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Sustaining the Pulses Revolution in India: Technological and Policy Measures

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Preface

Pulses comprise the most important source of dietary protein for vegetarians. India with a share of 39% of global demand is the largest consumer of pulses. It is also the largest producer contributing 28% to global production. The domestic production, however, falls short of the demand, resulting in huge imports. Recognizing the nutritive value of pulses and their chronic shortfall, the Government of India took several measures to boost their production. In 2020-21, pulse production reached an all-time high of 25.72 million tons, a 58% increase over that in 2015-16, almost double of the increase of 29% between 1960-61 and 2015-16. This situation can be described as "Pulses Revolution" in India. Now the question is: how to sustain this growth?

To deliberate on this question, the National Academy of Agricultural Sciences (NAAS) organized a Brainstorming Session on 5th April, 2022. Several issues and strategies for accelerating and sustaining the growth momentum in pulses production were discussed. This policy paper is the outcome of the issues deliberated in the brainstorming session. The document clearly brings out the constraints and opportunities for pulses production and suggests technological, institutional and policy measures to sustain the recent growth in their production.

I thank Drs Anjani Kumar and Shivendra Kumar Srivastava for convening this brainstorming session, synthesising the opinions, comments and suggestions of the participants in the form of this document. I am grateful to all the participants for their contribution. My sincere thanks are due to Drs Pratap S. Birthal and Dr (Ms) Malavika Dadlani for their editorial support in bringing out this document in its present shape.

(Trilochan Mohapatra)
President, NAAS

December, 2022
New Delhi

Sustaining the Pulses Revolution in India: Technological and Policy Measures

1. BACKGROUND

Pulses being leguminous crops are rich in dietary protein and thus, constitute an important component of daily diet to address protein malnutrition. By fixing the atmospheric nitrogen pulses also contribute to improving soil fertility and health. These crops have low water footprints, hence, can be cultivated in resource-constrained and climatically stressed conditions. India is the world's largest producer and consumer of pulses —28% of the production and 39% of the consumption (FAO 2018). Despite all efforts in the past, pulse production has chronically remained short of the domestic demand, compelling the country to resort to imports to meet the domestic demand and manage price fluctuations.

Between 1960-61 and 2015-16, India' s pulses production increased by 29% as against an increase of 239% in cereal production. The sluggish growth in the pulses production can be attributed to a marginal increase in their yield (22%) and stagnation in the area (around 24 million hectares) because of a policy bias towards staple cereals, rice and wheat, that resulted in unfavorable revenue terms of trade for pulses (Srivastava, Sivaramane and Mathur 2010). In 2015-16, the per capita availability of pulses was 43.83 g/day, which is less than the minimum requirement of 68.49 g/day recommended by the Indian Council of Medical Research (ICMR).

Nevertheless, since 2015-16, pulses production registered a remarkable increase reaching 25.72 million tons in 2020/21, an increase of 58%, as against an increase of 29% between 1960-61 and 2015-16. As a consequence, imports of pulses declined more than 50%, suggesting that the country is gradually heading toward self-sufficiency in pulses. Yet, pulses remain the third-largest imported agricultural commodities, after edible oils and fresh fruits. In 2020-21, the country imported pulses worth INR 11,900 crores in 2020-2021 (US$ 1700 million). For making the country self-reliant in pulses, it is imperative to sustain recent growth in pulse production. Any increase in area would also have a positive impact on nutrition, human health and environment and thus would aid achieving the country's commitments to the sustainable development goals (SDGs).

This policy paper examines pulses scenario in India and suggests measures to improve sustainability of production. Specifically, it diagnoses the causes of significant growth in pulse production in recent years, besides discussing the emerging challenges and identifying priorities for their future production.

