Food security has long been the mainstay of public policy in India. Only in the 1970s did the country begin to come out of the shadow of severe food scarcity with its history of acute famines. Even in the mid-1960s, its import dependency concerning cereals was as high as 16 percent, which coupled with the country’s small export base also had serious balance-of-payment repercussions. Consequently, India’s agricultural policy has always aimed to maximize agricultural production and achieve self-sufficiency, particularly in cereals.

Several technological, infrastructural, and institutional changes were implemented to increase agricultural production. Even with those advances, however, rapid growth in the country’s population meant its land and other resources remained under great pressure to meet food needs. Therefore, high-yielding crops such as rice and wheat, which could lead to increased food production, received greater attention. The late 1960s and 1970s witnessed a spectacular growth in the production of these crops with the introduction of Green Revolution technologies.\(^1\) The spread of these technologies did not confer equal benefits across crops or regions of the country. Vast areas in the eastern and western regions remained untouched by the technologies. An additional challenge was that with the adoption of technology and new access to irrigation, wheat and rice recorded significant growth at the cost of displacing other crops, particularly coarse cereals, pulses, and oilseeds.

\(^1\) The Green Revolution in India refers to a period when agriculture principally of cereals increased its yields due to improved agronomic technology in the early 1960s. This led to a significant increase in food production of rice and wheat, especially in such areas as Punjab, Haryana, and western Uttar Pradesh. It was brought about by the spread of higher-yielding varieties of the crops supported by the increased use of chemical fertilizers and irrigation.
The Case for Pulses

Pulses, long considered “the poor man’s meat” because of their protein profile, occupy a unique place in India. India ranks as the country with the world’s largest number of malnourished people. Because of this, coupled with the country’s high incidence of vegetarianism, the future of pulses is of special significance to India’s large poor population. Pulses are also among the crops that have been adversely affected by the dominance of cereals over the past several decades, so it is clear that agricultural policy is implicated in both the nutritional challenges and, as we hope to show, in potential solutions.

Naturally, the cost of food is significant to India’s poorest population, and in recent years the country has suffered a persistent problem of food price inflation. Many basic foods exhibit a higher average rate of inflation than the overall Wholesale Price Index (WPI); Sonna et al. (2014) observe that cereals, pulses, milk, fruits and vegetables, meat-fish-eggs (MFE), and sugar all exhibited higher average rates of inflation. At the same time, the relative price increases have been driven largely by protein-rich foods (Gokarn 2011), whose cost has been rising uniformly at a faster rate than the cost of other foods. The most common contributors to this inflation are milk and fish (Mishra and Roy 2011); since 2005, the average inflation rates for pulses and MFE have been higher than the rates for the composite food WPI. Taken together, pulses, MFE, milk, and milk products constituted around 30 percent of the total food expenditure according to the 66th Round (2009–2010) of the national survey by the National Sample Survey Office (NSSO), but they were responsible for approximately 42 percent of food inflation since 2005 (Sonna et al. 2014; Mishra and Roy 2011). It is important to note that although the cost of pulses has been an important driver of food price increases, pulses continue to be cheaper than several of the other sources of protein, including animal source food (ASF).

Pulses, in fact, constitute the most common source of noncereal protein in India, where the frequency of pulse consumption is higher than that of any other protein source. Among Indian consumers, pulses contributed nearly 10 percent of the protein consumed in 2011–2012. This is closely linked with the Indian tradition of vegetarianism—widespread reliance on plant-based diets—a common and deeply ingrained dietary pattern that dates back at least 2,500 years. Indians constitute about 70 percent of the world’s population of vegetarians. About three-quarters of Indian vegetarians are lacto-vegetarians—that is, although they do not consume meat or eggs, they

2 ASF comprises meat, fish, eggs, and dairy.
have no prohibitions for milk or other dairy products. And up to 25 percent of India’s vegetarians are lacto-ovo vegetarians—they too do not eat meat, but they consume eggs as well as dairy products (Rammohan, Awofeso, and Robitaille 2012). As a source of protein, pulses of different types are eaten across all of India’s regions. Other principal sources of protein include MFE. A more recent figure on vegetarianism is available from the baseline data for the Census of India. Based on this data, there still is significant presence of vegetarians in the population. In 2014, of those 60 years and older, nearly 33 percent report as vegetarians in both urban and rural areas. Also, the incidence of vegetarianism is slightly higher among women than men in all age groups in urban and rural households. In the age group that is above 30, 29.8 percent of women report as vegetarians compared with 28.2 percent among men (Census of India 2014).

