rise more modestly across all household groups, mainly reflecting population growth.

Under the business-as-usual environment, the real value of India's agrifood production is projected to more than double from US$283.3 billion in 2009 to US$574.6 billion in 2050 (in 2009 US dollars). This increase is driven by higher production of beef (up 179 per cent), rice (162 per cent), fruit (113 per cent), vegetables (107 per cent) and dairy products (88 per cent). For most commodities, the projected increase in production is smaller than that of consumption. As a result, imports are projected to increase.

In 2050, imports of vegetables and dairy products are projected to be around US$47 billion and US$12.7 billion, respectively (in 2009 US dollars), compared with negligible vegetable or dairy trade in 2009 (Figure S2). Imports of fruit are projected to be around US$58.2 billion in 2050, compared with exports of US$0.9 billion in 2009. For wheat, the value of imports is expected to increase by 395 per cent by 2050, to US$14.8 billion (in 2009 US dollars), which would increase the import share of wheat consumption from 16 per cent in 2009 to 55 per cent in 2050.

Figure S2 Trade of selected agrifood commodities, India



Source: ABARES model output

In contrast, the projected increase in the production of rice and beef is greater than the increase in domestic demand. By 2050, India is projected to be a net exporter of rice, with the real value of exports at US$26.3 billion (in 2009 US dollars) (Figure S2), compared with imports of US$4.7 billion in 2009. For meat products, particularly beef, the rise in production largely reflects strong projected export demand. India is the world's largest exporter of carabeef (mostly buffalo). By 2050, Indian exports of carabeef are projected to increase more than sevenfold to US$10.8 billion (in 2009 US dollars).

Hypothetical policy environments

To investigate the effect policy can have on the agricultural sector, the report includes analysis of hypothetical reform to the existing producer price support and consumer subsidy policies reflected in the business-as-usual policy environment (policy environment 1). Three hypothetical policy environments are considered that progressively modify policy environment 1.

- In policy environment 2, domestic support policies are removed for rice and wheat and access to food for the poorest citizens is assured through a social security policy.
- Policy environment 3 builds on policy environment 2 by increasing investment in the rice and wheat industries to raise the productivity of these two crops.
- Policy environment 4 builds on policy environment 3 by assuming that significant investment in transport infrastructure lowers transport costs.

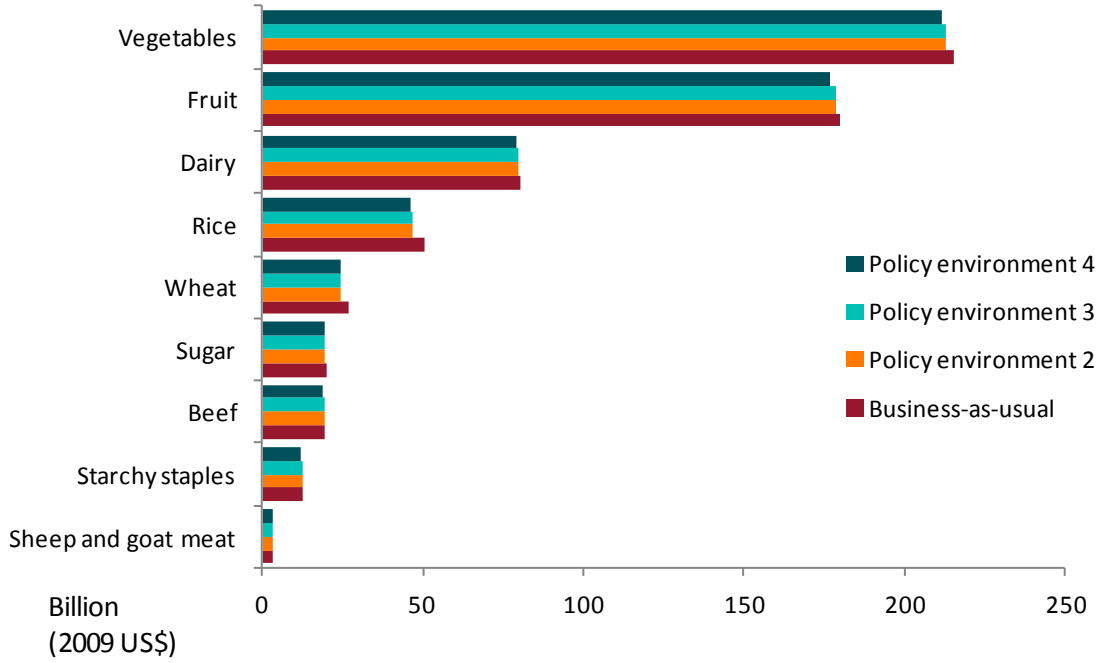
Under the hypothetical policy environments 2 and 3, consumption and production of the staple grains continue to rise significantly compared with 2009 (in value terms) but by less than the

business-as-usual case (Figure S3 and Figure S4). This occurs principally because the removal of government price support payments leads to a fall in domestic prices as the grains industry becomes more market oriented. Under policy environment 3, the value of production of staple grains is higher than the business-as-usual case because of the higher volume of rice and wheat produced.

For vegetables and fruit, the projected values of consumption and production are lower in policy environments 2 and 3 compared with the business-as-usual case (Figure S4) because of a relatively lower increase in prices. The volume produced is also lower as production shifts toward rice and wheat given the assumed productivity improvement.

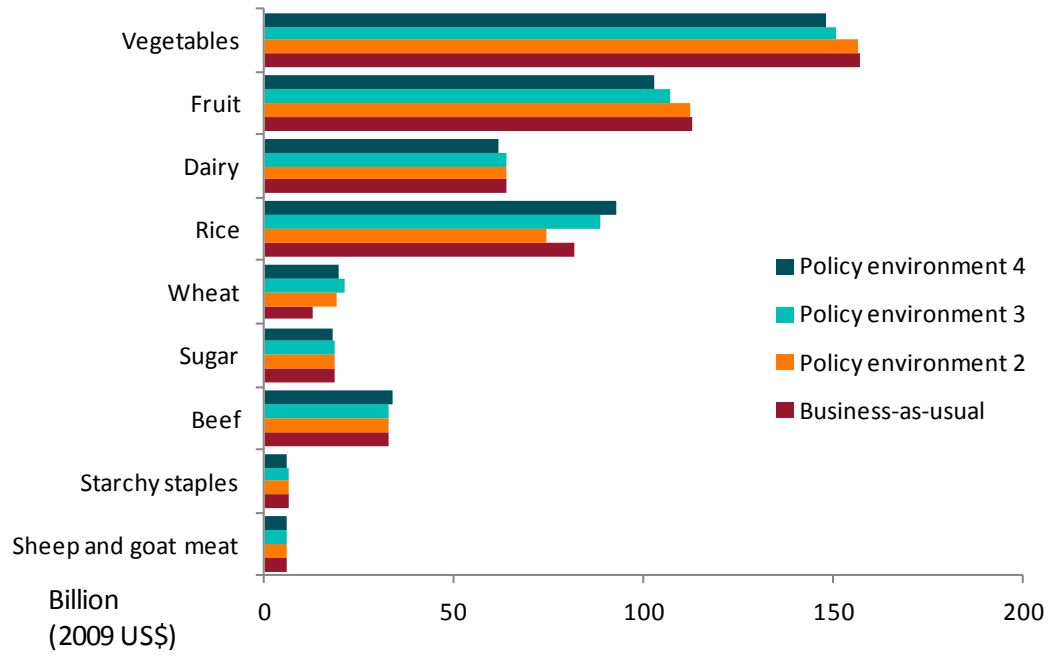
Relative to the business-as-usual environment, India's total agrifood imports in 2050 are 6 per cent lower under policy environment 2 but 2.4 per cent higher under policy environment 3. In the latter scenario, the relative rise in imports is driven by the need to satisfy growth in domestic demand following a shift out of horticulture by some producers as they opt to engage in the relatively more productive and market-oriented grains sector (Figure S5).

Figure S3 Agrifood consumption in India in 2050



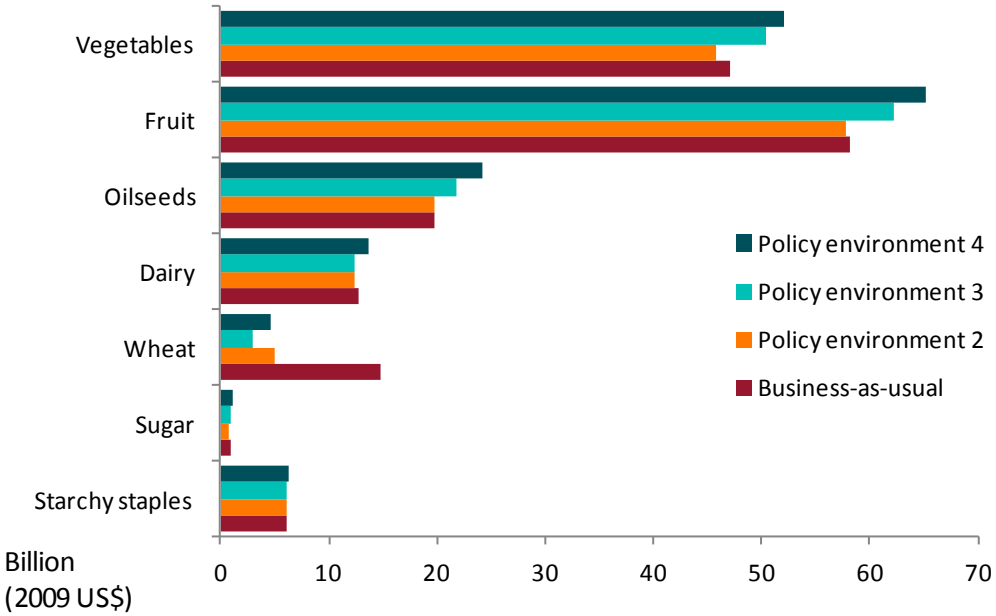
Source: ABARES model output

Figure S4 Agrifood production in India in 2050



Source: ABARES model output

Figure S5 Imports of selected agricultural commodities in India in 2050



Source: ABARES model output

Policy environment 4 assumes that a portion of the resources saved following the hypothetical domestic policy reform is reinvested in transport infrastructure, halving the costs of domestic transport. This scenario allows for more cost effective transport of the higher volume agrifood commodities being demanded in 2050, while mitigating the increase in prices that would otherwise occur. In so doing, the rise in agrifood demand can be satisfied while the affordability of food is maintained.

In this more complex policy environment, production of rice and other cereals is again projected to rise to 2050 (in value terms) while that of vegetables, fruit and dairy products is projected to decline. As a result, the real value of total agrifood imports increases by 11.2 per cent more than in the business-as-usual case in 2050 (and 18.3 per cent and 8.5 per cent more than policy environments 2 and 3, respectively).

The analysis in this report indicates that long term growth in India's import demand for agrifood products is driven predominantly by a relatively small subset of food products, mainly vegetables, fruit, dairy products and wheat. The hypothetical domestic policy reforms examined will not significantly affect this consumption trend although it is projected to positively affect agrifood production for staple grains and to mitigate any significant increase in prices paid by consumers, ensuring that the most vulnerable citizens have access to food.

The demand for vegetables, fruit, dairy products and wheat will be satisfied through increased imports. Australian agriculture is well place to meet increased import demand in India. However, there will be strong competition from India's domestic production and products of other exporters that will require an ongoing focus on productivity enhancements in Australian agriculture.

1 Introduction

World demand for agrifood products is expected to increase significantly over the period to 2050, with the real value of Asian agrifood demand expected to double (Linehan et al. 2012b). The rise in the global population, per person incomes and rates of urbanisation, especially in developing countries, are driving this increase. India is projected to become the world's most populous country by 2025 and benefit from strong economic growth over the coming decades. Together, these factors are projected to result in a marked increase in total food consumption. Over the long term, the real value of the projected increase in food demand in India accounts for more than 10 per cent of the global increase (Linehan et al. 2012b).

Given India's potential future importance in world agrifood markets, the objective of this report, the third in the *What Asia wants* series, is to build upon existing ABARES analysis of global food consumption and production by examining the factors likely to influence the future pattern of India's food consumption. The analysis is distinct from that carried out in *What Asia wants: Long-term food consumption trends in Asia* (ABARES 2013) because it focuses on projected household consumption trends across urban and rural consumers and how they are influenced by hypothetical changes to Indian agricultural policies.

For this analysis, an updated version of the ABARES agrifood model (Linehan et al. 2012a) was developed. The model is a partial equilibrium economic model of global agricultural supply, demand and trade. The agrifood products include primary agricultural products and lightly transformed agricultural products, such as flour and meat. Highly processed food items, such as beverages and packaged foods are not included. The model has been updated to a new baseline and starts from a new base year (from 2007 to 2009). Also included are India's domestic market price stabilisation policy and a targeted consumer subsidy for both wheat and rice, as modelled by Thorpe et al. (2014). Consumption in the model is apparent consumption, which reflects the total use of agrifood products (food, feed and industrial use). Income growth estimates across urban and rural consumers are also included. Other demand and supply-side assumptions follow those of the OECD–FAO (2012).

Section 2 of this report examines the factors expected to influence India's food demand trends to 2050 and presents the income and population assumptions used in the analysis. Section 3 discusses the production constraints or challenges with which India will have to contend over the longer term in order to increase its agricultural output. Section 4 presents India's principal policies supporting grain production and consumption. Section 5 discusses projected consumption, production and trade trends to 2050 in a business-as-usual policy environment in which all existing agricultural and consumer support policies are assumed active. This section also contains results from three hypothetical policy environments that build on each other to examine the effect on agricultural production, consumption and trade following:

1) reform to the principal domestic grain policies
2) increased productivity in rice and wheat production
3) reduced domestic transport costs.

Section 6 summarises the main findings of the analysis and discusses some of their implications for Australia.

2 Drivers of food demand

Food consumption per person in India has increased over the past two decades. This rise has been the result of more varied diets and greater consumption of some foods, particularly dairy products, fruits and vegetables. These changes have been influenced by a rising level of affluence and other factors such as age, lifestyle and urbanisation. At the national level, higher food consumption also reflects population growth.

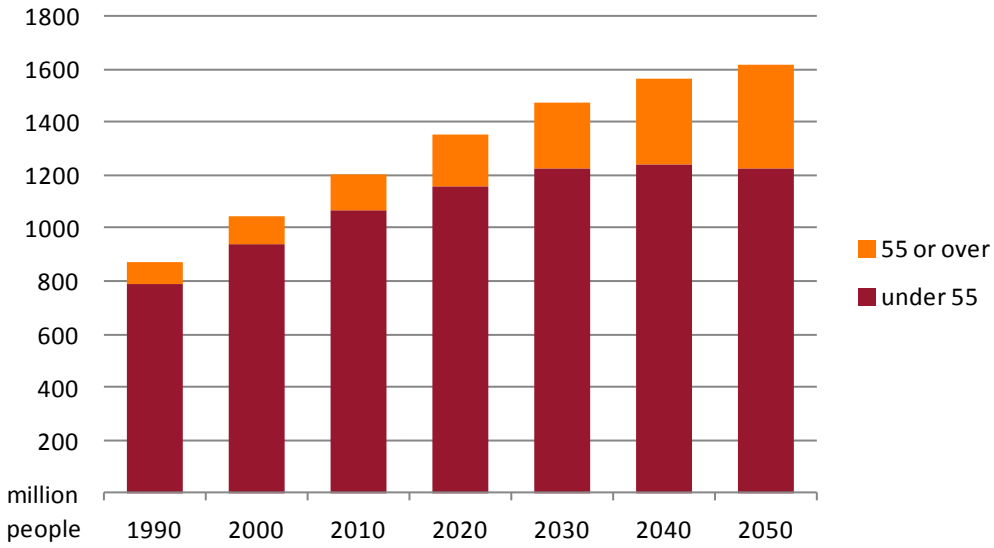
Population growth

India's population grew from 869 million in 1990 to 1.2 billion in 2010, making it the second most populous country in the world after China. Its population growth rate is one of the highest in Asia although it is slowing. Between 1990 and 2000, its population grew at an average rate of 1.8 per cent a year. Between 2000 and 2010 it moderated to 1.5 per cent a year as birth rates fell in conjunction with rising incomes and rates of education (United Nations Population Division 2013).

The United Nations Population Division (2013) projects India's population growth rate will average 1 per cent a year between 2010 and 2030 and 0.5 per cent a year between 2030 and 2050. Despite the slowing growth rate, its population is expected to increase substantially, surpassing that of China by 2025. By 2050, India's population is projected to be 1.6 billion.

India's population is young, with 88 per cent of the population under the age of 55 in 2010, compared with 82 per cent in China and 62 per cent in Japan (United Nations Population Division 2013). Its population is expected to remain relatively young by 2050, when around 75 per cent of its population is projected to be aged under 55 (Figure 1).