2. ROLE OF PULSES IN NUTRITION SECURITY AND ENVIRONMENTAL SUSTAINABILITY

2.1 Pulses for Nutrition Security

Pulses comprise an important constituent of Indian diet, especially of vegetarians. These play an important role in improving the nutrition security. The country is currently facing a burden of malnutrition characterized by both the underweight and overweight/obesity. According to the latest National Family Health Survey (NFHS), 32.1% and 3.4% of the children under five years of age, respectively, are underweight and overweight (India, Ministry of Health and Family Welfare, n.d.). The prevalence of underweight condition among adults (15 to 49 years of age) is 16.2% in men and 18.7% in women, while, 22.9% adult males and 24.0% adult females suffer from obesity. Besides, 67.1% of the children aged 6 to 59 months, 57.0% of adult women and 25% adult men are anaemic (India, Ministry of Health and Family Welfare, n.d.). For such people, a balanced healthy diet is essential. Pulses supply low-fat protein with a high fiber content and a low glycemic index. Compared to cereals, pulses have 1.67 times more iron, 2.47 times more protein, 3.54 times more vitamin A, and 5.31 times more dietary folate. Due to their high nutritional values, pulses are the preferred supplement for a balanced diet. The nutritional value of pulses is further enhanced if these are eaten in combination with other foods. The protein quality of a vegetarian diet, for example, is significantly improved when pulses and cereals are eaten together (FAO 2016). Eating pulses along with vitamin-C rich foods enhances absorption of iron, rendering pulses a potent food for preventing anemia. Pulses, being high in fiber, low in fat, and with a low glycemic index, are thus an ideal food for weight management, particularly for the diabetic patients. The high fiber content in pulses lowers LDL cholesterol, reducing the risk of coronary heart disease. Pulses also contain phytochemicals and antioxidants, which lend them to have anti-cancer properties.

Because of their high nutritional value, pulses have been recommended by the ICMR as an essential component of a balanced healthy diet. The ICMR recommends an average daily intake of about 68 g/capita/day, while the actual consumption is only 27 g/capita/day as per the analysis of data from the National Sample Survey on Consumption Expenditure (2011-12). Especially, when consumption pattern is tending towards animal-based foods (Srivastava et al. 2013), the nutrition status can be improved by increasing public awareness of the benefits of pulses consumption and by improving its physical and economic accessibility.

2.2 Pulses for Environmental Sustainability

Apart from being a rich source of nutrients, pulses have immense potential in improving soil fertility and resource-use efficiency, reducing greenhouse gas emissions, and augmenting system diversity. Through a symbiotic relationship with soil microbes, pulses fix atmospheric nitrogen and make nitrogenous compounds available to other crops. By including pulses in crop rotations or their intermixing with non-leguminous crops, the requirement for nitrogen compounds—which is a limiting factor in plant growth—can be naturally met without (or with less) synthetic fertilizers. The reduction in the use of synthetic fertilizers lowers greenhouse gas emissions and reduces the risk of soil and water pollution. The symbiotic relationship between pulses and soil can be leveraged to improve soil structure (soil aggregate stability, soil aeration, and soil water-holding capacity) and can support soil's microbial biodiversity, which in turn improves soil health and augments crop yields. With deep root system, pulses can access water that is stored further below the surface; and thus these can perform better under water-stressed conditions compared to the crops with shallow root systems. The ability of pulses to withstand some of the climate stresses make their cultivation as a measure of adaptation to climate change.

The unique characteristics of pulses can be leveraged to achieve at least three of the SDGs. By supplying the required nutrients (protein, fiber, vitamins, and minerals) and improving resource-use efficiency, the cultivation and consumption of pulses can contribute to achieving SDG 2, which aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture. Increased pulse consumption can also help achieve SDG 3 that aims at ensuring healthy lives and promoting well-being. Finally, with the lower carbon and energy footprints, pulses can contribute towards achieving SDG 13, which aims combatting climate change and its impacts.

3. CHANGING STATUS OF PULSE AVAILABILITY AND CONSUMPTION

3.1 Pulse Production

Figure 1 and Table 1 present the trends in pulses production in India over the past seven decades. Pulses have been an important constituent of country's cropping system; in 1951-52, these were cultivated on 19 million hectares with a grain production of 8 million tons. During the 1950s, the area under pulses increased at an annual rate of 2.62%; this, together with an annual growth of 1.15% in yield resulted in an annual growth of 3.80% in production. Production of pulses increased to 12 million tons in 1960-61. The Green Revolution technologies and economic incentive

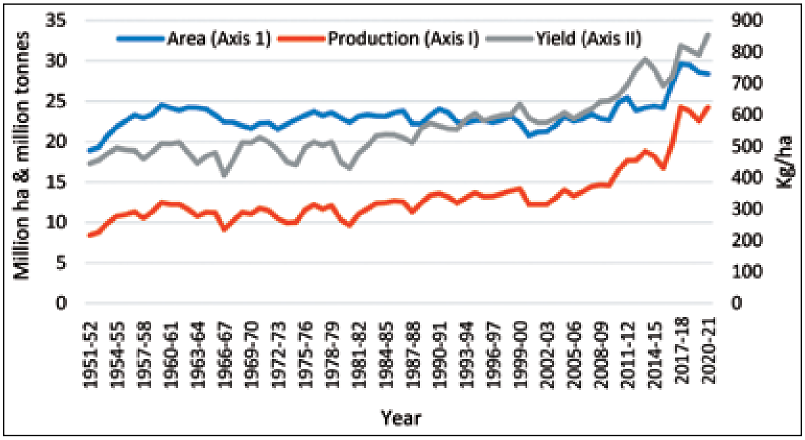

Figure 1. Trends in area, production, and yield of pulses in India

Source: Directorate of Economics and Statistics (DES), Ministry of Agriculture & Farmers' Welfare (MoAFW), GoI, New Delhi.