Pulses are consumed equally by India’s rich and poor as it is one of the less expensive sources of protein (Mohanty and Satyasai 2015). Around 89 percent of consumers eat pulses at least once a week, while the corresponding number for eating fish or chicken/meat once a week is only 35.4 percent (IIPS and ORC Macro 2007). Pulses complement the staple cereals in people’s diets with proteins, essential amino acids, vitamins, and minerals. They contain 22 percent to 24 percent protein, almost twice the amount of protein found in wheat and three times that found in rice. Pulses have a unique nutritional profile consistent with several dietary composition factors thought to assist with weight control. They also contain several antinutrients that play a role in energy regulation. Pulses are high in fiber, relatively low in energy density (1.3 kcal per gram), and a good source of digestible protein (average of 7.7 grams of protein per half cup). Pulse carbohydrates are slowly digested (McCrory et al. 2010). The amount of protein in pulses is 17 percent to 35 percent on a dry weight basis (Boye, Zare, and Pletch 2010). Jukanti et al. (2012) provide the nutrition benefits of chickpea specifically and present it as a good source of carbohydrates and protein, with protein quality in particular better than other pulses. Chickpea has significant amounts of all the essential amino acids except the sulfur-containing types, which can be complemented by adding cereals to daily diet as cereals are rich in sulfur-containing amino acids. Jukanti et al. (2012) list chickpea as an affordable source of protein, carbohydrates, minerals and vitamins, dietary fiber, folate, beta-carotene, and health-promoting fatty acids.

Pulses also possess advantages for soil health and farming sustainability. Because of India’s diverse agroclimatic conditions, pulses are grown in various parts of the country throughout the year. Their growth reduces soil
pathogens and fixes nitrogen in the soil, which enhances soil productivity, improving the yields of crops that follow their harvest. In this way, pulses play a vital role in crop rotation and intercropping. Studies show that because of these factors, the yield of crops that follow pulses can increase by 20 percent to 40 percent (Pande and Joshi 1995). The changes in soil fertility brought about by pulse cultivation have been assessed for different crops, including maize (Dwivedi et al. 2015; Peoples et al. 2009). Because pulse farming itself requires less use of fertilizer, pesticide, and irrigation than many other crops, pulses are also an environmentally friendly crop group (Reddy, Bantilan, and Mohan 2013). India currently suffers from excessive chemical usage, and the government is saddled with a huge burden in fertilizer subsidies (equal to 1.5 percent of GDP on average). Moreover, heavy pesticide use presents food safety issues. Finding relief from these stresses is of first-order importance in India.

**Portfolio of Pulses Grown in India**

Several types of pulses are grown in India, as illustrated in Box 1.1. Despite being the leading producer of pulses, India has been consistently unable to meet its own domestic demand for the food. For several reasons, pulse production has been increasingly disadvantaged over the years and has become relatively less profitable compared with cereal production in areas of reasonable fertility and access to irrigation:

1. The Green Revolution pushed pulse cultivation away from irrigated areas to rainfed areas, where nearly 87 percent are now grown. This reliance on rain, however, makes pulses a risky crop.

2. Technology development has been far more extensive and more yield-improving for cereals than for pulses.

3. In addition, being protein-rich also makes pulses more prone to different types of pests and diseases.

On the policy side, the system of a minimum support price (MSP) with procurement may make growing and selling pulses comparatively less risky for farmers. Where MSP is announced at the time of sowing and procurement occurs, the government agrees to buy all the grain (rice and wheat) that is offered for sale at that price, removing all the price risk. MSP currently applies to paddy rice, wheat, five coarse grains, four pulses, eight oilseeds,
cotton, jute, tobacco, and sugarcane. The announced MSP for pulses (with insignificant procurement) has risen consistently over time. Notwithstanding these increases, the MSP in pulses still serves only as a benchmark price and remains far below the market price; for pigeon pea, for example, in 2015 the MSP notional price was less than one-fourth of the market price. For this reason, pulse farmers must continue relying on traders for their sales rather than selling to government procurement. NSS data, however, show that in the case of wheat and rice, only 6 percent of farmers gain access to government procurement, casting doubts on how many pulse farmers would gain (and to what extent) from a larger pulse procurement program if one were enacted. The effectiveness of such a system remains in question and the issue certainly warrants further research.