Figure 1 India's population, by age

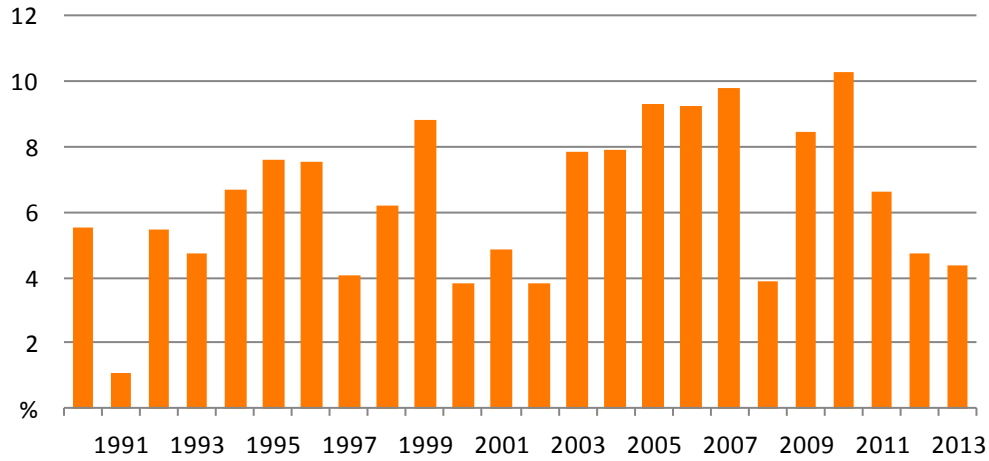


Note: Medium-variant projections.
Source: United Nations Population Division 2013

Income growth

Over the past two decades, India has emerged as one of the world's fastest growing economies. In the 20 years to 2010, real gross domestic product (GDP) increased at an average annual rate of 6.6 per cent (Figure 2). Indian consumers have benefited significantly from this growth because per capita GDP in constant prices increased 2.5 times over the same period (IMF 2013).

Figure 2 Annual real economic growth rate in India



Source: IMF 2013

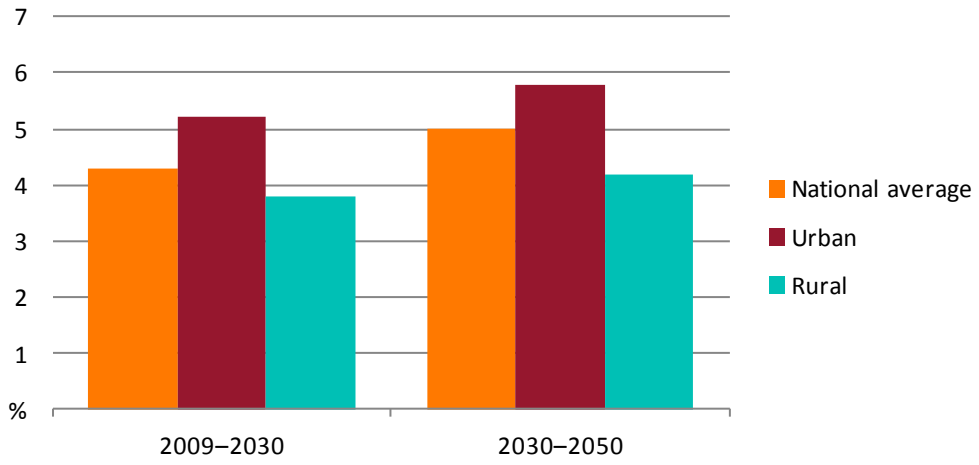
India's strong economic growth mainly reflects reforms implemented in the 1990s to support economic activity and increase the openness of the economy to global markets. The success of these reforms is especially evident in the growth of the services sector, particularly with the development of software, information technology and other business services. Between 1990 and 2010 the services sector grew at an average annual rate of 8.3 per cent and its share of GDP increased from 44 per cent to 54 per cent (World Bank 2013a). Additionally, India's increased participation in global trade led to average growth of goods and services exports of 12 per cent a year over the same period, from 2 trillion rupees to 17 trillion rupees.

Average per capita incomes have also been rising in India over the past two decades, albeit from a low base. However, a large portion of the population continues to live in poverty, defined by the Indian Government as having income of less than 816 rupees ($US15.0) per person a month in rural areas and 1000 rupees ($US18.3) per person a month in urban areas (Indian Planning Commission 2013). In 2012, around 276 million people, or 22 per cent of the population, lived in poverty (World Bank 2014a). Projected economic growth will drive a rise in per person incomes, underlining the potential for strong growth in food demand toward 2050.

Sustaining India's rapid economic growth will require overcoming a number of challenges. In particular, there is limited availability of modern infrastructure, such as electricity grids and transport networks. For example, McKinsey & Company (2010) report that rail and coastal shipping costs in India are approximately 70 per cent higher than those in the United States, while road costs are around 30 per cent higher. These inefficiencies are estimated to cost India around 4.3 per cent of its GDP a year (McKinsey & Company 2010). Unless substantial improvements in infrastructure are made, bottlenecks and production constraints will become major impediments to economic growth (World Bank 2013b).

In this analysis it is assumed that GDP growth in India will average 4.3 per cent a year to 2030 and then 5.0 per cent a year to 2050. Urban incomes are assumed to continue to grow more rapidly than rural incomes (Figure 3).

Figure 3 Average annual income growth rates in India



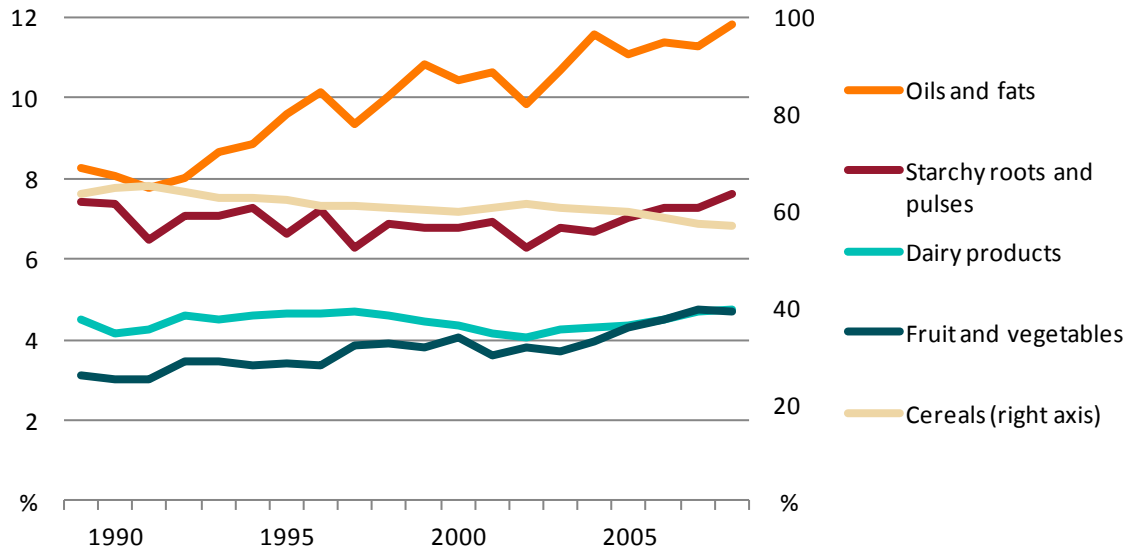
Source: ABARES agrifood model assumption

Food consumption

Increasing income levels have led to a diversification of diets in India, with rising per person consumption of dairy products, fruit and vegetables. Between 1990 and 2009, per person food consumption increased by 6 per cent to 2300 calories a day. Per person consumption of cereals fell by 5 per cent, while consumption of dairy products grew by 12 per cent and fruit and vegetables by 60 per cent, albeit from a low base (FAO 2013).

Cereals remain the largest component of Indian diets, although their share of total national consumption declined from 64 per cent of calorie intake in 1990 to 57 per cent in 2009. In contrast, the share of oils and fats in total consumption increased from 8 per cent in 1990 to 12 per cent in 2009; the share of dairy products increased from 4 per cent to 5 per cent; and the share of fruit and vegetables, together, increased from 3 per cent to 5 per cent (Figure 4).

Figure 4 Share of total consumption of selected commodities



Source: FAO 2013

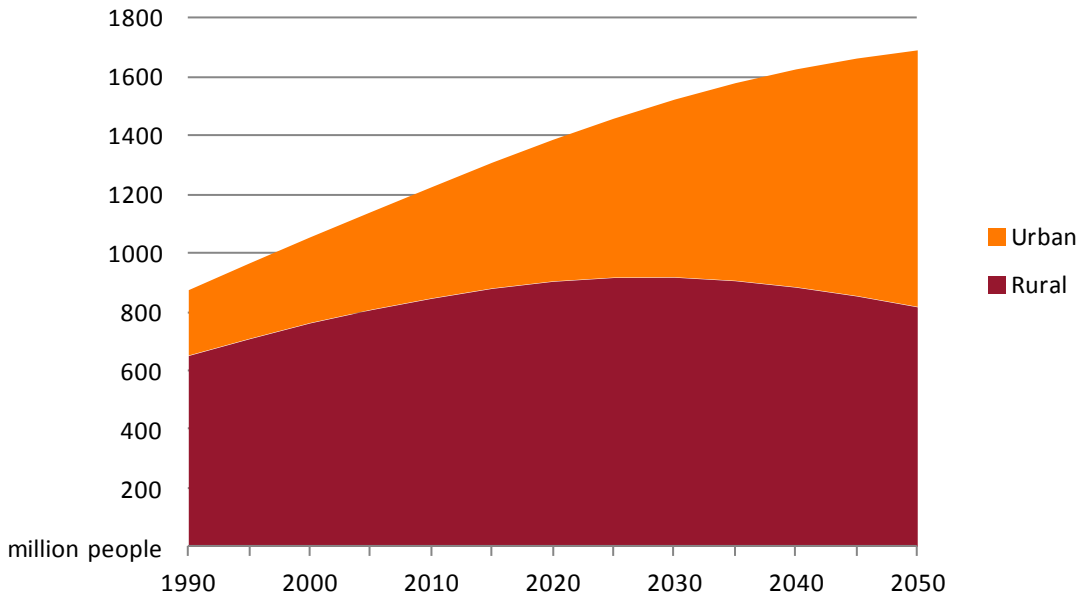
Consumption of meat in India is markedly lower than in other Asian countries. For example, in 2009, consumption of meat in India was 17 calories per person a day compared with 462 calories per person a day in China and 242 calories per person a day in the Republic of Korea (FAO 2013). The relatively low level of consumption reflects the prevalence of vegetarian diets in line with local religious beliefs.

Urbanisation

Urbanisation describes the increasing proportion of a country's population living in cities. It is an important determinant of the quantity and type of food demanded. Urban dwellers typically have higher incomes than their rural counterparts, access to a wider variety of foodstuffs and different dietary patterns.

With incomes around double those of rural areas (Desai et al. 2010), the share of India's population living in urban areas increased from 26 per cent in 1990 to 31 per cent in 2010 (Figure 5). This trend is projected to continue, with 52 per cent of the population living in urban areas by 2050 (United Nations Population Division 2012). In contrast, the rural population is projected to decline marginally between 2010 and 2050. This implies that any increase in food demand from rural consumers will be the result of rising rural incomes.

Figure 5 Size of urban and rural populations

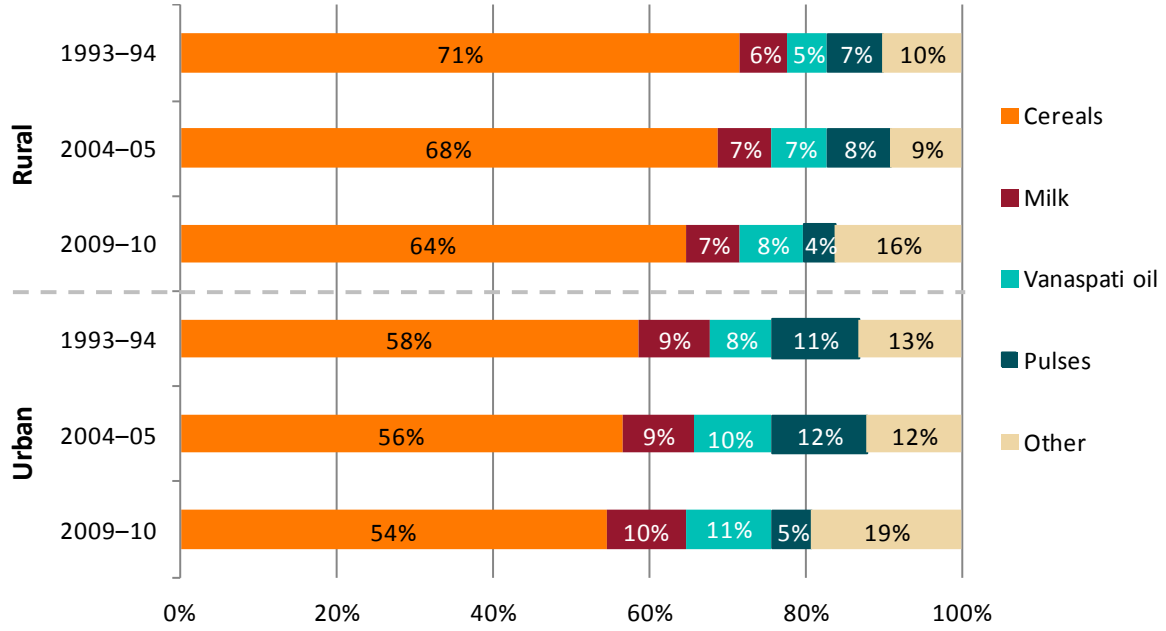


Source: United Nations Population Division 2012

Higher average incomes in urban areas allow urban consumers to not only spend more on food than rural consumers but also to have a more diverse and higher value diet. In 2004–05, per person expenditure on food was around 32 per cent higher in urban areas than rural areas (Deaton & Dréze 2009).

Indian Statistics Bureau data reported by Gaiha et al. (2012) show that consumption of cereals—wheat and rice, in particular—accounted for a greater share of total food calories in rural diets than urban diets (Figure 6). Consumption of more high value foods, such as dairy products, oils and pulses, were common in urban diets. In 2009–10, for example, cereals accounted for 64 per cent of the food calories consumed in rural areas and only 54 per cent in urban areas, while dairy products represented 7 per cent of food calories in rural areas and 10 per cent in urban areas. Consumption of other foods, including sugar, fruit and vegetables, each accounted for between 5 and 6 per cent of calorie intake in both rural and urban areas.

Figure 6 Share of calorie intake, by food commodity



Note: Eggs and meat accounted for less than 1 per cent of calorie intake for all years in urban and rural areas. Vanaspati oil is a popular vegetable cooking oil in India that is often used as a cheaper substitute for ghee (clarified butter) (Passi & Bhardwaj 2014).
Source: Gaiha et al. 2012

The higher incomes and lifestyle changes that characterise urban dwellers have led to higher consumption rates of convenience foods, fast foods and restaurant food than their rural counterparts. Using India's Household Consumption and Expenditure Surveys, Smith (2013) reports that meals at commercial establishments have become more common over the past two decades, increasing by 58 per cent in urban areas and 34 per cent in rural areas between 1993–94 and 2009–10. By 2009–10 the share of urban households with members purchasing meals in commercial establishments was 16 per cent, compared with 6 per cent in rural areas. While this rate is low compared with other Asian countries, continued urbanisation toward 2050 will support the growing demand for food consumed outside the home.

3 Production constraints in Indian agriculture

India's agricultural sector will be challenged to supply the quantity and variety of foods being demanded over the next forty years. While it is projected that most of India's food demand will be met by domestic production (Linehan et al. 2013), this will not be easy to achieve. Challenges to improving productivity growth include India's domestic agricultural market support policies (described in Chapter 4), increasing input costs and depleted natural resources used in agricultural production. This chapter briefly addresses some of these issues.

Agricultural production in India increased at an average annual rate of 2.9 per cent over the past two decades. Between 1990 and 2010, production of vegetables increased at an average of 3.7 per cent a year, livestock production by 3.6 per cent and cereal production by 1.5 per cent (FAO 2013).

The rise in production is in part attributable to increases in the use of inputs and in part to productivity growth. Although labour and land use contracted slightly between 1990 and 2010, net capital stock increased by 1.4 per cent a year between 1990 and 2007 (FAO 2013) and the use of fertiliser increased by 4 per cent a year between 1991–92 and 2009–10 (Jaga & Patel 2012).

Total factor productivity (TFP) in India's agricultural sector increased at an average of 1.1 per cent a year between 1991 and 2000 and 2.1 per cent a year between 2001 and 2010 (Fuglie 2012). The productivity improvement is mainly the result of increased public spending on research and development, and the adoption of new technologies by farm businesses (Beintema et al. 2012).