Table 1. Growth in area, yield, and production of pulses in India (% per annum)

Period	Area	Yield	Production
1951-52 to 1960-61	2.62	1.15	3.80
1961-62 to 1970-71	-1.30	1.36	0.04
1971-72 to 1980-81	0.45	-0.47	-0.01
1981-82 to 1990-91	0.09	1.41	1.50
1991-92 to 2000-01	-0.64	0.67	0.04
2001-02 to 2011-12	1.45	1.62	3.09
2011-12 to 2020-21	2.68	1.85	4.58
2015-16 to 2020-21	1.58	4.45	6.09

Source: Estimated using data from the Directorate of Economics and Statistics, MoAFW, GoI, New Delhi.

introduced during the mid-1960s, however, favored cereal crops (wheat and paddy) pushing the cultivation of pulses to marginal lands. The area under pulse cultivation declined by 1.30% a year between 1961-62 and 1970-71. Productivity improvement during this period—at 1.36 percent a year—only served to compensate for the decline in area under pulses, and production remained stagnant during the 1960s. The stagnation in pulse production continued until 2000-01, except during 1981-82 to 1990-91 when production, fueled by productivity improvement, increased at an annual rate of 1.5%. The pulses area thus either declined or remained stagnant between 1961-62 and 2000-01. Pulse production during this period hovered around 12 million tons.

The decade beginning 2001-02 witnessed an increase in both the acreage and yield of pulses, leading to an increase in production to 16 million tons in 2011-12, with an annual growth of 3%. During 2011-12 to 2020-21, the acreage and yield of pulses registered an acceleration in their growth, and by the end of 2020-21 their production peaked reaching 25.46 million tons. During the last five years (2015-16 to 2020-21), pulse production increased by 56%. The increase in pulse production in recent years is also 2.63 times higher than that of cereal production, a phenomenon that can be attributed to increases in area and improvements in yield.

Gram alone contributed 53% to the increased production of pulses. Gram currently predominates the pulses, with a share of 45% in total pulse production (Figure 2). Madhya Pradesh is the top pulse-producing state, contributing a quarter to the total pulse production (Figure 3). Although pulses are grown widely, three-fourths of their total production comes from five states, viz., Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, and Karnataka.

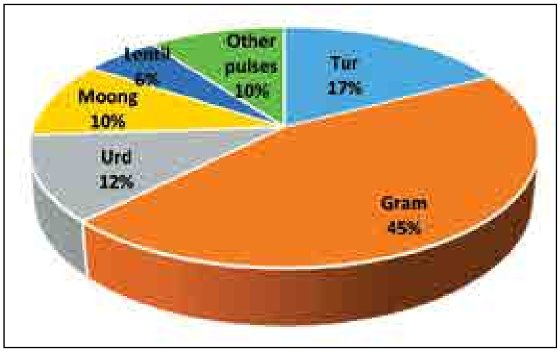

Figure 2. Composition of pulses basket, Quinquennium Ending (QE) 2020-021

Source: DES, MoAFW, GoI, New Delhi.

3.2 Availability of Pulses

Domestic production of pulses has always remained short of domestic demand, and hence the imports. Until 2000-01, less than 10% of the total supply of pulses was imported. Afterwards, the demand for pulses increased faster than their production, leading to a substantial increase in imports (Table 2). The per capita availability increased from 11 kg per year in 2000-01 to 17 kg per year in 2015-16. By 2015-16, import dependency reached its peak of 26.5 percent of the total

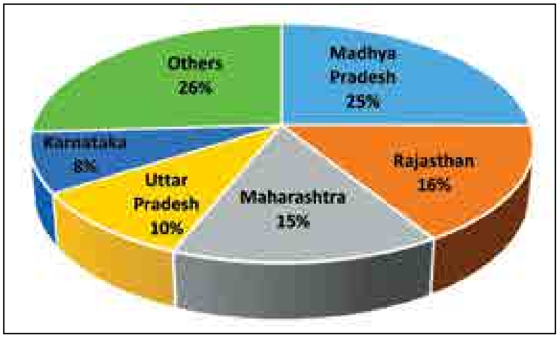

Figure 3. Major pulse-producing states, QE 2020-21

Source: DES, MoAFW, GoI, New Delhi.