Pulse milling is almost a widespread industry in the Indian subcontinent, but it has not received the scientific and technological support from the government necessary to modernize it, unlike other food-processing industries, such as rice and wheat milling (Banerjee and Palke 2010).

**Challenge: The Decline of Pulses over Time**

Because of the relatively disadvantaged position of pulses in comparison with cereals, over the past 56 years, pulse production has risen by only 32 percent as compared with a roughly 280 percent increase in cereal production over the same period. The crop yield from pulses has shown a similar trend, gaining only by 25 percent as compared with a 211 percent gain in cereals (Srivastava, Sivaramane, and Mathur 2010). Moreover, pulse yields have been widely variant across the different areas where the crop is grown.

At the same time, the land area devoted to pulses marginally decreased, from 24 million hectares during the triennium ending in 1975 to 23 million hectares during the triennium ending in 2005. This shrinkage was due to

---

3 The MSP for pulses has been increased by more than 50 percent over the past five years and has often been boosted with bonuses. For example, the agriculture ministry announced up to a 6 percent increase in MSP in 2014–2015, including a bonus of 200 rupees per quintal. With the increase, the MSP of black matpe reached 4,625 rupees per quintal for the crop year 2015–2016 (July–June) as against 4,350 rupees per quintal the previous year. Over the past four years, the increase in MSP was a massive 87 percent for tur, 71 percent for black matpe, and 63 percent for green gram. Among rabi pulses for MY 2014–2015, the MSP for chickpea was fixed at 3,100 rupees per quintal and the MSP for lentil at 2,950 rupees per quintal; these prices represented a modest increase over the 2013–2014 levels of 3,000 rupees and 2,900 rupees per quintal, respectively, but they represented a massive increase of 76 percent and 58 percent, respectively, since 2010–2011 (NCAER 2014).
**Box 1.1 Supply and demand characteristics of different types of pulses in India**

India is the world’s largest producer and consumer of pulses. Major pulses grown in India include chickpea or Bengal gram, pigeon pea or red gram, lentil, black matpe, mung bean or green gram, lablab bean, moth bean, horse gram, pea, grass pea or khesari (*Lathyrus sativus*), cowpea (*Vigna unguiculata*), and broad bean or faba bean (*Vicia faba*). Popular pulses in India are chickpea, pigeon pea, green gram, black matpe, and lentil. Pulses are mostly grown in two seasons: (1) the warmer, rainy season or *kharif* (June–October), and (2) the cool, dry season or *rabi* (October–April) (Gowda et al. 2013). Chickpea, lentil, and dry peas are grown in the *rabi* season, while pigeon pea, black matpe, green gram, and cowpea are grown during *kharif*. Among the various pulses, chickpea dominates, claiming a more than 40 percent share in production of all pulses grown, followed by pigeon pea (18–20 percent), green gram (11 percent), black matpe (10–12 percent), lentil (8–9 percent), and other legumes (20 percent) (IIPR 2011).

The major pulses—chickpea, pigeon pea, lentil, green gram, and black matpe—account for nearly 80 percent of total pulse production in India. India’s total production, in turn, accounts for 33 percent of world production by area and 22 percent of world production by volume. By area, India’s production makes up 90 percent of global production of pigeon pea, 65 percent of chickpea, and 37 percent of lentil; this corresponds to 93 percent, 68 percent, and 32 percent of the global production of these pulses, respectively, by volume (FAO 2011). Among all pulses, lentil is the most actively traded (about 25 percent of world production of lentil is internationally traded) (Reddy and Reddy 2010). Lentil is an important *rabi* pulse crop, next only to gram, and it is distinctive in being the only pulse grown in India with a net exportable surplus (all other pulse trade has a significant net import reliance). Pulses with their local names are presented Table B1.1.