Resource constraints

Land availability

Over the past two decades, urbanisation and land development for industrial, environmental and recreational purposes have reduced the area of land available for agriculture. In the twenty years to 2010, the total area of arable land in India fell from around 185.2 million hectares to 182.5 million hectares. While competition for land is expected to continue toward 2050 (OECD–FAO 2012), the downward trend of available land is expected to reverse toward 2050. This is partly a result of the Indian Government's land reform policies to restore barren wastelands to cultivation (Agricoop 2013). Arable land is projected to increase by 3.7 per cent between 2005–07 and 2050 (Alexandratos & Bruinsma 2012).

Indian agriculture is characterised by small farms, which limit the capacity for economies of scale (Balakrishan et al. 2008). In 2010–11, around 85 per cent of farms were less than two hectares in size while 67 per cent were less than half a hectare. Just 0.73 per cent of farms were over 10 hectares (Agricoop 2013).

The production of food crops competes with non-food crops (such as cotton and forest products) on significant areas of prime cultivated land. In 2009–10, non-food crops comprised around 26.6 per cent of the total cropped area, up from 21.1 per cent in 1990–91 (Agricoop 2013). Toward 2050, competition for land use from non-food crops is expected to increase (Raju et al. 2012).

Land degradation

Land degradation is the long-term decline in ecosystem function and is an issue that affects soils, biomass, water, biodiversity and socio-economic services derived from ecosystems (Nachtergaele et al. 2011). In 2005, around 44 per cent, or 147 million hectares, of India's total geographic area was degraded (Indian Ministry of Environment and Forests 2009). The main causes of land degradation in India are water erosion, water logging and soil acidity (Indian Ministry of Environment and Forests 2009). Water erosion is the most widespread, accounting for 63.9 per cent of total degraded land, followed by soil acidity, which accounts for 10.9 per cent. Poor farm management practices have also contributed to land degradation, water logging and soil erosion, stemming from a combination of improper crop rotation techniques, overuse of fertilizers and a lack of soil conservation measures (Mateo-Sagasta & Burke 2008).

Water

Growth in urban centres competes with agriculture for water, and this pressure will increase as the population continues to grow. Per person availability of water is expected to fall to around 1140 cubic metres a year in 2050, a decline of 26 per cent from 2011 (Gupta & Deshpande 2004). Compounding the issue of water availability is that of water quality, which has been compromised by pollution from domestic and industrial sources, as well as from excessive fertilizer and pesticide use (UNICEF et al. 2013).

Adequate water quality and infrastructure will be required if India is to continue to expand its agricultural production. To that end, investment in water resources in recent decades has led to improvements in India's water infrastructure, particularly irrigation, which has been an important contributor to growth in agricultural production. Between the 1950s and 2010, irrigated land increased from 17 per cent to 35 per cent of the gross cropped area (Gundimeda et al. 2005, FAO 2013). In 2010 irrigated land produced more than half of India's total food grain (Pandy 2012).

The Indian Government has recently announced further initiatives to continue improving water availability. A plan for inter-basin water transfer has been developed by the National Water Development Agency with the intention of securing water supplies in the future (Agricoop 2012). If this plan is successfully implemented, water could be moved from water surplus regions to water deficit regions. This would be expected to increase agricultural production and productivity in semi-arid and rain-fed areas of India.

Productivity growth

Output growth in India over the past two decades was lower than in China, a country against which it is often compared for socio-economic and geographical reasons. Total agricultural production in India grew by 2.9 per cent a year between 1990 and 2010 compared with 4.5 per cent in China over the same period (FAO 2013). This difference can be partly attributed to slower productivity growth in India. Average annual TFP growth was around 1.6 per cent in India between 1991 and 2009 compared with 3.5 per cent in China over the same period (Fuglie 2012).

Crop yields in India are also considerably lower than in China. In 2010, yields in India were 2.8 tonnes a hectare for wheat, 2.5 tonnes a hectare for maize and 1.3 tonnes a hectare for soybeans, while in China they were 4.7 tonnes a hectare for wheat, 5.5 tonnes a hectare for maize and 1.8 tonnes a hectare for soybeans (Table 1). Relatively low crop yields in India underline the potential for increased growth in agricultural production in the future.

Table 1 Crop yields in China and India

Year	Wheat tonnes/ha		Maize tonnes/ha		Soybeans tonnes/ha	
	China	India	China	India	China	India
1990	3.2	2.1	4.5	1.5	1.5	1.0
2000	3.7	2.8	4.6	1.8	1.7	0.8
2010	4.7	2.8	5.5	2.5	1.8	1.3

Source: FAO 2013

While factors such as land and water quality, weather and climatic conditions could limit India's agricultural productivity relative to that of China, the potential exists for productivity to improve if appropriate investment and structural and institutional reforms are undertaken.

Four types of technologies have raised yields in Indian agriculture and animal husbandry in the past: improved crop varieties and livestock genetics, fertilizer and feed, mechanisation, and chemicals underpinning crop protection and animal health (Ferroni & Zhou 2011). The potential to increase productivity depends largely on the availability of new technologies, India's regulatory environment, institutional arrangements (such as land ownership provisions), farm management practices and investment in water and land infrastructure.

India's support for agricultural research is among the highest in the world, with spending in purchasing power parity (PPP) terms equal to US$2.3 billion in 2009, ranking third after China and the United States. Indian expenditure on agricultural research and development (R&D) in constant PPP terms grew at an average annual rate of 6.7 per cent between 1990 and 2000 and 4.5 per cent between 2000 and 2009 (Beintema et al. 2012; Pal et al. 2012). The increase in public expenditure on R&D has also been accompanied by an increase in private expenditure, although public expenditure remains dominant. Private R&D expenditure increased five-fold since the mid-1990s and amounted to US$0.5 billion or 19 per cent of the total in 2008–09 (Pal et al. 2012).

In line with strong investment in research and development over the past two decades, India almost doubled its agricultural productivity growth, from an average annual rate of 1.1 per cent between 1990 and 2000 to an average of 2.1 per cent a year between 2000 and 2010 (FAO 2013).

Productivity growth constraints

There are a number of factors that will constrain agricultural productivity growth in India over the coming decades. First, the small farm size that characterises the Indian agricultural sector is likely to constrain the take-up of new technologies. Small farms have reduced capacity to leverage credit compared with larger farms and difficulties in obtaining economies of scale (Balakrishan et al. 2008).

Second, there may be slow adoption of new technology. Uptake of new technology depends on a number of factors, including the efforts made by extension agencies to disseminate new ideas; incentives or disincentives created by price support and other policies; the age and education level of farmers; the appropriateness of technologies to the scale of production; and the capacity to invest in any new capital equipment associated with technology. For example, Jha et al. (2012) report that the actual yield of rain-fed rice in eastern India is 86 per cent lower than its potential because of slow adoption of technologies such as pesticides.

India's domestic market support policies, to be discussed in Chapter 4, lead to misallocation of resources, thereby hindering productivity growth (Dev 2012). Policies such as farm input subsidies and minimum price support programs reduce incentives to adopt more efficient farm practices. Any reduction in these subsidies would lead to an adjustment by producers which, after an adjustment period, would lead to stronger productivity growth.

ABARES agrifood model productivity projections

The analysis in this report uses the projection of India's agricultural TFP growth from the Agricultural Model Intercomparison and Improvement Project (AgMIP). AgMIP is an international project linking climate, crop and economic modelling organisations with the objective of producing long-term projections to improve crop and economic models. Between 2009 and 2050, AgMIP projects that India's agricultural TFP growth will average 2.7 per cent a year.

This assumed productivity growth rate is around 28.6 per cent higher than the average achieved between 2000 and 2010. Historical precedent suggests this is achievable for a number of reasons. First, investment and reform in India's agricultural sector led to an almost doubling of average agricultural productivity growth between 1990–2000 and 2000–2010. Second, the Indian Government is continuing to make significant investment in water storage and transport infrastructure, agricultural regulatory reform and agricultural R&D. Finally, existing low crop yields in India relative to many other developing countries underline the potential for strong productivity gains.

4 Indian agricultural and food policies

India's agricultural and food policies have three broad objectives: food security, food self-sufficiency and income support for farmers (USITC 2009). Policies encompass protecting domestic producers from foreign competition and protecting consumers from price fluctuations for food staples such as wheat, rice and vegetable oils. To achieve this, the policies provide food to consumers at subsidised prices, purchase food from producers at guaranteed prices, provide subsidised inputs to producers, apply tariffs on imported food, and fund research and development.

The tension between the objectives of keeping food prices high for the benefit of farmers and keeping them low for the benefit of consumers has resulted in the Indian Government intervening heavily in the farm sector with multiple policy instruments (USITC 2009). For example, the Indian Government supports production by maintaining minimum support prices (MSP) for 24 commodities and by providing subsidies for farm inputs such as water, electricity, seed, chemicals, crop insurance and transport. Producer prices are supported by the imposition of tariffs on most imported food, and by purchasing and stockpiling rice, wheat and other grains.

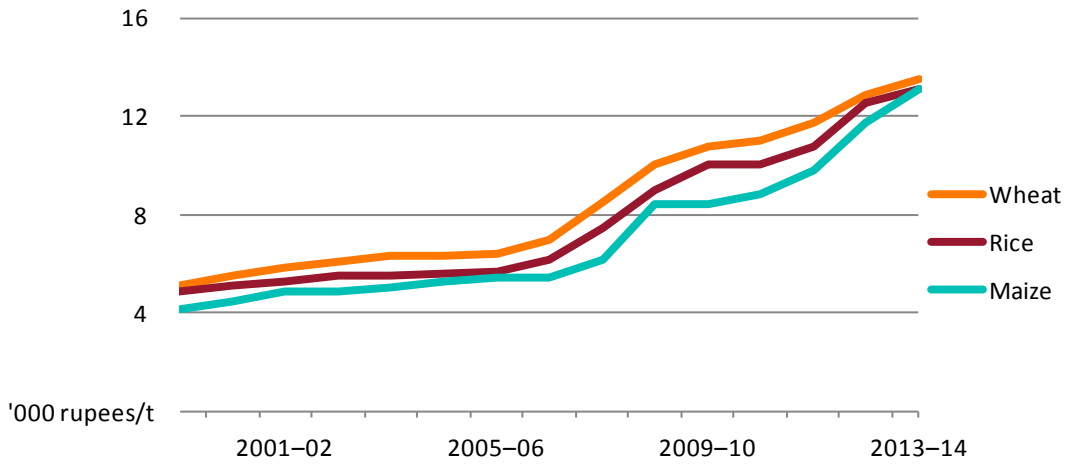
The producer side: Policies to support agricultural production

Minimum support prices

Grain producers in India are eligible to receive minimum support prices, which are underpinned by procurement by the Food Corporation of India (FCI), state governments and other state agencies. Producers are able to sell as much as they wish to procurement agencies at set prices, subject to meeting quality standards (DFPD 2014a, FCI 2014a). Procured grain is stored in government stocks.

The minimum support prices for wheat, rice and coarse grains (maize, barley, grain sorghum and millet) have generally been raised each year (Figure 7). MSPs are set by the Commission for Agricultural Costs and Prices. When determining MSPs the commission takes into account factors such as the costs of production and the condition of domestic and world markets (CACP 2013).

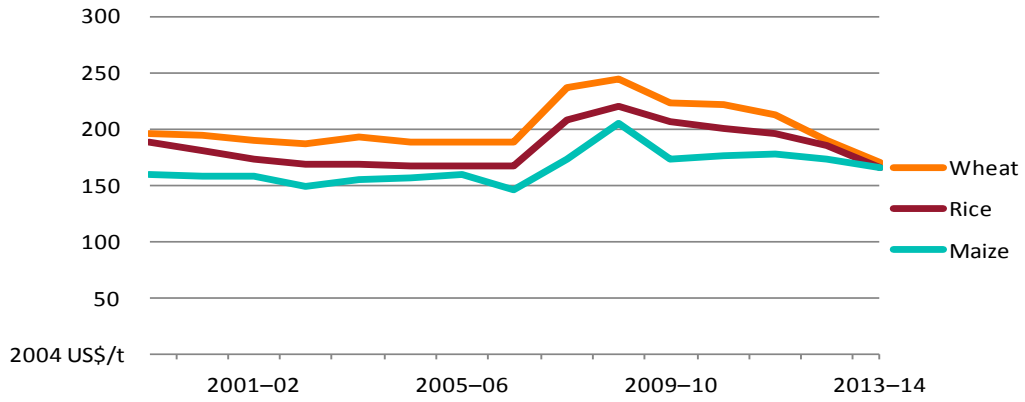
Figure 7 Minimum support prices



Note: Several minimum support prices apply for coarse grains. Maize is taken as a representative price for coarse grains.
Source: DAC 2014, FCI 2014b

Although MSPs have been raised markedly in recent years, input costs have also risen as rural wages have increased, offsetting any significant benefit to farmers of the higher MSPs (Rajan 2014). As a result, the ratio of wholesale prices to input costs has remained largely constant. The increases in MSPs in recent years largely reflect inflation. When deflated and expressed in US dollars, MSPs for wheat, rice and maize were relatively constant until the mid-2000s, increased late in the decade and have been declining since (Figure 8).

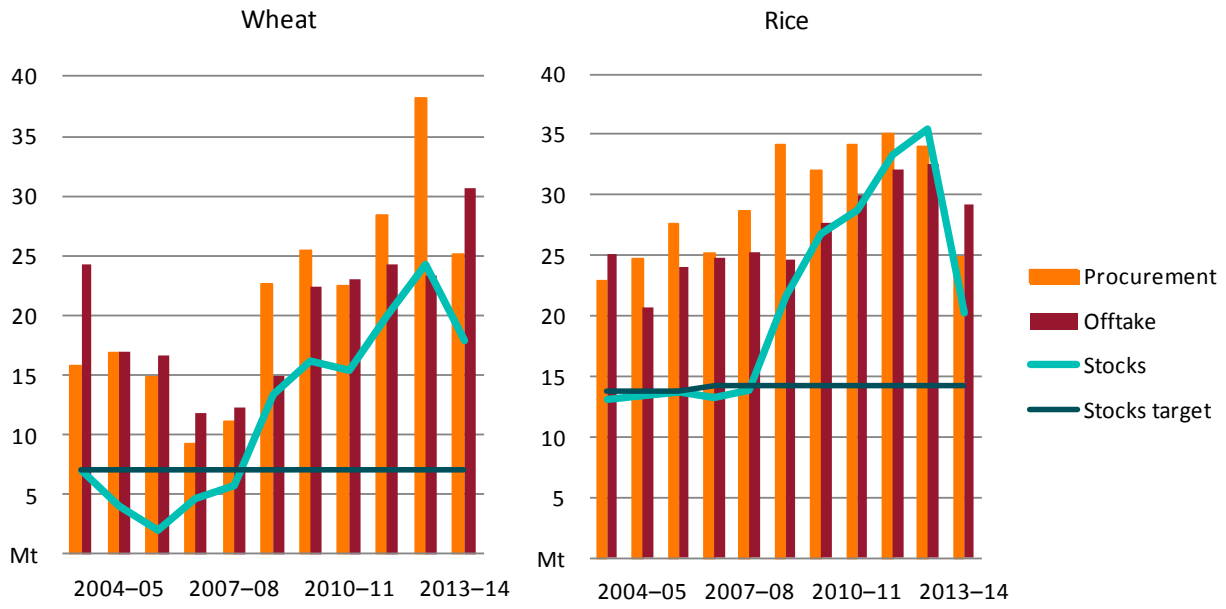
Figure 8 Real minimum support prices, in US dollar terms



Note: MSP in Indian rupees deflated by Indian GDP deflator, converted to US dollars.
Source: DAC 2014, FCI 2014b, World Bank 2014b

Wheat and rice procurement expanded markedly from 2008–09 to 2012–13 (Figure 9). The rise in nominal MSPs, coupled with the government's open-ended procurement policy for grain purchases, encouraged increased area planted of both wheat and rice. In addition, above average yields were achieved in recent seasons. The increase in production led to a rise in government wheat procurements, from 24 per cent of production in the 10 years to 2011–12 to 40 per cent in 2012–13. However, it declined to 27 per cent in 2013–14, largely because of high domestic prices. Rice procurement followed a similar pattern, increasing to 34 per cent in2012–13 from a 10 year average of 21 per cent, then declining in 2013–14 to 19 per cent (USDA–FAS 2014a, b).