Table 2. Trend in availability of pulses in India

(000 metric tons)

Year	Export total	Import total	Net import	Production	Total availability	Per capita availability (kg/capita/year)	Import dependency (%)
1996-97	55	692	637	14,148	14,785	16	4.7
2000-01	245	353	108	11,075	11,183	11	3.2
2010-11	209	2,778	2,569	18,241	20,810	18	13.3
2015-16	256	5,798	5,542	16,320	21,862	17	26.5
2016-17	137	6,609	6,473	23,130	29,603	23	22.3
2017-18	180	5,608	5,428	25,420	30,848	23	18.2
2018-19	287	2,528	2,241	22,080	24,321	18	10.4
2019-20	232	2,898	2,666	23,150	25,816	19	11.2
2020-21	277	2,466	2,189	25,460	27,649	20	8.9

Source: DES, MoAFW, GoI, New Delhi.

supply. In 2015-16, India spent INR 25,619 crores (US$ 3700 million) on imports with pulses being the second-largest imported food commodity, after vegetable oils. Increase in availability of pulses came at the cost of foreign exchange, and serious efforts to replace imports with domestic production became necessary.

Efforts to achieve self-sufficiency in pulses resulted in bumper production in 2016-17 and 2017-18. It, however, was not accompanied by a reduction in their imports, and the availability of pulses increased to 23 kg/capita/year in 2017-18. Between 2018 and 2021, their imports declined by 56%; import dependency reached 8.9%, the lowest in the past two decades. Per capita availability of pulses in 2020-21 was 20 kg/year, which also includes their use as seed and feed, and wastage. Although, the pulses import declined significantly by 2020-21, it remained the third-largest imported food item. To achieve the self-sufficiency in pulses, a sustained increase in production must match the rising demand.

3.3 Pulse Consumption and Utilization

The available pulses and their related products are directly consumed by households and are also used as seed and feed. Table 3 disaggregates the availability of pulses by their uses over time. In 2004-05, an average Indian consumed 8.8 kg of pulses, spending 5.7% of the food budget. Between 2004-05 and 2011-12, household consumption of pulses increased at an annual rate of 1.63%. Using this growth rate, the per capita annual household consumption of pulses for 2020-21 has been estimated at 11.5 kg, indicating that 56% of the available supply of pulses is consumed at home. In the FAO food balance sheet, about 15% percent of the pulses go as seed, feed and wastage. The remaining 29% of supply is consumed outside the home as cooked or processed products. Over the years, there has been an increase in the away-from home consumption of pulses that is served in restaurants, hotels, office canteens, and in food served as part of public and social programs.

The Consumption Expenditure Survey, 2011–12 of the National Sample Survey Office (NSSO) shows an average daily per capita consumption of 27.3 grams accounting 6.42% of the food budget. This level of consumption is 61% less than the recommended dietary allowance (RDA) of about 70 grams (Table 4). Thus, from nutrition perspective, consumption of pulses is extremely inadequate. And the inadequacy is widespread across all income classes. For poor households, their consumption is 75% less, which implies that pulses are less affordable to low-income households.

Table 3. Utilization of available pulses in India

Year	Total availability* (kg/capita/year)	Household consumption (kg/capita/year)	Out-of-home consumption+ (kg/capita/year)	Seed, feed and wastage*** (kg/capita/year)
2004-05	13.2	8.8 (67)	2.4 (18)	2.0 (15)
2011-12	16.7	9.9 (59)	4.3 (26)	2.5 (15)
2020-21	20.4	11.5** (56)	5.9 (29)	3.1 (15)

Note: * excludes stock variation due to unavailability of data; ** estimate based on rate of growth of consumption between 2004-05 and 2011-12 as per Consumption Expenditure Surveys (CES) of NSSO; *** estimate based on food balance sheet of FAO for the year 2017; + residual, based on food balance sheet approach. Figures in parentheses indicate the share in the total availability.