On the consumption side, the annual per capita consumption of pulses declined between 1993–1994 and 2004–2005 (from 9.44 kilograms to 8.82 kilograms) and then rose again by 2011–2012 (to 9.6 kilograms), a consumption pattern that has been mirrored by each of the major pulse crops: pigeon pea, gram (split), green gram, and black matpe. As a share of total food expenditure, pulses represent about 5 percent. Among pulses, pigeon pea is the most heavily consumed, making up more than 30 percent of total pulse expenditure, although the type of pulse most demanded varies significantly across states. The major chickpea-consuming states are Haryana, Punjab, and Rajasthan. The major pigeon pea-consuming states are Andhra Pradesh, Karnataka, and Maharashtra, while the major green gram-consuming state is Gujarat. In Assam, Bihar, and West Bengal, lentil is the
farmers’ shifting over to nonpulse crops, for which the government has made irrigation and infrastructural facilities available (Gowda et al. 2013). Only recently, possibly because of price increase, the area allocation to pulses recovered to 26.3 million hectares in 2011–2012 (Gowda et al. 2013) and receded again to 25 million hectares in 2013–2014 (Mohanty and Satyasai 2015). The decline of the pulses sector in India is reflected in three broad facts:

1. **Per capita consumption.** Consumption of pulses has fallen over time and currently stands at levels below those attained in the 1980s. Consumption fell continuously from the 1980s through the 2000s, although it has been improving again over the past few years.

### Table B1.1 English, local, and scientific names of the pulses

<table>
<thead>
<tr>
<th>English name</th>
<th>Local name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigeon pea, red gram</td>
<td>Arhar, tur</td>
<td>Cajanus cajan</td>
</tr>
<tr>
<td>Chickpea, bengal gram, garbanzo bean</td>
<td>Chana</td>
<td>Cicer arietinum</td>
</tr>
<tr>
<td>Lentil</td>
<td>Masoor</td>
<td>Lens culinaris</td>
</tr>
<tr>
<td>Green gram, mung bean</td>
<td>Moong</td>
<td>Vigna radiate</td>
</tr>
<tr>
<td>Black matpe, black gram, black matpe bean</td>
<td>Urad, udid, urad bean</td>
<td>Vigna mungo</td>
</tr>
<tr>
<td>Pea</td>
<td>Matar</td>
<td><em>Pisum sativum</em> var. <em>arvense</em></td>
</tr>
<tr>
<td>Grass pea</td>
<td>Khesari</td>
<td><em>Lathyrus sativus</em></td>
</tr>
<tr>
<td>Yellow pea</td>
<td>[No local name]</td>
<td><em>Lathyrus aphaca</em></td>
</tr>
<tr>
<td>Lablab bean</td>
<td>[No local name]</td>
<td><em>Lablab purpureus</em></td>
</tr>
<tr>
<td>Moth bean</td>
<td>Moth</td>
<td><em>Vigna aconitifolia</em></td>
</tr>
<tr>
<td>Horse gram, madras gram</td>
<td>Kulti</td>
<td><em>Dolichos uniflorus</em></td>
</tr>
<tr>
<td>Broad bean, faba bean</td>
<td></td>
<td><em>Vicia faba</em></td>
</tr>
<tr>
<td>Cowpea</td>
<td></td>
<td><em>Vigna unguiculata</em></td>
</tr>
</tbody>
</table>

**Source:** Authors.
(2012–2014), a period when production significantly increased to 17–18 million metric tons.\(^4\)

2. **Inflation.** There has been a persistent increase in pulse prices, resulting in accessibility issues for the poor.

3. **Imports.** Imports of pulses have sharply increased and have been expanding on the extensive margin.

Although pulses may become marginalized, one of the book’s themes is that this set of crops offers a wealth of opportunities, and its potential in India has not yet been fully exploited. Advances in food and crop technology have not been fully deployed to advantage in the case of pulses, opportunities for inducing more efficient value chains have not been taken up, and the potential efficacy of price management has not been adequately studied regarding the different pulses crops.

Better price management could involve combining support prices with procurement (although the likely effectiveness of minimum support prices policies combined with procurement for pulses entails potential challenges and requires further study) and seeking to ensure better transmission of prices to the farmgate through direct purchases along with processing. Such a combined approach could help arrest the consumption slide that these crops have experienced since the 1990s. In a comprehensive study, Tiwari, Gowen, and Mckenna (2011) have shown that pulses are nutritionally diverse crops that can be successfully used as a food ingredient or a base for innovative product development. Today, new options have become available in food processing, including technologies for processing whole pulses, techniques for fractionating pulses into ingredients that preserve their functional and nutritional properties, and other potential applications to incorporate pulses into new food products.

The remainder of this chapter presents some facts that form the background motivation for this book: the production and consumption patterns of India’s pulse sector, the global context of trade in pulses and the position of India therein, the nutritional and environmental characteristics that make pulses a salient crop in meeting human needs, and the different initiatives for the pulses sector taken up by the government of India.