Figure 9 Procurement, use and stocks of wheat and rice

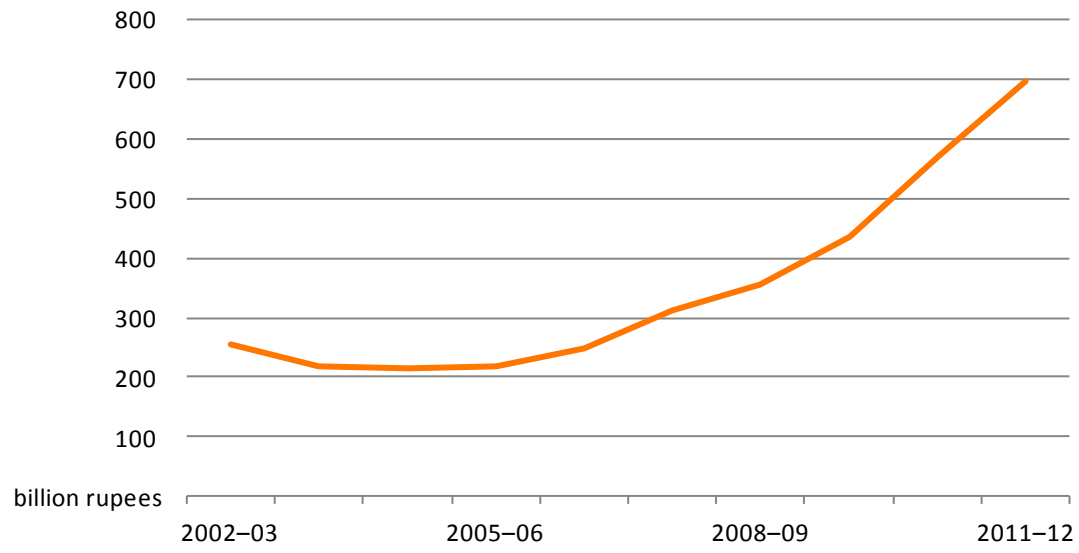


Note: Stocks and stocks target as at 1 April following each marketing year (April–March).
Source: FCI 2014c, d, e

Growing procurement volumes have also resulted in government wheat and rice reserves rising (USDA–FAS 2013a). The Government of India sets stock targets in order to meet demand and to intervene in the domestic market to stabilise food price rises (FCI 2014f). The level of target stocks varies through the year, reflecting yearly harvesting patterns. In years when stocks exceed target levels, grains may be sold by the FCI to the domestic market or made available for export (DFPD 2014a, USDA–FAS 2013a). On 1 April 2013, government stocks of wheat and rice totalled around 38 million tonnes, well above the total target level of 21.2 million tonnes.

As a result of the rising level of procurement, the FCI has operated at an increasing cost to the central and state governments. The cost of procuring grains from farmers is well above the receipts from sales, and the difference is paid by the Government of India as a consumer subsidy (Figure 10). Should India's grain production continue to increase, the budgetary cost of this policy will, if unchanged, become increasingly burdensome.

Figure 10 Consumer subsidy paid to Food Corporation of India



Source: FCI 2012

Input subsidies

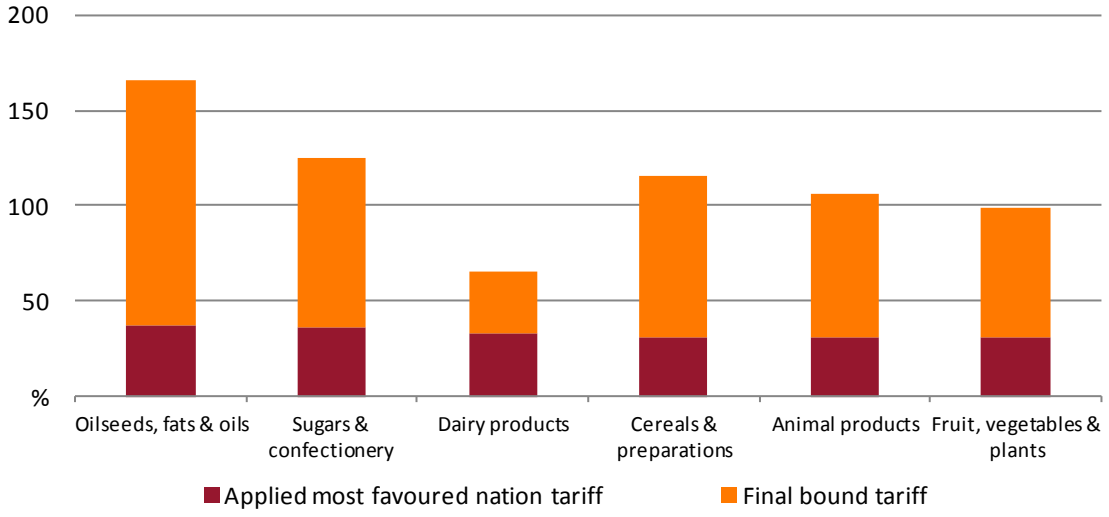
The Government of India also supports farmers through a range of input subsidies (USITC 2009). Fertiliser support is one of the largest input subsidies, whereby the government controls fertiliser prices and pays the difference between the controlled prices and market prices. Other subsidised inputs include irrigation, electricity, diesel and seeds (USITC 2009). One example of a program that administers such subsidies is the National Food Security Mission, a targeted program aimed at increasing wheat, rice and pulse production. Through this program, producers of these commodities receive subsidies for seed, inputs and product-specific investments, such as water pumps and sprinkler sets (Hoda & Gulati 2013).

Import tariffs

Import tariffs, which are applied to most imported food products, keep domestic food prices above world levels (OECD–FAO 2014). In the case of grains, increased prices support the purchasing operation of the FCI. For most other commodities, there is no effective mechanism, such as stockpiling policies, to maintain the minimum support prices.

While applied tariff rates have declined significantly since 1991, they remain among the highest in the world. Applied tariffs on animal products, cereals and cereal preparations average 31 per cent and dairy products 34 per cent (Figure 11). A few food items are imported with much lower tariffs, and imports of pulses and edible oils are subsidised.

Figure 11 Average tariff rates on selected food groups, India, 2012

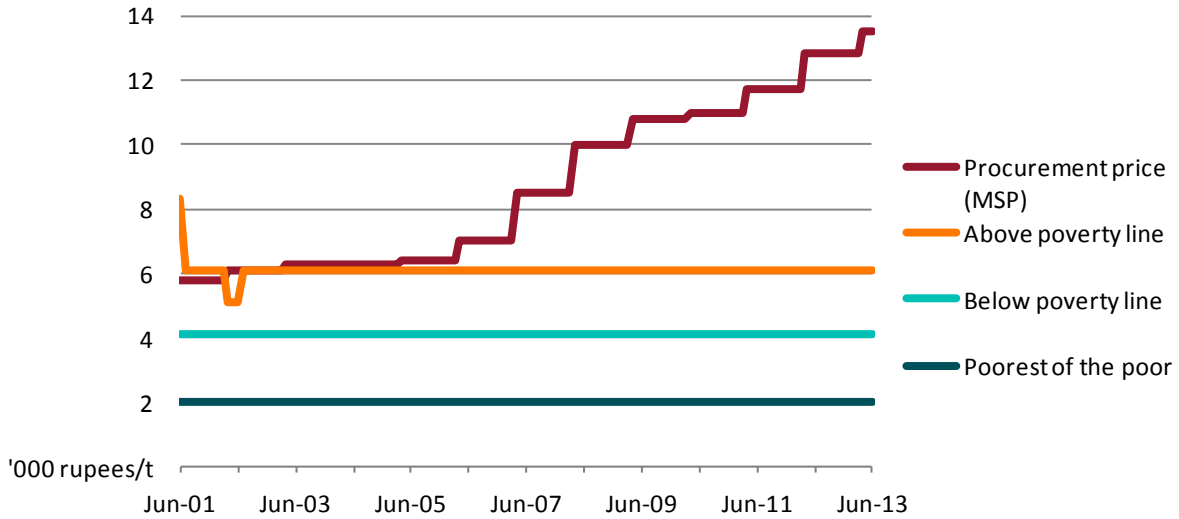


Source: WTO 2014

The consumer side: Food subsidies

The Indian Government operates a subsidised food distribution program to combat food insecurity. Under the scheme, low cost food grain is made available to Indian consumers through the Targeted Public Distribution System (TPDS). The FCI provides grain to the TPDS from government stocks. The TPDS first allocates the grain to state governments and union territories, which in turn distribute it to some 492 000 fair price shop dealers throughout India (AIFPSDF 2013). At these shops, consumers can purchase an allocated amount of grain at subsidised prices (Jha et al. 2007). Until 2013, three income groups eligible to purchase subsidised grain were classified under the TPDS: above poverty line, below poverty line and Antyodaya Anna Yojana, or the poorest of the poor (Figure 12).

Figure 12 Government procurement and central issue prices of wheat



Note: The poverty line refers to India's national poverty line, as discussed in Chapter 2.
Source: FCI 2014b, e

Rising procurement prices and increasing volumes of procurement, combined with the fixed price of grains made available by the Indian Government through the TPDS, resulted in the total value of India's food subsidy increasing significantly (USDA–FAS 2013a). The food subsidy more than tripled between 2005–06 and 2012–13, from 231 billion rupees to an estimated 850 billion rupees (USDA–FAS 2014c).

Both the purchase price and ration of food grains faced by eligible households are changing under the National Food Security Act (NFSA) 2013. The NFSA was signed into law in 2013 to enlarge India's food distribution program. At the completion of this report, the program is yet to be implemented in most states. When the program is fully implemented it will provide subsidised food for up to two-thirds of the population (75 per cent of the rural population and 50 per cent of the urban population), twice the proportion covered previously (OECD–FAO 2014).

Under the NFSA, there are only two categories of beneficiaries:

1) the entitled households, which are entitled to purchase 5 kilograms of grain per person per month

2) the Antyodaya Anna Yojana, which are entitled purchase to 35 kilograms per household a month.

All consumers face the same prices for purchasing grains sold through the TPDS. These prices are set for three years at 3 rupees a kilogram for rice, 2 rupees a kilogram for wheat and 1 rupee a kilogram for coarse grains (DFPD 2014b).

The Act does not specify criteria for the identification of households eligible for TPDS entitlements (Tehelka Bureau 2013). Rather, allocations are made to the states and the identification of eligible households is left to state governments.

The need for subsidised food in India arises from two sources: the existence of a section of the population living in poverty and the impact of policies (such as the maintenance of MSPs and tariffs) that keep food prices high.

Using India's national poverty line as a guide (as discussed in Chapter 2), 22 per cent of the population, or around 270 million people, lived in poverty in 2012 (World Bank 2014a). As incomes grow, poverty will be reduced. For example, 37 per cent of the population lived under the poverty line in 2005, 30 per cent in 2010 and 22 per cent in 2012. Assuming these trends continue, 5 per cent of the population, or around 80 million people, would be living in poverty in 2050. A reduced level of expenditure on the food subsidy would therefore be expected. Any reduction in food prices that could come about through, for example, reduced MSPs, lower tariffs or improved farm productivity would also reduce the need for food subsidies.

The cost of agricultural and food policies

India's agricultural and food policies have been a major cost to the Indian Government and have undermined incentives to improve productivity (Ganguly & Gulati 2013). They have also contributed to inefficient farming practices that have adversely affected farm productivity and depleted the quality and quantity of natural resources.

Budgetary costs

Government of India expenditure on agriculture and associated activities, including the food subsidy, have amounted to a little more than 2 trillion rupees a year in recent years (Table 2).

Annual increases in total government expenditure were between 10 and 15 per cent in this period but expenditure on agriculture has been more stable. As a result, agriculture as a proportion of total expenditure declined from 17 per cent (actual) in 2011–12 to 14.3 per cent (revised budget estimate) in 2013–14. The 2014–15 budget forecasts a further decline, to 11.7 per cent. This forecast incorporates a significant rise in expenditure on the food subsidy to accommodate the National Food Security Act and a sharp fall in spending in other areas, such as Ministry of Agriculture programs on crop and livestock husbandry, and programs on rural development and rural employment. However, budget forecasts are typically exceeded. For example, actual expenditure on agriculture in 2011–12 exceeded the budget forecast by 9 per cent and in 2012–13 by 2 per cent.

Table 2 Expenditure on selected agricultural and food items, Indian central government budget

Year [a]	unit	2011 –12 (Actual)	2012 –13 (Actual)	2013 –14 (Revised budget)	2014 –15 (Budget)
Agriculture and associated expenditure (including food subsidy)	billion rupees	2 052.9	2 145.1	2 270.2	2 071.3
of which food subsidy	billion rupees	*728.2*	*850.0*	*920.0*	*1 150.0*
Total budget expenditure	billion rupees	11 973.3	14 103.7	15 904.3	17 632.1
Agriculture expenditure (including food subsidy) as % of total	%	17.1	15.2	14.3	11.7
Food subsidy as % of total	%	*6.1*	*6.0*	*5.8*	*6.5*

Note: a The Indian fiscal year is from 1 April to 31 March.
Sources: USDA–FAS 2013b, Ministry of Finance 2014

State governments, which have constitutional responsibility for agriculture, collectively have expenditures roughly in line with those of the Government of India. Between 2000–01 and 2009–10, India's state governments spent, on average, 15 per cent of their budget expenditure on the rural economy (Jha & Acharya 2011). However, the share of combined expenditure (both Government of India and states) on agriculture and allied activities in total combined expenditure has declined over the past two decades. In the 1990s these governments, combined, allocated 25.9 per cent of their budgets to agriculture and allied activities; in the period 2000–01 to 2009–10, the share fell to 17.1 per cent (Jha & Acharya 2011).

Efficiency costs

Consumer and producer subsidies have resulted in higher agricultural production and reduced food insecurity. However, they have also distorted the pattern of production and the use of inputs. One result has been the overproduction of grains under the influence of pro-cereal policies relative to non-cereal commodities such as fruit, vegetables and dairy products. Growing demand for these products has been met by expanding imports (Gopinath 2013).

Subsidies on inputs induce wastage of scarce resources and promote inefficiency. Subsidised irrigation water, electricity and diesel lead to their wasteful use, as these resources are drawn away from other sectors of the economy in which they could be used more productively (Srivastava & Sen 1997). The overuse of fertilizer and low-cost electricity for pumping groundwater has led to deteriorating soils and shrinking groundwater supplies (USITC 2009, World Bank 2012). Government investment in, for example, irrigation has also precluded private investment, and long-term underinvestment in irrigation infrastructure has undermined agricultural yields (USITC 2009).

5 Policy environments

India's consumption, production and trade of agricultural products will continue to be influenced by the government's agricultural policies. Because it is not known which policies will be in place by 2050, modelling was undertaken to examine the implications of four policy environments on these market parameters. The first policy environment (the business-as-usual environment) assumes no change to the existing policy settings in India. The three alternative hypothetical policy environments progressively move away from the business-as-usual environment for rice and wheat to ones that are more market oriented, reduce government expenditure and improve the sector's potential for growth. The possible changes on consumption, production and trade are then assessed. Specifically, the four policy environments are:

- Policy environment 1, in which no changes are made to the existing policy settings in India.
- Policy environment 2, in which domestic support policies are removed for rice and wheat and access to food for the poorest citizens is assured through a social security policy.
- Policy environment 3, in which greater investment in the rice and wheat industries following the removal of support policies leads to a rise in productivity of those crops.
- Policy environment 4, which builds on policy environment 3 by increasing investment in transport infrastructure to reduce transport costs.

Policy environment 1, the 'business-as-usual' policy environment, assumes no change to India's market support policies over the projection period. Building on previous analysis (OECD–FAO 2014; Thorpe et al. 2014), this scenario includes the 2013 National Food Security Act, which expands the consumer subsidy policy as well as the minimum support price policy, as discussed in Chapter 4. The projections determined under this policy setting are dependent on the set of assumptions presented in chapters 2 and 3. The critical assumptions include:

- average population growth of 0.8 per cent between 2009 and 2050
- an increase in the proportion of the population in urban areas from 30 per cent in 2009 to 54 per cent by 2050
- average GDP growth of 4.3 per cent a year between 2009 and 2030, and 5.0 per cent a year from 2030 to 2050
- average annual agricultural productivity growth of 2.7 per cent between 2009 and 2050.

The population is divided into two income strata, urban income and rural income households, to account for the different rates of consumption growth across the two groups (as developed in Hamshere et al. 2014). Across these two household types, the income growth assumptions to 2050 are based on historical income data from the National Sample Survey Office (2011). Among urban households, income growth is assumed to continue at a higher rate than rural households given the faster rate of economic development in urban areas and the higher wages paid in these regions. Indian household food consumption data (National Sample Survey Office 2011) have been used as the basis for an assessment of consumption across urban and rural households.

Policy environments 2 through 4 impose stylised assumptions on the model and build progressively on the business-as-usual environment. These settings relate to changes to the

producer price floor and the consumer subsidy, productivity growth and transport costs. The projections for India's agrifood consumption, production and trade resulting from each of these alternative policy environments are indicative only. However, they are useful as a basis for comparison with the business-as-usual case to understand the possible market adjustments that could take place following such changes.