Table 4. Consumption of pulses and pulse products by expenditure class, 2011-12

Expenditure class	Share of pulses in food budget (%)	Household pulse consumption (grams/capita/day)	Deviation from RDA of 70 grams/day (%)	Share of pulses in total protein intake (%)
0–5	8.30	17.9	-74.4	9.0
5–10	7.76	19.5	-72.2	9.7
10–20	7.57	21.4	-69.4	10.1
20–30	7.33	22.9	-67.3	10.2
30–40	7.24	24.7	-64.7	10.5
40–50	7.06	25.9	-63.0	10.6
50–60	6.86	27.7	-60.4	10.9
60–70	6.65	29.3	-58.2	11.3
70–80	6.33	30.9	-55.9	11.4
80–90	6.05	33.9	-51.6	12.1
90–95	5.55	37.4	-46.6	12.4
95–100	4.44	40.9	-41.5	12.4
Overall	6.42	27.3	-61.0	10.9

Source: Estimated using Consumption Expenditure Survey, 2011–12 of NSSO, MoSPI, GoI, New Delhi.
Note: RDA = recommended daily allowance.

Income elasticity of demand for pulses is positive (0.2) and that the response of consumption to income increase is much higher for the poor households (0.50) than for the wealthy households (0.09) (Kumar 2017). Similarly, pulse consumption is price sensitive, and the price elasticity varies from -0.699 for the poor households to -0.349 for the high-income households, with an average of -0.456. These estimates imply that improving income and controlling prices within a fair range is essential for improving pulse consumption, particularly among poor households.

At the existing level of consumption, pulses contribute about 11% to the total protein intake. On the basis of a recommended dietary allowance of about 70 g/capita/day (for moderate activities), the normative requirement of pulses for an active and healthy life is projected at 40 million tons by 2035. With the addition of indirect demand, which has been assumed 25% of the household demand, the total normative demand for pulses would be about 50 million tons. To meet this demand, the domestic production of pulses has to increase at an annual rate of 4.39%. It is worth noting that in the past decade, pulse production increased at 4.59% a year (Table 1); it remains important to sustain the current growth in pulse production.

Table 5 reveals a mismatch in the composition of pulses production, imports, and household consumption. Pulse production is dominated by gram (47%) while the yellow pea dominates imports (28%), and tur (pigeon pea) dominates household consumption (29%). As peas constitute a minor share of the household consumption, most of the imported peas are used outside household boundaries. Diversifying pulse production towards imported pulses like peas can thus substantially reduce import dependency.

4. SOURCES OF RECENT GROWTH IN PULSE PRODUCTION

Between 2015-16 and 2020-21, pulses production increased by 56%, from 16.3million tons to 25.5 million tons. Decomposition of the change in production into area and yield reveals increase in pulses production due to an increase in both area and yield. Between 2015-16 and 2020-21, improvements in yield contributed 63% to increased production, and area expansion 28%. Some of the factors behind the recent growth in pulse production are discussed below.

4.1 The National Food Security Mission–Pulses and Other Initiatives

In 2007-08, the Government of India launched the National Food Security Mission (NFSM) aiming at increasing production of rice, wheat, and pulses by 10, 8 and 2 million tons, respectively, by the end of the eleventh five-year plan (2011-12). The NFSM–Pulses was implemented in 468 districts to achieve the target through area

Table 5. Composition of annual pulse production, import, and consumption in 2019-20

Pulses	Share in total production (%)	Share in total import (%)	Share in total household consumption* (%)
Gram	47	10	23
Peas	-	28	5
Tur (pigeon pea)	16	18	29
Urd (black gram)	11	16	11
Moong (green gram)	11		12
Masoor (lentils)	5	20	13
Other pulses	10	8	7
Total	100 (22.55)	100 (2.64)	100 (0.82)

Note: * figures are for 2011-12; figures within parentheses are quantities in million tons; for household consumption, the figure in parenthesis is in kg/capita/month.

Sources: Estimates based on DES, MoAFW and CES, NSSO, GoI, New Delhi.

expansion and productivity enhancement. The Rashtriya Krishi Vikas Yojana (RKVY) was also launched at the same time to accelerate pulses production. Due to the successful implementation of the NFSM and other programs, pulses production increased by 3 million tons by the end of the eleventh five-year plan. The NFSM continued during the twelfth five-year plan, setting a target of an additional 10 million tons of rice, 8 million tons of wheat, 4 million tons of pulses, and 3 million tons of coarse cereals. The NFSM–Pulses program was expanded to 622 districts from 2014-15 onwards. Based on the past experiences and feedback received from states, major changes were made in the approach, norms of financial assistance, and program implementation strategies. The area coverage of the NFSM–Pulses also expanded to 638 districts after 2016-17 and a revamped NFSM program was implemented through a centrally sponsored umbrella scheme called the Green Revolution–Krishonnati Yojana. This Mission aimed at producing an additional 3 million tons of pulses between 2017-2018 and 2019-2020.