\(^4\) Throughout this chapter, “tons” are “metric tons.”
Pulse Production and Consumption

The production of pulses in India tends to fluctuate quite significantly. Table 1.1 presents recent production statistics for different pulses, which show that there is little consistency. For example, consider chickpea production: while it was 8,833 thousand tons in 2012–2013, it was merely 7,170 thousand tons just two years later. Its share in total pulse production moved from 48 percent to just 42 percent.

Since production has been volatile and restricted within a narrow range, a demand-supply gap has been a constant feature of pulses since early 2000, resulting in stubbornly high prices. Figure 1.1 illustrates this price phenomenon using unit values from the NSSO Consumer Expenditure Survey (CES). There is a distinct rising trend in pulses prices and a falling trend in consumption over two decades. The demand elasticity has been estimated to be quite high for pulses, particularly for the poor households, by different studies (~0.7 or higher).

Table 1.1 Production of pulses in India, 2012–2013 to 2014–2015

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production of pulses (thousands of metric tons)</td>
<td>Share in total pulse production (%)</td>
<td>Production of pulses (thousands of metric tons)</td>
</tr>
<tr>
<td>Pigeon pea</td>
<td>3,023</td>
<td>16</td>
<td>3,170</td>
</tr>
<tr>
<td>Chickpea</td>
<td>8,833</td>
<td>48</td>
<td>9,530</td>
</tr>
<tr>
<td>Green gram</td>
<td>1,186</td>
<td>6</td>
<td>1,610</td>
</tr>
<tr>
<td>Black matpe</td>
<td>1,947</td>
<td>11</td>
<td>1,700</td>
</tr>
<tr>
<td>Lentil</td>
<td>1,134</td>
<td>6</td>
<td>n.a.</td>
</tr>
<tr>
<td>Other pulses</td>
<td>2,220</td>
<td>12</td>
<td>3,780</td>
</tr>
<tr>
<td>Total pulses</td>
<td>18,343</td>
<td>100</td>
<td>19,780</td>
</tr>
</tbody>
</table>

Source: India, Ministry of Agriculture, New Delhi various years, Directorate of Economics and Statistics (DES).

Note: n.a. = not applicable.

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References to demand-supply gap here and elsewhere in the book pertain to the gap between domestic demand and domestic production.
Production in India: Regional Trends

Although pulse production in India has remained stagnant since the late 1980s (with the exception of the last three years), significant changes have occurred at the subnational level. Crowding out by expanded cereal production, discussed earlier, has led to pulse production centers moving from the eastern to the western region and from the northern to the southern region. Apart from pushing pulses to more marginal environments, this has also meant that for many pulses, areas of production ceased to be same as the areas where they are most consumed. This has made the role of the supply chain especially important.

Some crowding out of pulses over time has also occurred due to the cultivation of noncereal crops. Rapid expansion of soybean, for example, has had adverse effects on the areas planted in certain kharif pulses, including pigeon pea and green gram. Even though pulse yields have not shown much dynamism, important technological developments have improved yield, mostly in the case of chickpea and pigeon pea. For technology development to improve pulse yield, it must encompass some unique features, such as the need to fit pulse cultivation into the cereal-farming complex in crop rotation and intercropping, which makes attributes like crop duration very important. It also has to deliver productivity in marginal environments where irrigation is lacking and farmers have little purchasing power. The successful development of short-duration and wilt-resistant chickpea varieties, for example, has led to their adoption in new niches in southern India and in the rainfed rice fallow
lands (Gowda and Gaur 2004; Gaur et al. 2008). This book aims to draw useful lessons from these successes.

Figure 1.2a and Figure 1.2b show that the little yield growth that has happened is concentrated in few pulses, mainly chickpea. Even at its peak production, chickpea yield was much lower in India than in leading countries like Israel (3 tons per hectare), Australia (more than 2 tons), and China (2 tons). Similarly, for pigeon pea, countries like the Philippines attain yields greater than 1 ton per hectare compared with a peak yield of about 800 kilograms per hectare in India. In 2013, pigeon pea yields were 650 (kilograms per hectare) for India; 2,520 for Canada; 2,037 for the United States; 1,550 for China; and 1,409 for Australia (FAO 2013).
Global Trade and India’s Performance over Time