Policy environment 2 assumes India reforms its market support policies as a means of reducing the financial burden on the Government of India. The consumer subsidy and producer price floor on wheat and rice are removed over the projection period. One of the weaknesses of this scenario is that it could be criticised for compromising the food security of the poorest citizens given the increased potential for significant price variability of staple grains. To address this risk, a social security policy is assumed, which ensures those below the poverty line are provided with the means to access enough food. The social security policy is funded from a portion of the savings generated from the cessation of the market support policies. The nature of adjustment in India's agrifood markets under this policy setting is assessed relative to the business-as-usual case.

Policy environment 3 builds on the previous setting by assuming that resources saved from the removal of the domestic support policies for grains (net of the social security policy) are reinvested in the grains industry to improve the productivity of rice and wheat farms in India. Under this policy setting, it is assumed that productivity growth of rice and wheat farms rises by 5 per cent over the business-as-usual case. That is, productivity growth of rice and wheat farms is assumed to rise to an average of 2.84 per cent a year over the projection period, compared with an average of 2.7 per cent in the business-as-usual case.

Policy environment 4 builds on the previous setting by assuming the Indian Government reinvests another portion of the resources saved from the removal of the domestic support policies for grains into transport infrastructure. As discussed in Chapter 1, transport costs in India are significantly higher than in other countries because of inefficient logistics infrastructure. Under this policy environment, transport costs in India are assumed to be reduced by half, in real terms, compared with the business-as-usual case.

An updated version of the ABARES agrifood model (Linehan et al. 2012a) was developed to investigate the potential agricultural trends in India. Changes to the model include an update of the baseline data from 2007 to 2009, the inclusion of India's domestic market price floor and a targeted consumer subsidy for both wheat and rice. For details on how these policies were included in the model refer to Appendix A.

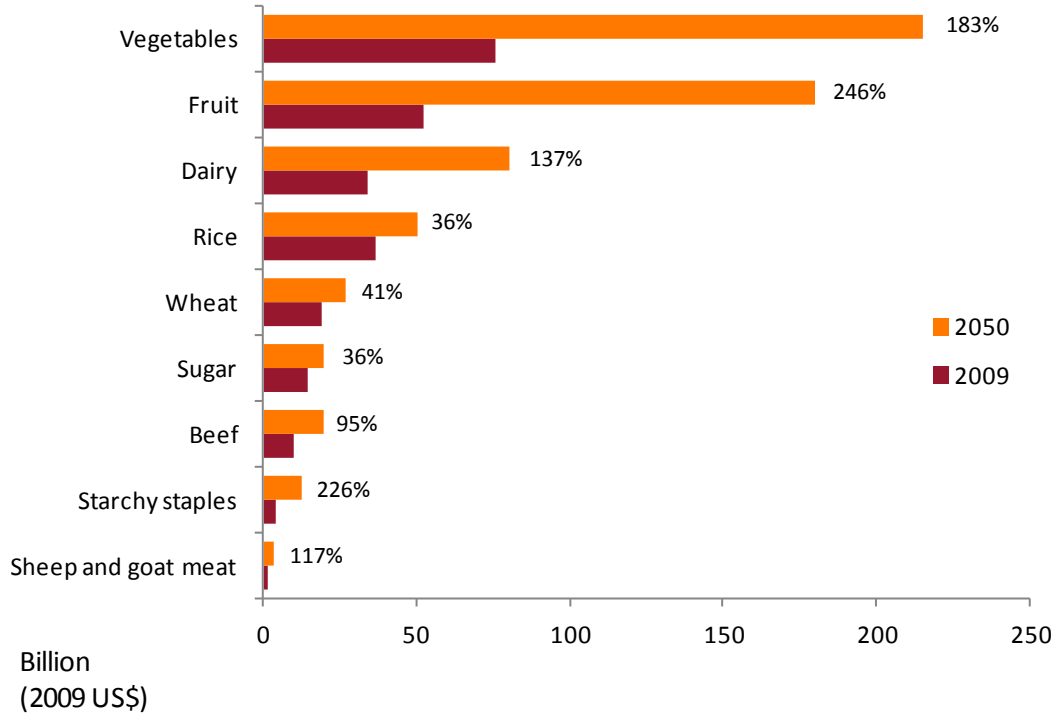
As in any forecasting exercise, there is uncertainty around the projections as they are conditional on the assumptions made. Any changes to the assumptions could result in changes to the projections. Sensitivity analysis is therefore conducted to improve understanding of the relationships between the assumptions on income and population growth used in the business-as-usual policy environment (results from which are reported in Appendix B).

Policy environment 1: Business-as-usual

In policy environment 1, the business-as-usual policy environment, the real value of food consumption in India is projected to increase by 136 per cent between 2009 and 2050 to US$709.4 billion (in 2009 US dollars). The largest increases are for high value products, including fruit, vegetables and dairy products, as real per person incomes increase (Figure 13). Together these commodities account for 77 per cent of the projected rise in the real value of consumption. Between 2009 and 2050, consumption of vegetables is projected to rise by

183 per cent to US$215.4 billion (in 2009 US dollars); fruit by 246 per cent to US$179.9 billion and dairy products by 137 per cent to US$80.6 billion.

Figure 13 Agrifood consumption under the business-as-usual policy environment



Note: starchy staples include pulses and yams.
Source: ABARES model output

For cereals and starchy staples (which include pulses and yams), consumption is projected to increase more slowly than high valued products. Between 2009 and 2050, consumption of rice is projected to rise by 36 per cent to US$50.3 billion (in 2009 US dollars) and wheat consumption by 41 per cent to US$26.9 billion. Consumption of starchy staples is projected to more than double to around US$12.6 billion.

Consumption of meat products is projected to rise modestly between 2009 and 2050, albeit from a low base given the predominately vegetarian population. Over this period, consumption of beef is projected to rise to US$19.4 billion (in 2009 US dollars) and sheep and goat meat to US$3.2 billion. Sugar consumption is projected to rise by 36 per cent to US$20 billion.

Urban and rural consumption

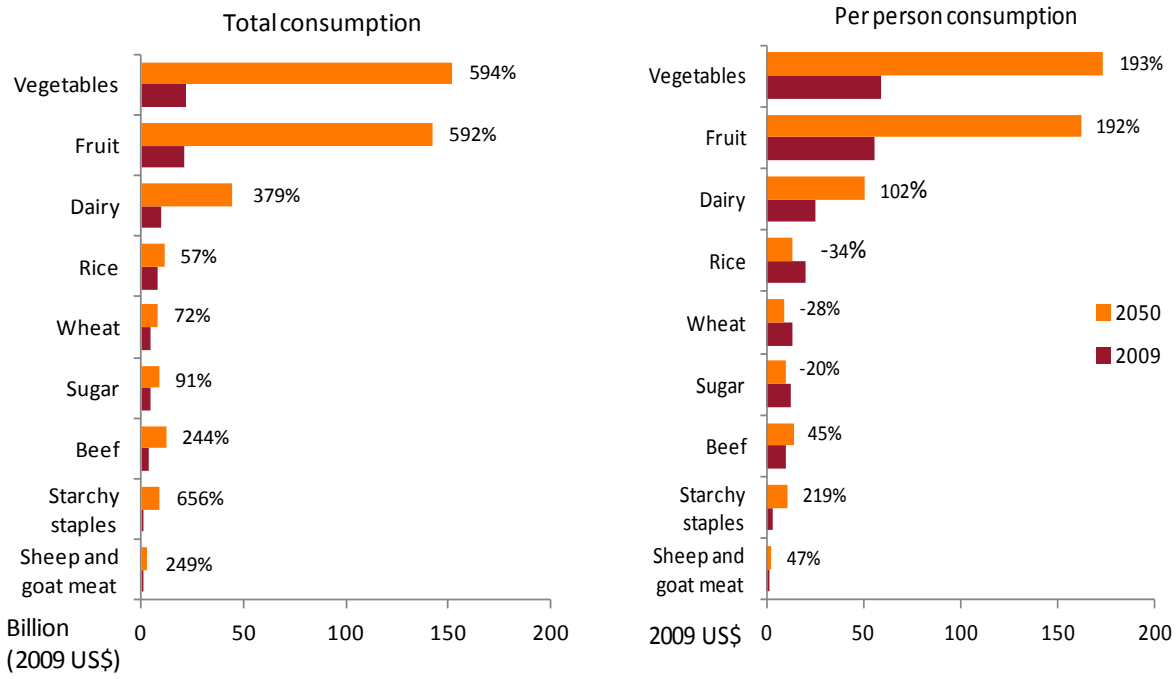
In 2050, 52 per cent of India's population is projected to live in urban areas, compared with 31 per cent in 2010 (United Nations Population Division 2013). By that time, Indian consumers are projected to have more diverse diets, with greater consumption of vegetables, fruit, dairy and meat products.

High value commodities

Urban consumers account for most of the growth in consumption of vegetables, fruit, dairy and meat products over the projection period because of rising urban populations and incomes. Between 2009 and 2050, urban consumption of vegetables is projected to rise by 594 per cent to US$151.6 billion (in 2009 US dollars), fruit by 592 per cent to US$142.2 billion and dairy by

379 per cent to US$44.6 billion (Figure 14). In per person terms, the value of urban vegetable and fruit consumption is projected to nearly triple between 2009 and 2050, and for dairy it is projected to double. These increases occur at the expense of rice and wheat, consumption of which is projected to fall by 34 per cent and 28 per cent, respectively.

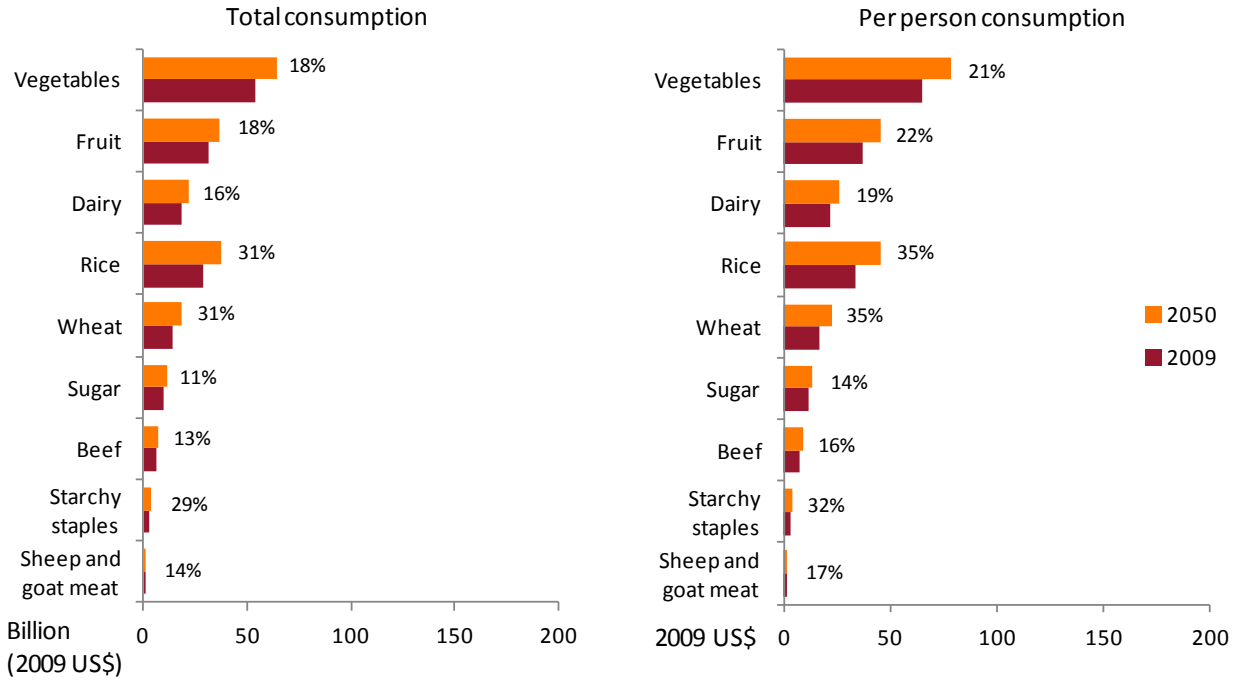
Figure 14 Urban consumption of selected agricultural commodities in India



Source: ABARES model output

For rural consumers, growth in consumption of vegetables, fruit, dairy and meat products is lower than for the urban households. This can be attributed to relatively lower income and population growth. Between 2009 and 2050, rural vegetable consumption is projected to rise by 18 per cent to US$63.8 billion (in 2009 US dollars) (Figure 15). Fruit consumption is also projected to rise 18 per cent to US$36.9 billion; and dairy products by 16 per cent to US$21.5 billion.

Figure 15 Rural consumption of selected agricultural commodities in India



Source: ABARES model output

For both income groups, the rise in the real value of vegetable, fruit and dairy consumption between 2009 and 2050 is principally the result of an increase in the quantity demanded rather than a significant projected rise in the real price. This is especially pronounced in urban households. Total consumption of dairy products (expressed in milk equivalents) by urban households in 2050 is projected to be 345 per cent higher than in 2009 at 134 million tonnes. Total consumption of vegetables is projected to increase by 525 per cent to 157 million tonnes, and fruit consumption by 527 per cent to 157 million tonnes. In contrast, rural dairy consumption in 2050 is projected to rise by 7 per cent from 2009 to 65 million tonnes, vegetables consumption by 6 per cent to 66 million tonnes and fruit consumption by 7 per cent to 41 million tonnes.

Cereals and starchy staples

Projected growth in consumption of cereals and starchy staples between 2009 and 2050 is most pronounced in urban areas. Rising urban consumption of these commodities is the result of population growth, as per person consumption actually declines for many cereals and starchy staples. Urban consumption of wheat is projected to rise by 72 per cent to US$8.2 billion (in 2009 US dollars), rice by 57 per cent to US$11.7 billion and starchy staples by 656 per cent to US$9.2 billion (albeit from a low base). In contrast, the value of per person consumption of wheat by urban consumers is projected to fall by 28 per cent and rice by 34 per cent.

The composition of rural diets is not expected to change significantly between 2009 and 2050. In rural households, consumption of cereals and starchy staples is projected to increase as incomes rise. Rural consumption of wheat is projected to rise by 31 per cent to US$18.6 billion (in 2009 US dollars), rice by 31 per cent to US$37.7 billion and starchy staples by 29 per cent to US$3.4 billion. On a per person basis, rural consumption of all agrifood commodities is projected to change by a similar magnitude. In value terms, rural per person consumption of dairy

products is projected to rise by 19 per cent, vegetables by 21 per cent and fruit by 22 per cent. Similar increases are projected for rice (35 per cent), wheat (35 per cent) and starchy staples (32 per cent).

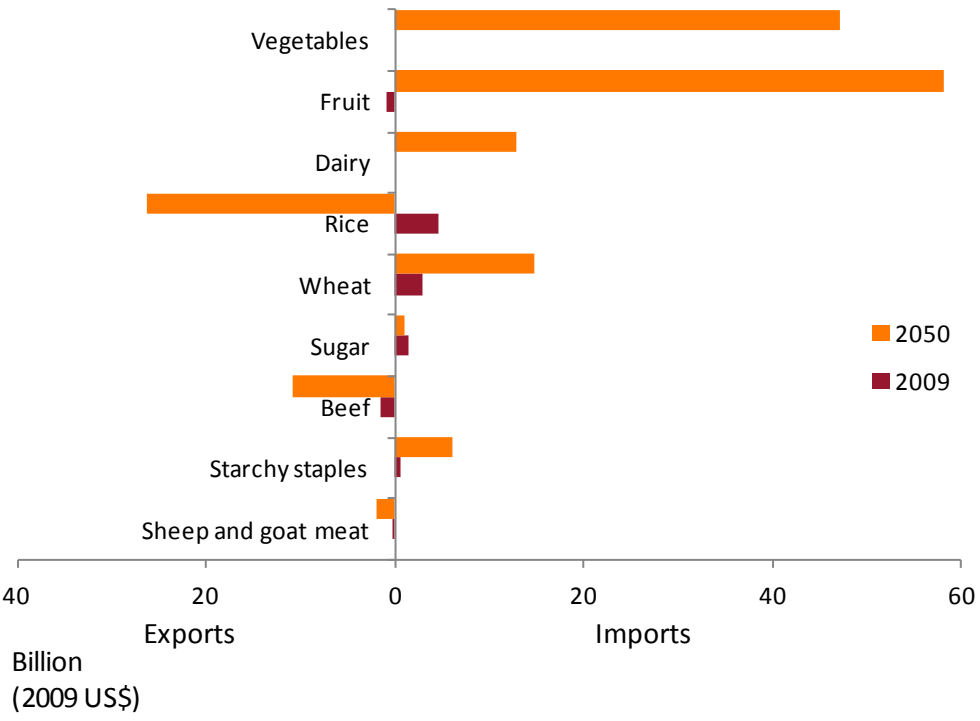
Production and trade

Under the business-as-usual environment, the real value of India's agrifood production is projected to more than double from US$283.3 billion in 2009 to US$574.6 billion in 2050 (in 2009 US dollars). This increase is driven by higher production of beef (up 179 per cent), rice (162 per cent), fruit (113 per cent), vegetables (107 per cent) and dairy products (88 per cent).