Among the other motivations justifying the need for this book is the need to better understand the potential and actual effects of India’s pulse sector on other countries and the effects of other countries’ production on India. Figure 1.3 shows the shifting rank in production of the top global producers since 1961. While other countries have switched ranks (for example, China), India has consistently remained the largest producer. The Indian trade deficit in pulses, however, has turned some countries into large producers and sellers as they have found a big market opportunity in Indian consumers. For example, Myanmar, which before 2000 was not ranked among the world’s top five producers, now ranks as the largest exporter of pigeon pea, black matpe, and green gram to India. India’s pulse market has also had significant spillover effects for countries as far away as Canada and Australia, and most recently for several African countries, including Malawi, Mozambique, and Tanzania. The availability of African pigeon pea production is synchronous with the seasonal incidence of high prices in the Indian market, since the bulk of African pigeon pea exports occur from September to January, before the harvest of India’s own rainy-season crop (Walker et al. 2015).

The advent of imports of pulses by India is a relatively new phenomenon. Until the late-1990s, India continued to be nearly self-reliant in this product and did not require any sizable imports, but as Figure 1.4 shows, the country is now the largest importer of pulses, with imports making up as much as a quarter of its total pulse consumption in some years. Before 2001, India figured among the top five importers only once, in the 1980s. India’s pulse imports are concentrated across just four or five countries, which generally constitute up to 95 percent of what it imports. Since trade has grown significantly (the import values equal nearly US$1.5 billion) and has become a sizable part of the consumption portfolio, this book examines the dynamics of pulses trade in detail. Currently, pulse imports are second only to edible oils in terms of import penetration in food.

Nutritional Value and Cost to Consumers

This book is also motivated by the role of pulses in nutrition. Pulses are important components of the Indian diet and constitute a major source of quality protein. They provide other nutrients, including carbohydrates, dietary fiber, unsaturated fat, and vitamins and minerals, as well as non-nutrients, such as antioxidants and phytoestrogens. Their most common and widely recognized role is in supplying proteins for vegetarian consumers. The
latest round of the NSS (68th round) found that in rural India pulses contribute 10 percent of protein intake, the same proportion as milk and milk products contribute, and in urban India slightly more (11 percent). In some states, pulses contribute as much as 14 percent of protein intake, and in many states, they contribute more than milk or meat-fish-eggs. In India’s urban sector the contribution of pulses to protein was in the range of 10 to 13 percent for 13 of the major states.
The value of pulses as a source of protein is important today because, among both poor and middle-income households, protein intake levels have declined since 1988. Indeed, based on the NSS data over different rounds, in India’s rural areas this fall in protein intake has even affected rich households. In short, the only population in the country whose protein intake has improved over the past two decades is that of urban rich households. All of this places pulses in a comparatively important role, particularly in rural India, where a 2010 study (Arlappa et al. 2010) found that 73 percent of households did not consume the recommended dietary intake (RDI) of pulses. The latest NSSO survey indicates that 50 percent of the Indian population consumes less than the recommended daily intake of protein, which is 60 grams a day (NSSO 68 report 560, Table T11, NSSO 2014). The deficiency is more pronounced in the lower income strata (for example, the bottom 20 percent of the population consumes only 80 percent of the recommended protein intake).

The rising cost of food is certainly relevant to the decline in protein intake. Mishra and Roy (2011) examined the drivers of food inflation in India and found that the rate of price increases after 2005 has been high in pulses, although it has been relatively higher in milk and milk products as well as fish and meat. Two pulses, particularly pigeon pea and green gram, have consistently been in the cluster of pulses undergoing high price increases.

The latest round of NSS data provides information on nutrients per unit of food, and Table 1.2 lists, for comparison, these measures for calories, protein, and fat for a number of the most common foods alongside seven pulses. It is evident that per unit of weight, pulses provide high levels of protein. Whether they turn out to be the cheapest source of protein for a household varies across time.

**Government Policy Responses**

As discussed earlier, the performance of the pulses sector in India seems to have been subpar, with consistent gaps between demand and supply over a long period leading to more than a billion dollars’ worth of annual imports. Importantly, this has happened despite many large-scale government initiatives combined with such policies as a hike in the MSP (even though there is limited procurement) to stimulate the pulses sector. For example, the government has launched several productivity enhancement programs. In 1967 it established the All India Coordinated Pulses Improvement Project (AICPIP), which was later elevated to the Indian Institute of Pulses Research (IIPR).