For meat products, particularly beef, rising production largely reflects strong export demand. India is the world's largest exporter of carabeef (mostly buffalo). By 2050, it is projected to continue to be a large net exporter of carabeef. For meat products, as well as rice, maize and sugar, the rise in consumption by 2050 is projected to be met largely by a rise in domestic production, with imports playing a minor role, mainly for high quality niche markets.

In contrast, a significant portion of India's dairy, fruit, vegetables and wheat consumption is projected to be met by imports. In 2050, imports of vegetables are projected to be around US$47.0 billion (in 2009 US dollars), compared with no vegetable trade in 2009. Imports of fruit are projected to be around US$58.2 billion in 2050, compared with exports of US$0.9 billion in 2009 (Figure 16). The share of imports in India's consumption of fruit and vegetables is projected to be 32 per cent and 22 per cent, respectively, in 2050.

Figure 16 Trade of selected agrifood commodities, India



Source: ABARES model output

The real value of India's dairy imports is projected to increase significantly between 2009 and 2050 to US$12.7 billion (in 2009 US dollars). If achieved, the import share of India's dairy consumption will rise to 16 per cent by 2050, compared with no dairy imports in 2009.

India is projected to remain an importer of wheat in 2050, with the real value of imports projected to increase by 395 per cent from 2009 to US$14.8 billion (in 2009 US dollars). This would increase the share of imports in total consumption from 16 per cent in 2009 to 55 per cent in 2050.

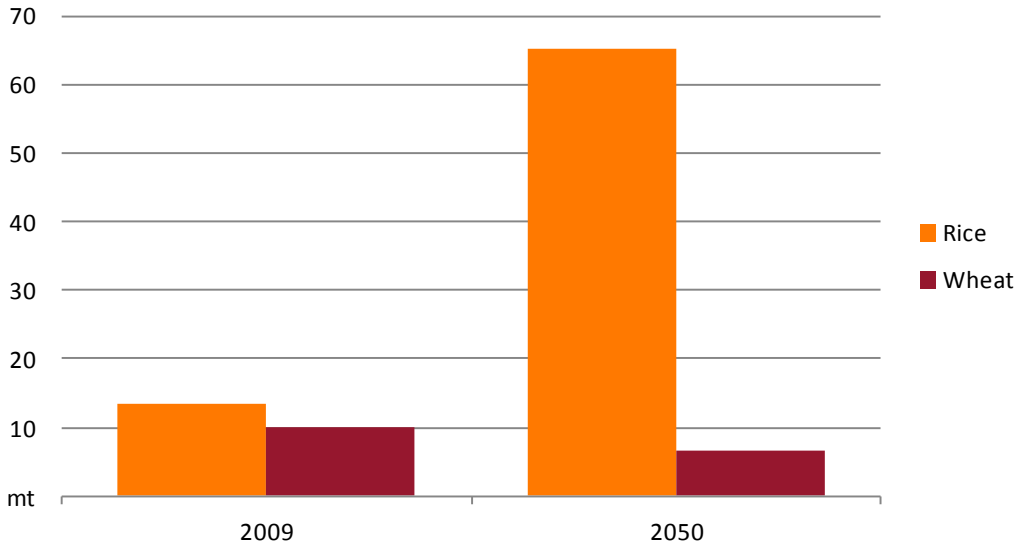
Policies

The producer price floor and consumption subsidy are costly policies for the Indian Government (Chapter 4) and they are projected to become more so by 2050. If unchanged, spending on these policies is projected to more than double between 2009 and 2050 to US$43.9 billion (in 2009 US dollars). This rise will be driven principally by the costs associated with the producer price floor policy, which are projected to rise by 385 per cent to US$20.0 billion in 2050.

Between 2009 and 2050, under existing policy, India is projected to accumulate significant stocks of rice to keep the price from falling to the floor (Figure 17). Assuming storage capacity remains unchanged to 2050, it is projected that India's storage capacity will become fully utilised, prohibiting any further build-up of rice stocks. Once this occurs, India's exports of rice are projected to rise rapidly. In 2050, it is projected that India will export around 86 million tonnes of rice, compared with almost nothing in 2009.To do so will require an effective export subsidy in order to maintain a domestic rice price that is higher than the world price.

India is not expected to hold significant stocks of wheat over the projection period. This is because the domestic and world wheat prices are projected to exceed the minimum support price in each year between 2009 and 2050.

Figure 17 Stocks of rice and wheat in India



Source: ABARES model output

Policy environment 2: Removal of the producer price floor and consumer subsidy

In the business-as-usual policy setting it is assumed India's producer price floor and consumer subsidy policies will remain over the projection period. However, the increasing cost of these policies will be an issue for decision makers. For that reason, a reduction in the support received by agricultural producers and consumers is assumed. This assumed policy environment considers an agricultural sector in which producers of rice and wheat are no longer supported by a price floor and the price paid by consumers for these grains is determined by the market rather than by the government. For the purpose of this analysis, the policy changes are assumed from 2015 onward. The Indian Government currently has no intention to alter either the price floor policy or consumer subsidy.

An issue associated with this scenario is the food security of India's poorest citizens. This is because a portion of India's population depends on the consumer subsidy to purchase sufficient food. For that reason, part of the budgetary savings from this policy change is assumed to be reallocated to a social security policy that enables food insecure people to access food.

Using the United Nations World Food Programme (UNWFP) (2014) definition of the recommended daily calorie intake and ABARES' projections of agrifood prices, it is projected that between 2015 and 2050 the daily per person food expenditure required in India will average US$0.18 (in 2009 US dollars; for estimation details see Appendix C). For the purpose of this analysis, a social security policy is assumed to provide a minimum payment of this base amount to those people who fall below India's national poverty line, as discussed in Chapter 4. In 2050 income growth is projected to reduce this number to around 80 million people, down from 276 million people in 2015.

As incomes rise and fewer people fall below the poverty line, less support will be required. As a result, the resources saved from the removal of domestic support (less cost of the social security policy) are projected to rise from US$5.4 billion in 2015 to US$38.6 billion in 2050 (in 2009 US dollars; Appendix C).

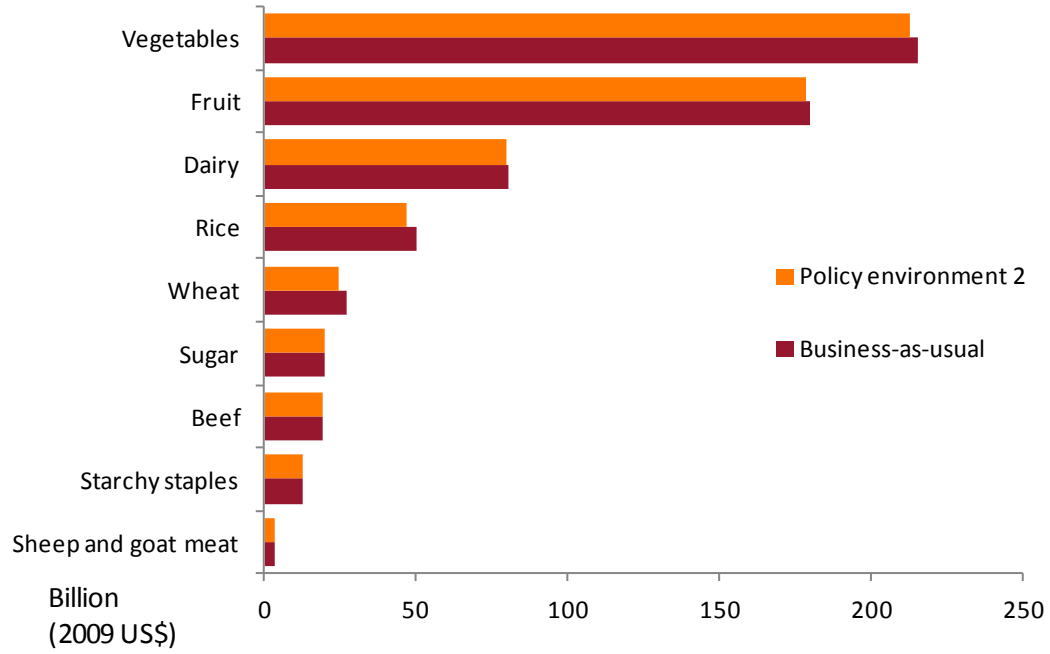
Results

In the business-as-usual policy environment, the producer price floor for rice effectively acts as an export subsidy, while for wheat it is not sufficiently high to generate a significant effect on the market. When the price floors are removed, the domestic rice price declines. This affects the production decisions of producers. In particular, rice production falls and wheat production rises, because of the higher relative returns. Lower rice production leads to a decline in stocks and exports.

Because the consumer subsidy on rice and wheat acts as a form of income support, total food consumption is higher in the business-as-usual case than in this scenario. Thus, when the consumer subsidy is removed, total food consumption falls relative to the business-as-usual policy setting, although only marginally.

The real value of India's agrifood consumption following the removal of domestic support is projected to reach US$697.8 billion in 2050, 1.6 per cent lower than the projected US$709.4 billion under the business-as-usual setting (in 2009 US dollars). In terms of commodity groups, the relative differences in growth are largest for rice (US$3.6 billion lower than the business-as-usual case), vegetables (US$2.4 billion lower) and wheat (US$2.2 billion lower) (Figure 18).

Figure 18 Agrifood consumption in India in 2050, policy environment 2

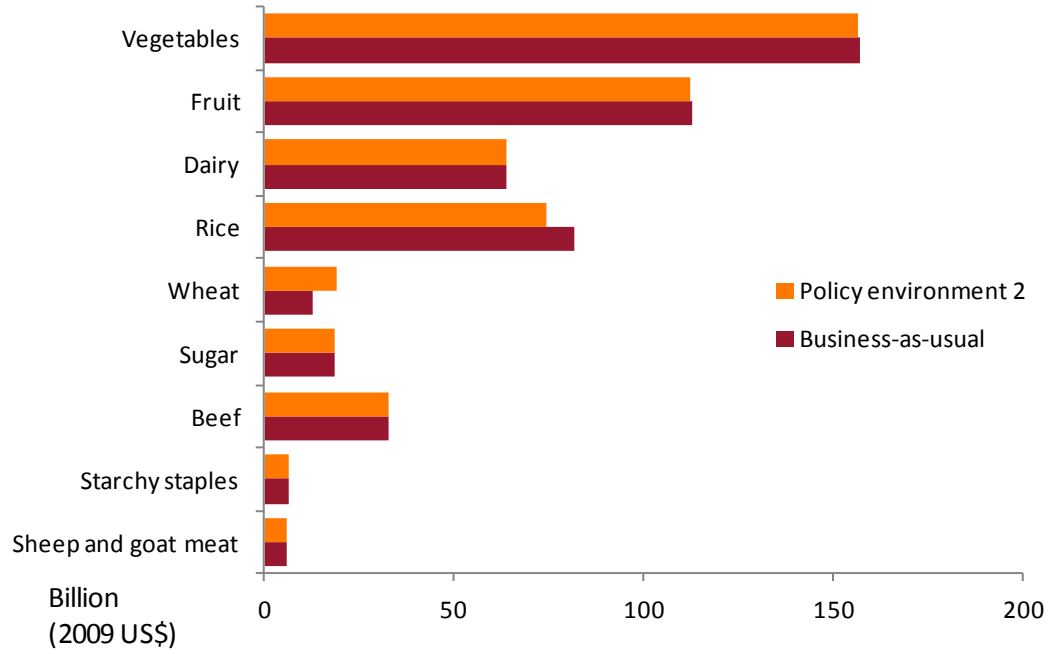


Source: ABARES model output

The difference in consumption values between the business-as-usual case and this policy environment is mainly the result of the lower volume of food consumed, rather than from any significant change in prices. The exception to this is wheat and rice. In 2050, India's domestic price for wheat is projected to be 14 per cent higher than in the business-as-usual case because a projected reduction in imports is only partially offset by higher domestic production, (discussed below). In 2050 India's domestic rice price is projected to be 4 per cent lower than in the business-as-usual case.

In this policy environment the real value of India's agrifood production is projected to rise to US$569.9 billion in 2050 (in 2009 US dollars), around 1 per cent lower than the projected US$574.6 billion under the business-as-usual case. In terms of commodity groups, the declines are largest for rice (US$7.6 billion lower than the business-as-usual environment) and vegetables (US$0.8 billion lower) (Figure 19). In contrast, the value of wheat production is projected to be US$6.1 billion higher because of an increase in relative prices and the volume of production.

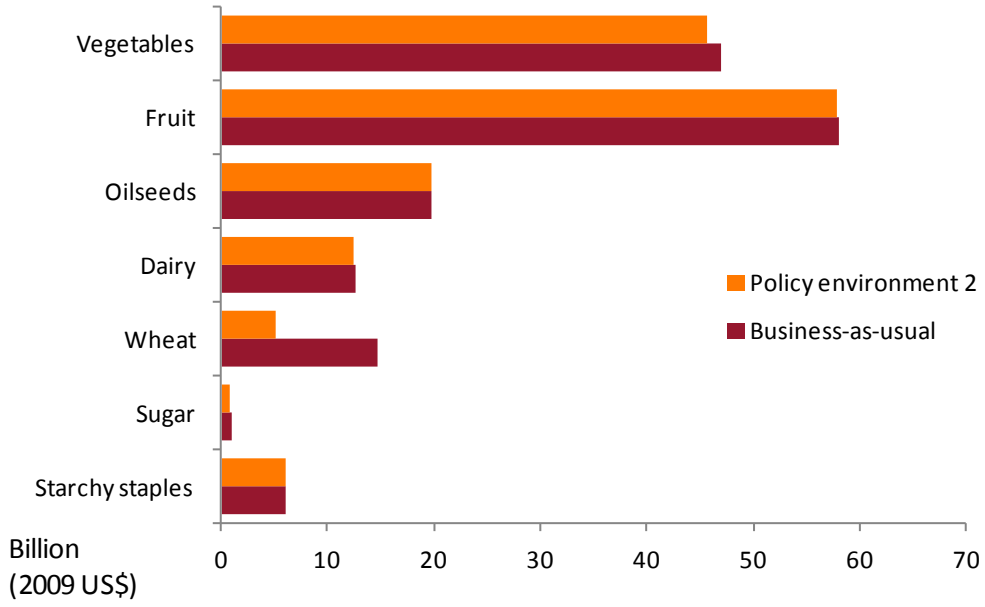
Figure 19 Agrifood production in India in 2050, policy environment 2



Source: ABARES model output

The total value of India's agrifood imports is projected to be around 6 per cent lower relative to the business-as-usual environment as a result of lower consumption (in 2009 US dollars). This decline is driven principally by smaller import values for wheat (US$9.7 billion lower than the business-as-usual environment) and vegetables (US$1.3 billion lower) (Figure 20). In this scenario, India continues to be a rice exporter in 2050, although the value of rice exports is projected to be US$2.3 billion (or 9.6 per cent) lower than in the business-as-usual environment.

Figure 20 Imports of selected commodities in India in 2050, policy environment 2



Source: ABARES model output

Policy environment 3: Higher productivity growth for rice and wheat

In policy environment 2, the removal of domestic support to producers and consumers results in a small reduction in production and consumption of key agricultural commodities. In this policy environment the previous scenario is built upon by assuming a portion of the savings generated from removing the domestic support policies (less the cost of the social security policy) is invested back into research and development for the rice and wheat industries, the two commodities from which support was removed. The increased spending is assumed to lead to an increase in productivity growth in rice and wheat. By 2050, productivity growth for these two grains is assumed to average 2.84 per cent, 5 per cent higher than the baseline assumption of 2.7 per cent. TFP growth for other agricultural industries is assumed to continue to average 2.7 per cent a year, as in the business-as-usual case.

The assumed productivity improvement in the rice and wheat industries is consistent with Chand et al. (2012) who reported that a doubling of research and development spending would be expected to increase the productivity of rice and wheat farms by around 5 per cent. As discussed in Chapter 3, higher productivity growth over the long term can be achieved in a number of ways, including improved farm management practices, higher yields and reform of regulatory and institutional frameworks.