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6 Pulses are not unique in this context in terms of a coordinated research program.
TABLE 1.2 Nutrients per kilogram for common food items in India

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Calories per unit (kilocalorie)</th>
<th>Protein per unit (grams)</th>
<th>Fat per unit (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>kilograms</td>
<td>3,460</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>Wheat</td>
<td>kilograms</td>
<td>3,410</td>
<td>121</td>
<td>7</td>
</tr>
<tr>
<td>Lowar (sorghum) and products</td>
<td>kilograms</td>
<td>3,490</td>
<td>104</td>
<td>19</td>
</tr>
<tr>
<td>Bajra (pearl millet) and products</td>
<td>kilograms</td>
<td>3,032</td>
<td>97</td>
<td>42</td>
</tr>
<tr>
<td>Maize and products</td>
<td>kilograms</td>
<td>3,420</td>
<td>111</td>
<td>36</td>
</tr>
<tr>
<td>Pigeon pea</td>
<td>kilograms</td>
<td>3,350</td>
<td>223</td>
<td>17</td>
</tr>
<tr>
<td>Chickpea (split)</td>
<td>kilograms</td>
<td>3,720</td>
<td>208</td>
<td>56</td>
</tr>
<tr>
<td>Chickpea (whole)</td>
<td>kilograms</td>
<td>3,720</td>
<td>208</td>
<td>56</td>
</tr>
<tr>
<td>Green gram</td>
<td>kilograms</td>
<td>3,480</td>
<td>245</td>
<td>12</td>
</tr>
<tr>
<td>Lentil</td>
<td>kilograms</td>
<td>3,430</td>
<td>251</td>
<td>7</td>
</tr>
<tr>
<td>Black matpe</td>
<td>kilograms</td>
<td>3,470</td>
<td>240</td>
<td>14</td>
</tr>
<tr>
<td>Peas</td>
<td>kilograms</td>
<td>3,150</td>
<td>197</td>
<td>11</td>
</tr>
<tr>
<td>Other pulses</td>
<td>kilograms</td>
<td>3,400</td>
<td>220</td>
<td>12</td>
</tr>
<tr>
<td>Milk</td>
<td>liters</td>
<td>1,000</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>Eggs</td>
<td>number</td>
<td>100</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Fish, prawn</td>
<td>kilograms</td>
<td>1,050</td>
<td>140</td>
<td>20</td>
</tr>
<tr>
<td>Goat meat</td>
<td>kilograms</td>
<td>1,180</td>
<td>214</td>
<td>36</td>
</tr>
<tr>
<td>Chicken</td>
<td>kilograms</td>
<td>1,090</td>
<td>259</td>
<td>6</td>
</tr>
</tbody>
</table>

Source: NSSO 2014 and Indian Council of Medical Research (ICMR).

Pulses also have received significant attention in different five-year plans, including the Intensive Pulses District Program launched during the Fourth Five-Year Plan (1969–1974), the National Pulses Development Program launched during the Seventh Five-Year Plan (1985–1989), and a special food grain production program launched in 1988–1989.

In 2004 schemes for pulses, along with schemes for oilseeds, oil palm, and maize, were brought under one centrally sponsored scheme: the Integrated Scheme of Oilseeds, Pulses, Oilpalm, and Maize (ISOPOM) (India, Ministry of Agriculture, Agricultural Statistics at a Glance). In 2007 pulses were also made a focus crop in the National Food Security Mission (NFSM) in 171 districts across 14 states, and in 2011–2012 the government allocated

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7 The schemes were: ODP (Oilseed Development Programme), OPDP (Oil Palm Development Programme), NPDP (National Pulses Development Programme), and AMDP (Accelerated Maize Development Programme).
3 billion rupees for the integrated development of 60,000 pulse villages under Rashtriya Krishi Vikas Yojana (RKVY) (the national agricultural development plan). The government of India has also followed a liberal trade policy in pulses. Many of the trade barriers that were in place before the 1970s were removed to encourage cheap imports for general pulse consumption.