As outlined in policy environment 2, it is estimated that India's net savings from the removal of domestic policies would total around US$5.4 billion (in 2009 US dollars) in 2015 (see Appendix C for details). This is estimated to rise to US$38.6 billion in 2050 (in 2009 US dollars) as incomes rise and fewer people live below the poverty line, thereby reducing the requirements for social support. These net savings far exceed India's current spending on research and development, which was around US$2.3 billion in 2012. With savings of this magnitude, the findings of Chand et al. (2012) would suggest a 5 per cent productivity improvement in wheat and rice is plausible.

There is considerable uncertainty in projecting future productivity growth. The size of productivity gains from additional research and development spending depends on factors such as the take up of new technologies and weather or climatic events. Because of these factors, there is a possibility that productivity growth could increase at a slower or faster rate than is assumed here.

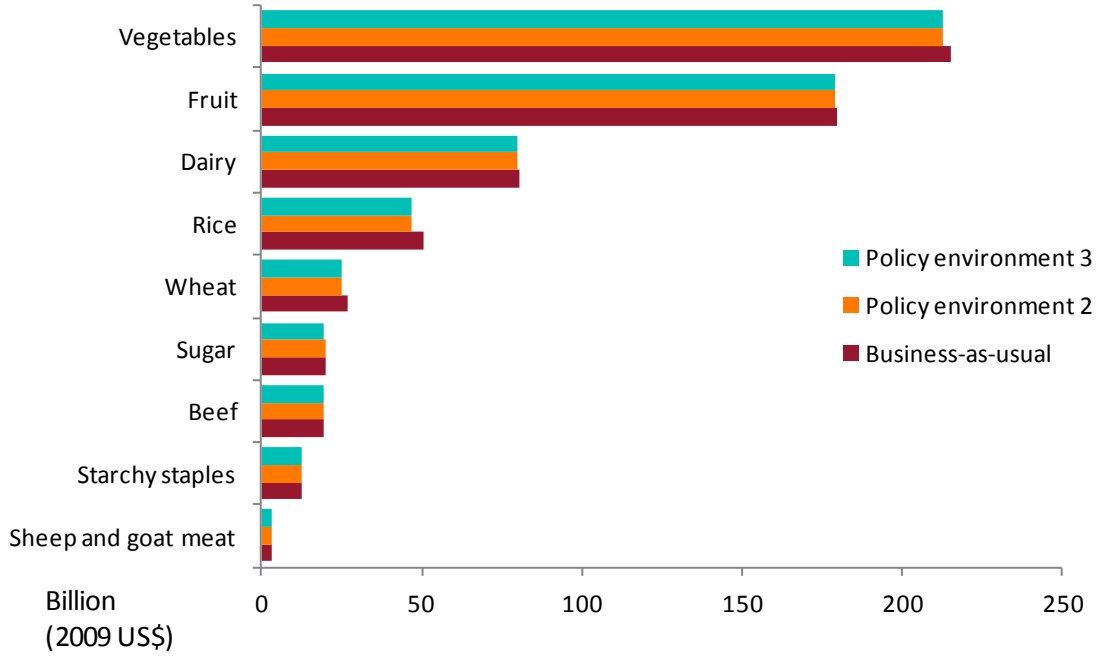
Results

In policy environment 2, the removal of India's domestic support policies was projected to lead to a fall in agricultural production and consumption. With higher agricultural productivity growth for rice and wheat, production of both grains in policy environment 3 increases and domestic prices fall. As a result, the total quantity consumed increases. It is the net effect of these factors that determines the change in India's total consumption and production.

A rise in productivity growth in rice and wheat lifts the real value of India's agrifood consumption to US$697.6 billion in 2050 (in 2009 US dollars), marginally lower than in environment 2, and 1.7 per cent lower than in the business-as-usual case. When compared against the business-as-usual case, the lower consumption value mainly reflects a reduced quantity consumed. In contrast, the marginally lower value of consumption relative to environment 2 mainly reflects lower prices, with the quantity consumed actually higher under policy environment 3.

The largest declines in value terms (in 2009 US dollars) between this policy setting and the business-as-usual case are for rice (US$3.4 billion lower), vegetables (US$2.7 billion lower) and wheat (US$2.2 billion lower) (Figure 21).

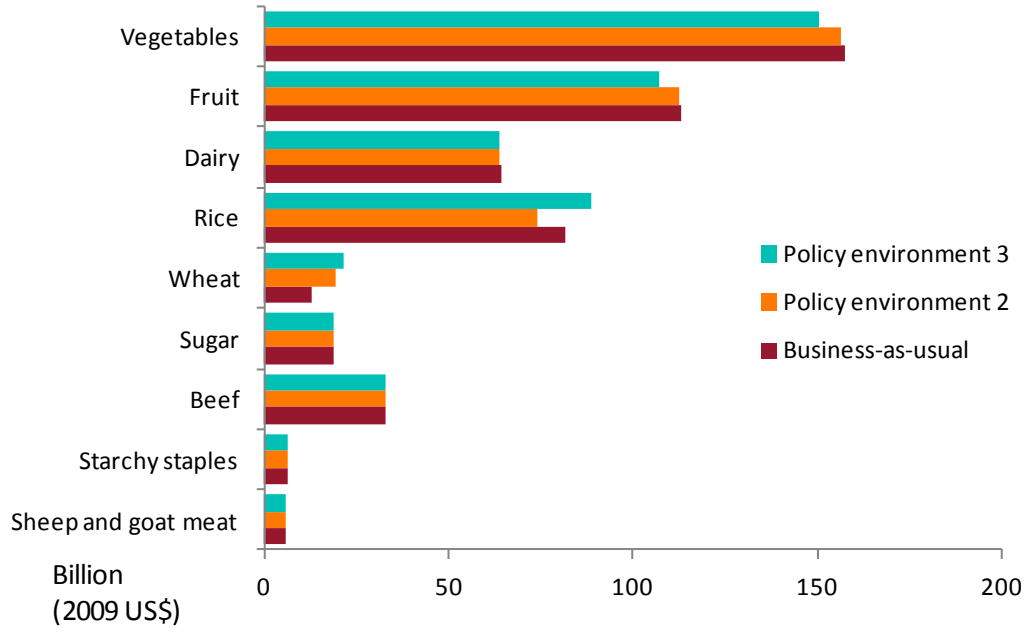
Figure 21 Agrifood consumption in India in 2050, policy environment 3



Source: ABARES model output

Under policy environment 3, the real value of India's agrifood production (in 2009 US dollars) is projected to rise to US$566.6 billion in 2050, around 1.4 per cent lower than the projected US$574.6 billion in the business-as-usual case. In terms of commodity groups, production is relatively lower for vegetables and fruit (US$6.8 billion and US$5.7 billion lower than in the business-as-usual case, respectively) (Figure 22), as these farms shift production to rice and wheat given the assumed productivity improvement. As a result, production is projected to be higher for both rice and wheat (US$7.0 billion and US$8.4 billion higher, respectively).

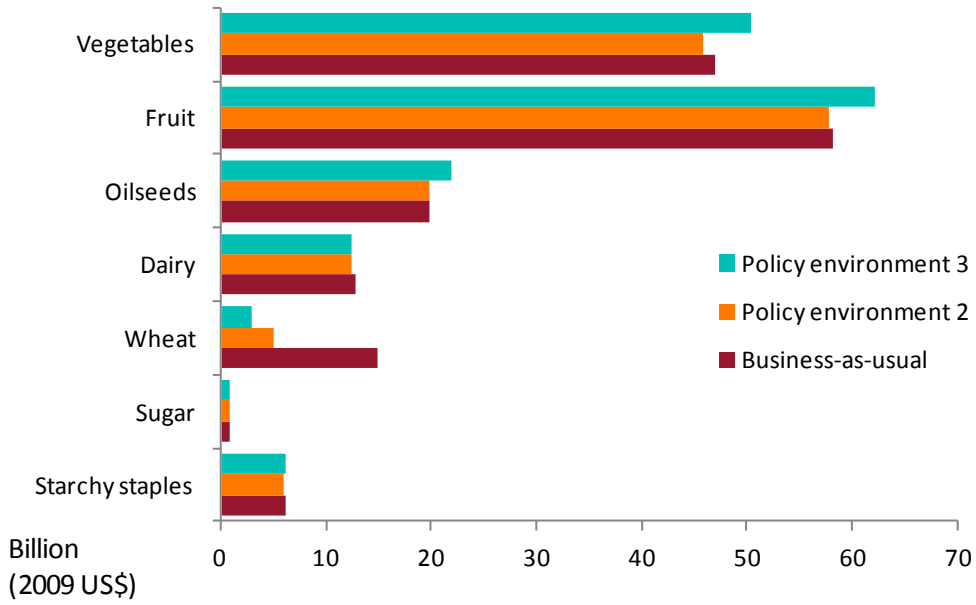
Figure 22 Agrifood production in India in 2050, policy environment 3



Source: ABARES model output

The value of India's agrifood imports in 2050 is projected to be around 2.4 per cent higher relative to the business-as-usual case (in 2009 US dollars), driven principally by continued strong demand for fruit, vegetables and oilseeds as their production declines. Under policy environment 3, the biggest increases in imports relative to the business-as-usual case are for fruit (US$4.0 billion higher), vegetables (US$3.3 billion higher) and oilseeds (US$2.0 billion higher) (Figure 23). India is projected to remain a rice exporter by 2050, with shipments US$10.3 billion higher than in the business-as-usual case in that year.

Figure 23 Imports of selected commodities in India in 2050, policy environment 3



Source: ABARES model output

Policy environment 4: Investment in transport infrastructure

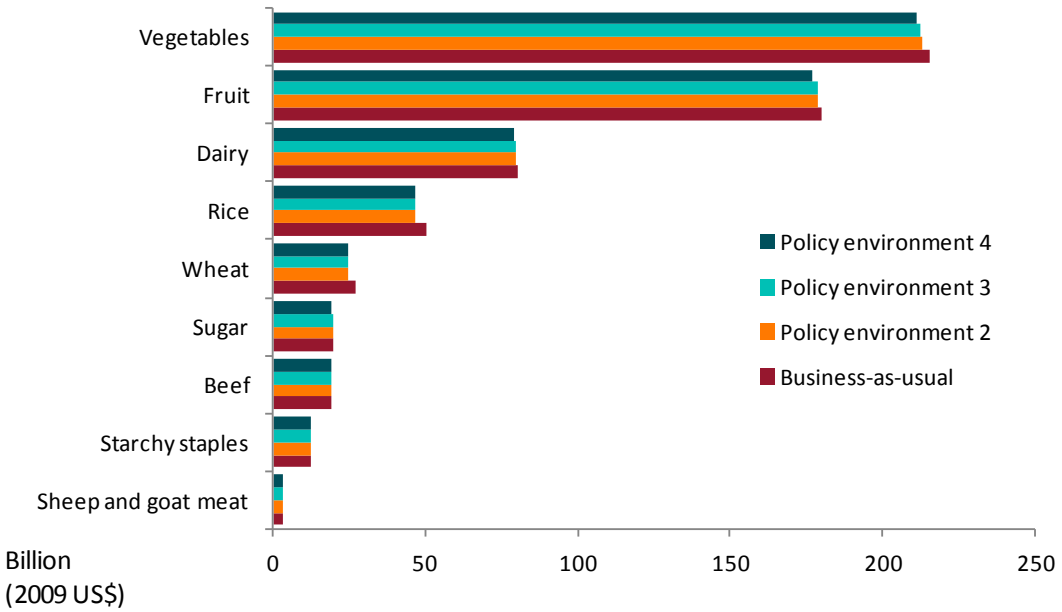
In the business-as-usual policy setting it is assumed that transport costs in India remain unchanged over the projection period. As discussed in Chapter 2, India's transport infrastructure is relatively inefficient. McKinsey & Company (2010) report that rail and coastal shipping costs in India are approximately 70 per cent higher than those in the United States, while road costs are around 30 per cent higher. These inefficiencies are estimated to cost India around 4.3 per cent of its GDP each year.

With freight, rail and shipping utilisation expected to rise as India's economy and population grow, the cost burden of inefficient logistics infrastructure is expected to increase (McKinsey & Company 2010). As a result, investment in infrastructure is likely to increase. McKinsey & Company (2010) show that transport costs in India could be reduced significantly with increased levels of infrastructure investment. India's Eleventh Five Year Plan proposed a large increase in logistics infrastructure spending equivalent to around 1.5 per cent of GDP (McKinsey & Company 2010). Policy environment 4 assumes government spending on transport infrastructure will increase and be financed by a portion of the resources saved from reform to domestic support policies. This reduces domestic transport costs by half relative to the business-as-usual case.

Results

The real value of India's agrifood consumption following a reduction in domestic transport costs is projected to rise to US$687.5 billion in 2050 (in 2009 US dollars), 3.1 per cent lower than the projected US$709.4 billion under the business-as-usual setting (Figure 24). The total value of consumption in this policy environment is marginally lower than in policy environment 3 but the volume of consumption is largely unchanged. This is because the improved, and hence less costly, movement of goods within India results in prices that are lower compared with policy environment 3.

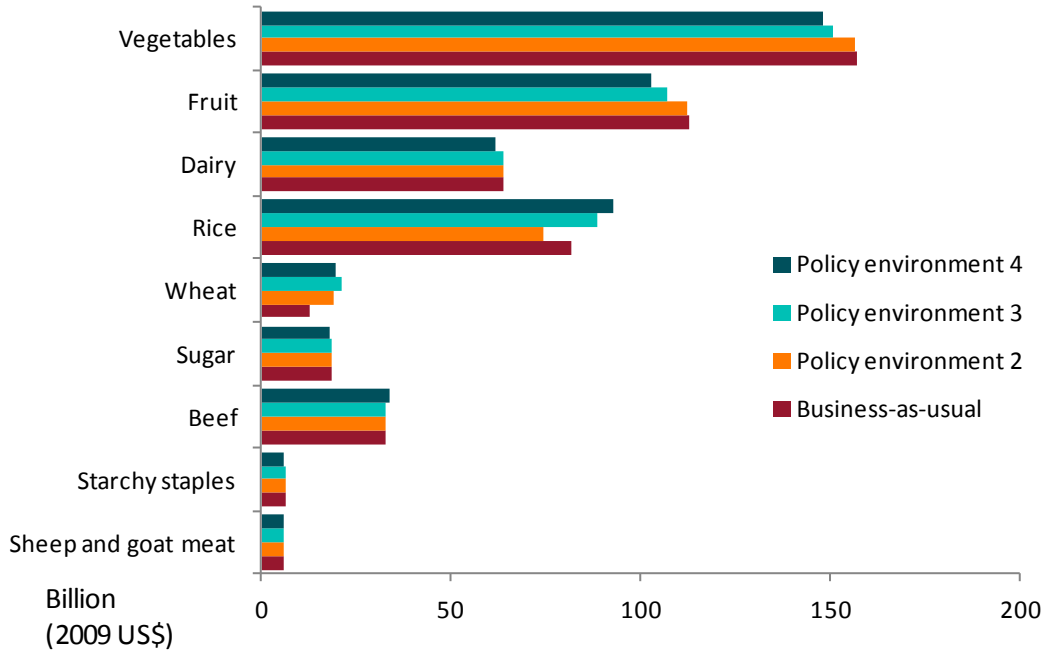
Figure 24 Agrifood consumption in India in 2050, policy environment 4



Source: ABARES model output

The real value of India's agrifood production (in 2009 US dollars) is projected to rise to US$562.1 billion in 2050, around 2.2 per cent lower than under the business-as-usual case. The total volume of agrifood production is also projected to be 2.5 per cent lower than in the business-as-usual scenario. In terms of commodity groups, the relative declines are largest for fruit (US$9.9 billion lower than the business-as-usual environment), vegetables (US$9.4 billion lower) and dairy products (US$2.5 billion lower) (Figure 25). This response is consistent with the previous scenarios, combined with the relatively lower prices across these commodities. In contrast, higher production is projected for rice (US$10.8 billion higher than the business-as-usual environment) and wheat (US$6.6 billion higher) following the domestic reforms, as well as for beef (US$0.8 billion higher).

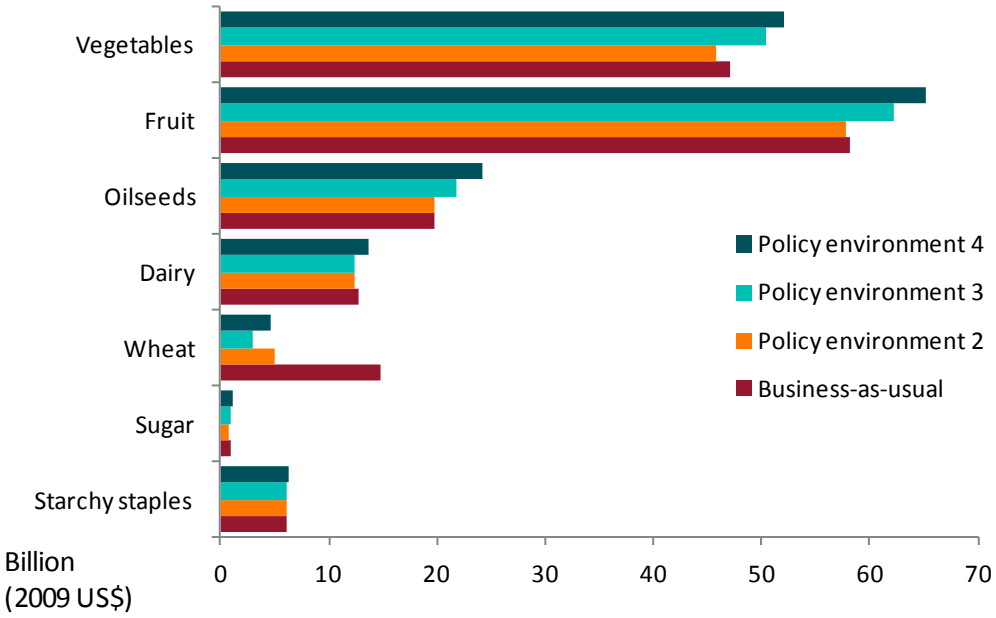
Figure 25 Agrifood production in India in 2050, policy environment 4



Source: ABARES model output

The value of India's agrifood imports is projected to be 11.2 per cent higher than the business-as-usual environment (in 2009 US dollars). This stronger rise in imports by 2050 is driven principally by higher imports of fruit (US$6.9 billion higher), vegetables (US$5.1 billion higher) , oilseeds (US$4.3 billion higher) and dairy products (US$1.0 billion higher) (Figure 26).

Figure 26 Imports of selected commodities in India in 2050, policy environment 4



Source: ABARES model output

6 Conclusion

Strong economic and population growth, combined with greater urbanisation, is driving India's increasing demand for more food and for a wider variety of foods. This demand is projected to be satisfied largely by increases in domestic production. However, to do so the Indian agrifood sector needs to contend with the challenge of increasing its production and productivity growth. Some of the existing production challenges are being addressed by significant and ongoing investment in the sector, investment that nearly doubled productivity in the 2000s compared with the previous decade. The Indian Government's commitment to agricultural investment will be required to further mitigate or overcome the persistent challenges of a deteriorating resource base, and rising costs of intermediate inputs and transport.

Under the assumptions established in the business-as-usual policy environment, the real value of food consumption in India is projected to more than double between 2009 and 2050. This will be characterised by a move toward more diverse diets, with higher intake of vegetables, fruit and dairy products. Between 2009 and 2050, the real value of consumption of vegetables is projected to rise by 183 per cent, fruit by 246 per cent and dairy by 137 per cent (in 2009 US dollars). These projected increases are driven by greater quantities demanded and not because of any significant projected rise in real prices. To support this rise in demand, imports of several agrifood commodities are expected increase to 2050.

The upward trend in food demand is most pronounced among urban households, whose income growth is assumed to be greater than rural households. In rural households, slowing rural population growth and relatively lower incomes will result in slower growth in total food consumption compared with the urban population.

Under the hypothetical policy environments 2 and 3, consumption and production of the staple grains continue to rise significantly but by less than the business-as-usual case. This occurs because the removal of government price support payments leads to a fall in domestic prices as the grains industry becomes more market oriented. Under these policy environments, India produces more wheat and rice but fewer vegetable and fruit products in 2050 compared with the business-as-usual case. In 2050, India's total agrifood imports are 6 per cent lower than the business-as-usual case under policy environment 2, but 2.4 per cent higher under policy environment 3. In the latter scenario, the relative rise in imports is driven by the need to satisfy growth in domestic demand following a shift out of horticulture by some producers as they opt to engage in the relatively more productive and market-oriented grains sector.

In policy environment 4, lower transport costs lead to a further decline in domestic prices of agrifood commodities. Production shifts further away from vegetable, fruit and dairy products to rice and other cereals. As a result, imports of these commodities increase further.

The analysis in this report indicates that food demand in India is expected to increase significantly toward 2050. This will provide opportunities for Australian agricultural exports, especially for vegetables, fruit, dairy products and wheat. While Australian agriculture is well placed to meet higher demand for food in India, there will be strong competition from India's domestic production, as well as from other exporting countries, that will require an ongoing focus on productivity enhancements in Australian agriculture.

Appendix A: Simulation design

The agristaples policies modelled in this report are the domestic market price floor and the targeted consumer subsidy for both wheat and rice. The price floor is modelled by keeping prices within an exogenous price band. Government stock purchases support the price floor and sales from the stockpile support the price ceiling (for details see Jha et al. 2007; Gouel 2013; Thorpe et al. 2014). In addition, when the upper or lower stock limits are reached, rather than abandoning the price band, the band remains feasible by triggering imports and exports under government supervision. To support the domestic price floor or ceiling, a trade policy measure, such as an export subsidy or an import tariff, is imposed with the associated costs borne by the government.

In the model, the floor and ceiling prices and the stockpile limits are chosen to be proportional to the domestic supply price and production, respectively, in the base year (2009). Using the base year real prices of rice and wheat, the minimum real prices for rice and wheat are set at US$314 and US$208 a tonne (in 2009 US dollars) and the maximum real prices are set to US$333 and US$221 a tonne, respectively. The assumption of a fixed minimum support price for wheat and rice, in real terms, is in line with the support prices set by the Indian Government over the past two decades (Figure 8). However, it is conceivable that the rising costs associated with maintaining the fixed minimum support price (as discussed in Chapter 4) could lead to it being lowered at some point during the projection period. The fixed minimum support prices were chosen to align the model with the base year prices for rice and wheat. Lower and upper stockpile limits are set at 10 per cent and 80 per cent of base year domestic production for both grains. The base year stock levels for rice and wheat held by the Indian Government are set at 13.3 million tonnes and 10.1 million tonnes, respectively.

In addition to the stockpile policy, the business-as-usual policy environment also takes into account India's recently announced National Food Security Act (2013). As discussed in Chapter 4, under the policy, low income households (around two-thirds of the population in the base year) receive a targeted and quota-rationed subsidy on agristaple consumption, including rice, wheat and other cereals. Following the assumptions made by OECD–FAO (2014), the effective subsidy for each individual under the new policy is 28 kilograms of rice at a price of 3 rupees a kilogram (or US$0.047 a kilogram), 24 kilograms of wheat at a price of 2 rupees a kilogram (US$0.031 a kilogram), and 8 kilograms of coarse grains at 1 rupee a kilogram (US$0.015 a kilogram). For illustrative purposes, these policy settings for rice and wheat consumption are converted to aggregate demand using base year data. The maximum subsidy quota for rice and wheat are set at 33.8 million tonnes and 28.9 million tonnes, respectively. Finally, the subsidised real price is kept constant over time.

Appendix B: Sensitivity analysis

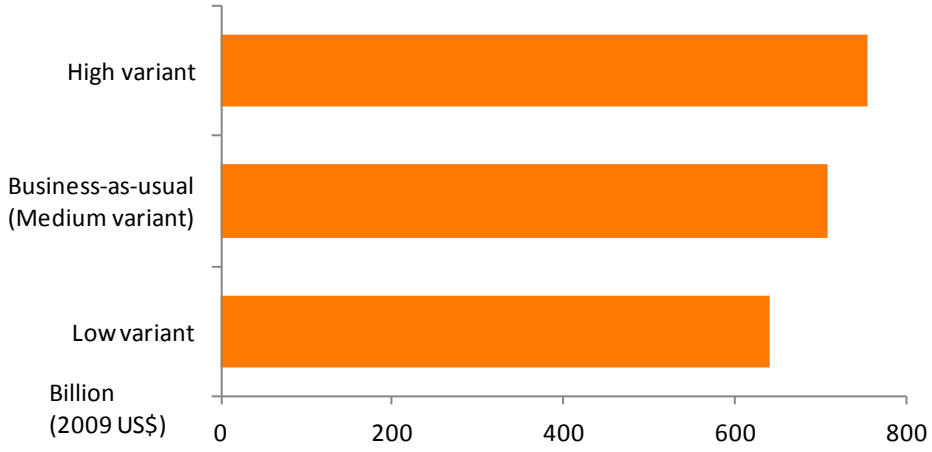
To improve understanding of the relationships between the assumptions used in the simulations and the model projections, sensitivity analysis around the population and income growth assumptions is applied to the business-as-usual policy environment.

Population assumptions

The business-as-usual policy setting in the agrifood model uses the medium variant of the United Nations population projections (2013) to derive the reported projections to 2050. Sensitivity analysis around the population assumption involves using both the UN's high variant (faster population growth) and low variant (slower population growth) population projections in the agrifood model and comparing the model's results with those from the business-as-usual case.

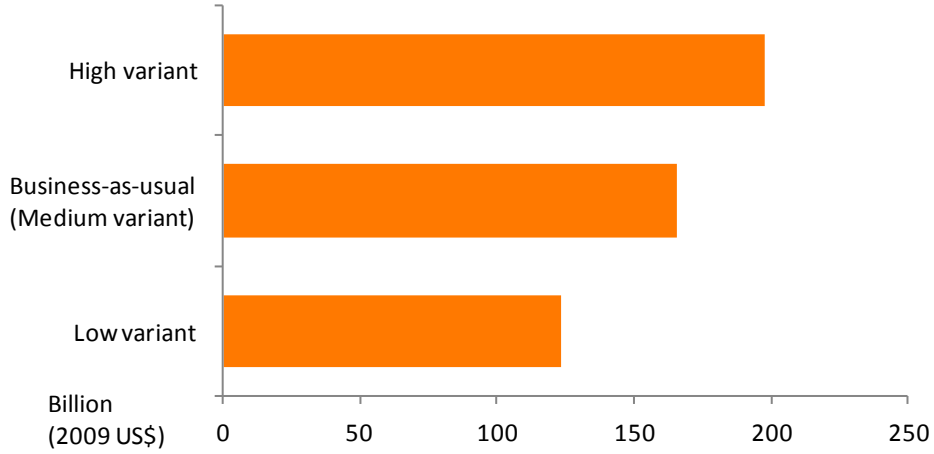
The value of India's agrifood consumption and imports in 2050 is projected to be around 7 per cent and 19 per cent higher, respectively, under the high population growth case than in the business-as-usual case. In the low population growth case, they are projected to be 10 per cent and 26 per cent lower, respectively (Figure B1 and Figure B2). The direction and similar magnitudes of these results affirm that the model responds as expected to changes in population size.

Figure B1 Population sensitivity – total agrifood consumption in 2050, India



Source: ABARES model output

Figure B2 Population sensitivity – total agrifood imports in 2050, India



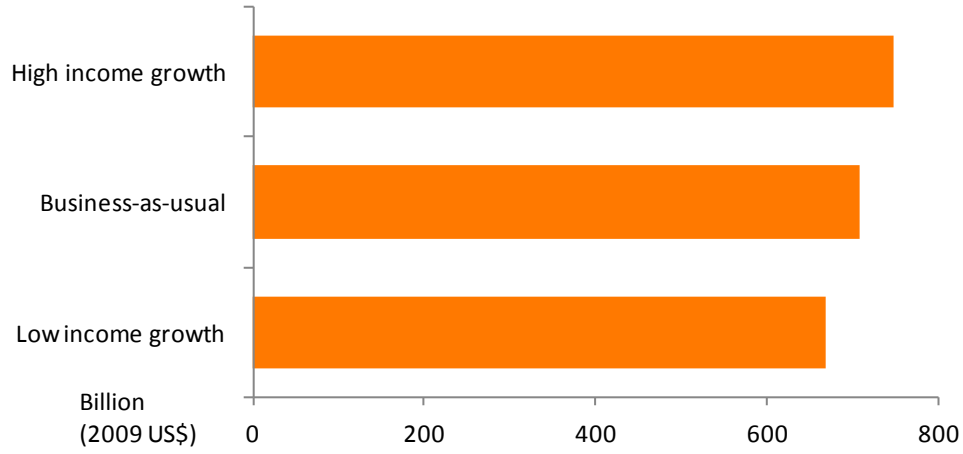
Source: ABARES model output

Income assumptions

Sensitivity analysis around the income assumptions used in this analysis is conducted by increasing and decreasing the income level in the business-as-usual case by 5 per cent, in each year and for all households. All other variables are held constant. Results under each of these settings are compared with the business-as-usual case.

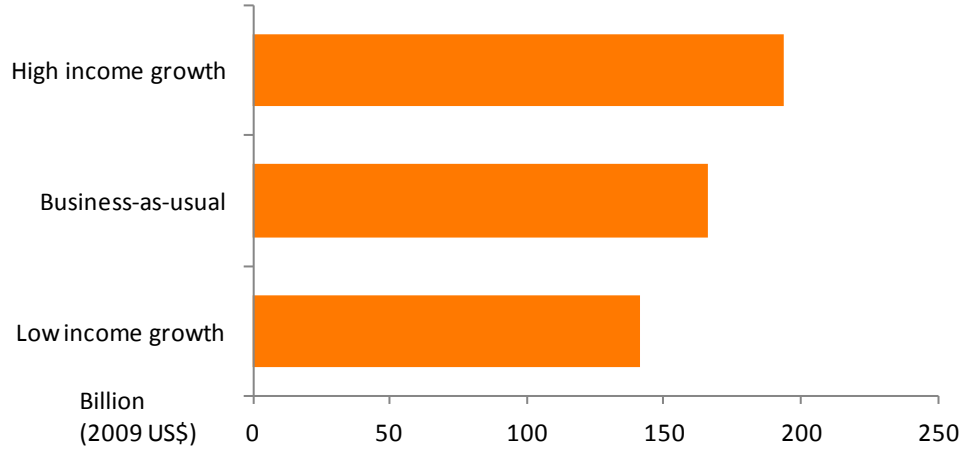
When incomes are 5 per cent higher than in the business-as-usual case, the value of India's agrifood consumption and imports in 2050 (in 2009 US dollars) is projected to be around 6 per cent and 17 per cent higher, respectively, than in the business-as-usual case. In contrast, when incomes are 5 per cent lower, total agrifood consumption and imports in 2050 are around 6 per cent and 15 per cent lower, respectively, than in the business-as-usual case (Figure B3 and Figure B4). Again, the direction and similar magnitude of the changes in consumption and imports affirms the model's power to adapt to changing income conditions.

Figure B3 Income growth sensitivity – total agrifood consumption in 2050, India



Source: ABARES model output

Figure B4 Income growth sensitivity – total agrifood imports in 2050, India



Source: ABARES model output

Appendix C: Social security policy

The social security policy assumed in policy environments 2 and 3 provides a minimum level of income support to all people below India's national poverty line, equal to the value of the recommended daily kilocalorie intake according to UNWFP (2014). The value of food consumption was calculated using (a) the recommended daily kilocalorie intake (b) the quantity of agricultural commodities which would make up this kilocalorie intake and (c) the price of these commodities over the projection period.

According to UNWFP (2014), the recommended daily intake is around 2100 kilocalories per person. In India, these kilocalories are assumed to be composed of rice (51 per cent), wheat (36 per cent) and other cereals (13 per cent), in line with India's aggregate cereal consumption patterns (National Sample Survey Office 2011). This is equivalent to 290 grams of rice, 230 grams of wheat and 73 grams of other cereals (US Nutrient database 2014). This consumption mix is held constant over the projection period.

Using the above quantities and ABARES' agrifood price projections between 2009 and 2050, the average value of the daily recommended calorie intake over the projection period is estimated to be around US$0.18 per person a day (in 2009 US dollars).

Policy costs

The amount saved from the removal of domestic support policies is obtained by adding the cost of the consumer subsidy and price floor policy in each year between 2015 and 2050. It is projected to rise from around US$22.1 billion in 2015 to US$43.9 billion in 2050 (in 2009 US dollars), equivalent to an average of US$33.0 billion a year.

The minimum cost of the social security policy was obtained by adding the yearly cost of support for each person under the poverty line between 2015 and 2050. As discussed in Chapter 4, ABARES estimates the number of people who fall below India's national poverty line in 2050 using a log-linear trend. It is estimated to fall from around 254 million people in 2015 to 80 million people in 2050, representing a decline of 69 per cent. The minimum cost of the social security policy is estimated by multiplying the value of the recommended daily intake and the number of people below the poverty line. Following this method, the minimum cost is projected to fall from around US$16.7 billion in 2015 to US$5.3 billion in 2050 (in 2009 US dollars), or $11.4 billion a year on average.

The difference between the savings from the domestic policy reform and the costs of the social security policy represent resources saved that can be reinvested in other parts of the economy. Although a simplistic estimate, the projected savings range from $5.4 billion in 2015 to US$38.6 billion in 2050 (in 2009 US dollars). Over the projection period the net savings are estimated to average around US$22 billion a year.

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