Despite the wide range of research and several government programs and policy stances, India’s pulses sector has recorded barely any growth either in the area planted or in yield for the past five decades. From the point of view of this volume’s contributors, the stubborn lack of change on the ground despite all those efforts represents one of the compelling reasons this important sector needs to be studied more closely. Rigorous impact assessments of the government’s several initiatives have not been done, apart from a summary evaluation by the government concerning the NFSM (India, Ministry of Agriculture 2014). In that evaluation, the government reported that after launching the mission in 2007–2008, the area covered under pulses increased by 3.1 percent but then declined during 2008–2009 by 4.8 percent. Pulse cultivation again picked up momentum in 2009–2010, and it registered a growth rate of 29 percent at the all-India level. Another evaluation of the NFSM, by Thomas, Sundaramoorthy, and Jha (2013), found that there were significant increases in pulse production with increases in area in Andhra Pradesh, Karnataka, and Maharashtra but significant increases in yields in just 2 of the mission’s 14 states (Karnataka and Maharashtra).

**How This Book Is Organized**

Chapter 2 examines the state of pulse demand and its distribution across space and over time. Among the findings, the chapter shows that the fall in per capita consumption of pulses has been consistent across all household income groups and across both rural and urban regions. Trends over time in pulse consumption are described in detail across different income and demographic groups, including projections for pulse demand extending to 2030. The chapter, by outlining the nutritional contribution of pulses, suggests that enhancing consumers’ access to pulses could improve nutritional status in terms of protein intake. High price responsiveness, particularly among the poor, suggests that managing inflation in pulse prices is likely to be important for raising pulse consumption.

Chapter 3 gives a detailed description of pulse production dynamics across regions and over time. It divides the history since 1960 into four time periods: pre– and early Green Revolution; advanced and post–Green Revolution;
postliberalization; and post–trade spike. To study the spatial movement in pulse cultivation, states are grouped into five geographic zones: north, east, south, west, and central. The chapter formally establishes that pulse production has shifted from traditional to nontraditional areas over time, moving from north to south and from east to west and central regions, with Madhya Pradesh and Chhattisgarh becoming the hub of pulses production.

Chapter 4 looks at the technology, with special importance given the stagnation in pulses’ yield as compared with that of other crops. Yield improvement in pulses will be needed to overcome the position of advantage that now favors cereals and oilseeds. To date, the history of technology improvements in pulses has been mixed, with the pace of development and adoption picking up only in the past decade or so. With muted supply response in pulses driven by technology and agricultural policies, India has faced a persistent deficit in pulses that has led to significant imports.

Chapter 5 studies another important segment of the pulses sector: food processing. Given that NSS data show an increase in consumption of processed food items, declining per capita consumption of pulses could possibly be checked by the development of innovative pulse products that processing could bring about. However, the report card for this sector is far from encouraging, as much pulse processing continues to be done with low levels of technology and at relatively small scale. The few examples of pulse processing that are claimed to be successful nevertheless suggest that introducing an element of product differentiation might offer promise to the sector, particularly in marketing pulses as a health food.

Chapter 6 addresses the problem of persistent and rising reliance on pulse imports. It looks at the expansion of trade along both the intensive and extensive margins. With the help of liberal trade policies—low import tariffs and export restrictions—the government tried to enhance the availability of pulses in the country. The chapter shows that, especially throughout the 2000s, pulse imports rose significantly, with import penetration increasing from 10 percent to 20 percent. It also notes how significant changes have taken place in the import basket. Whereas chickpea and pigeon pea had dominated the import basket in the first half of the 2000s, in the latter half, they were replaced by yellow pea, a variety not even produced in India. Yellow pea’s consistent importation from Canada in significant quantities and at low prices has created a sizable demand for it. These changes allude to the possibilities of the roles played by trade and the potential risks involved (if, for example, trade largely expands on intensive margin). The chapter also documents new pulse exports emanating from African countries, including Tanzania, where some Indian firms are
beginning to lease-in land to export pulses to India. The effect of imports on domestic prices for one of India’s most important pulses (in production and consumption)—pigeon pea—are also analyzed. Results are nuanced, in the sense that the dampening effect of imports on prices has not been large enough to actually bring prices down but has instead arrested the rate of price increase.

Chapter 7 reviews the role of convergent innovation for the development of the pulses sector and discusses an evolving framework focused on the significant health and environmental benefits that could accrue from pulses. Case studies of convergent innovation have shown improved outcomes that this approach can make possible, and it seems that the use of this approach to study the prospects of India’s pulses sector could be useful. Finally, Chapter 8 concludes, drawing lessons from the studies in the preceding chapters to provide policy suggestions for the way forward.

References