Pulse production was prioritized in the financial allocations also— about 60% of the total budget of the NFSM was allocated to pulses during the 2017-2018 to 2019-2020. The government spent about INR 1,000 crores a year on the NFSM-Pulses. Cluster demonstrations on improved technologies and practices comprise an important activity of the NFSM–Pulses, taking away about 37% of its total expenditure (Figure 4). Thirty percent of the demonstrations were conducted on the pulse-based cropping systems and on the pulses as intercrops with commercial crops, oilseeds, and coarse cereals. Another prominent activity was the production and distribution of certified/ seeds, which were allocated 25% of the total expenditure. Efforts were also made to augment productivity by promoting integrated nutrient management (INM) and integrated pest management (IPM). A quarter of the NFSM–Pulses budget was earmarked for

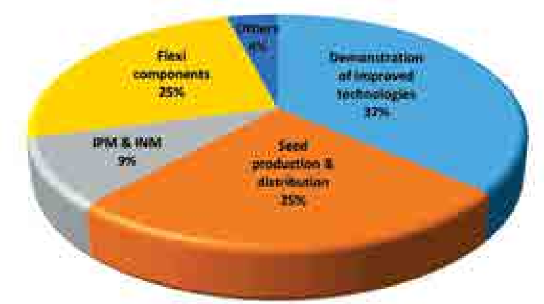

Figure 4. Expenditure pattern under National Food Security Mission–Pulses, 2017-18 to 2019-20

Note: IPM = integrated pest management; INM = integrated nutrient management.

Source: NFSM Cell, Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW), MoAFW, GoI, New Delhi.

flexible components such as the purchases of farm implements and equipment, water application equipment such as sprinklers, pump sets, and conveyance pipes; and cropping-system–based training. The NFSM–Pulses program also has provisions for marketing support, value chain integration, primary processing, etc.

These efforts led to increase in the seed replacement and variety replacement rates for pulses. The seed and variety replacement rates have been increasing consistently since 2010-11 (Figure 5). The increased seed and variety replacement rates have played a catalytic role in augmenting pulse production in the country. The pulse seed hubs programmes proved to be an important vehicle in improving seed replacement rates for pulses in India.

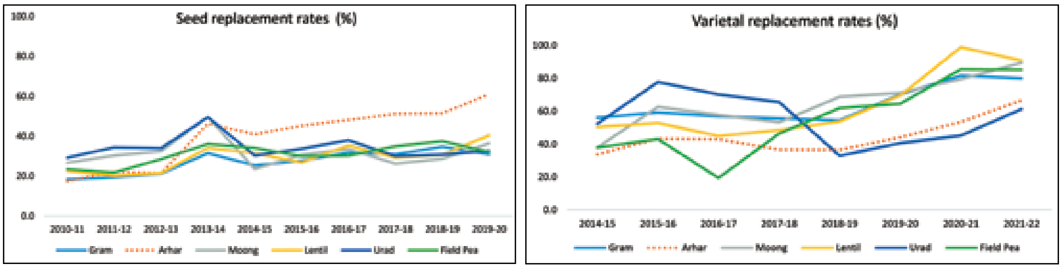

Figure 5. Trends in seed and variety replacement rates (%)

4.2 Incentivization through Minimum Support Prices

In addition to the government's production support, farmers were incentivized by raising minimum support prices (MSP) to grow pulses. The MSP of urd (black gram), tur (pigeon pea), gram (chickpea), moong (green gram), and lentils increased by 36, 36, 49, 48, and 62%, respectively, between 2015-16 and 2021-22; which are higher than the increase in the MSP of rice and wheat (about 33%) (Figure 6).

4.3 Procurement to Create Buffer Stock

The announcement of a hike in MSP was backed by a decision in 2016 to create a buffer stock of 2 million tons of pulses. Apart from the disposal of pulses through open-market sales, the central government also allowed distribution of pulses to supplement public nutritional requirements through programs such as the Mid-Day Meal (MDM) and the Integrated Child Development Services (ICDS). To that end, states were offered pulses at lower prices. Odisha has taken several measures to address malnutrition by including pulses, millets, fruits, and vegetables in ICDS, MDM and PDS. Such initiatives provided a push to the local demand for pulses and created a market where producers can profitably dispose of the output.

(₹ per quintal),

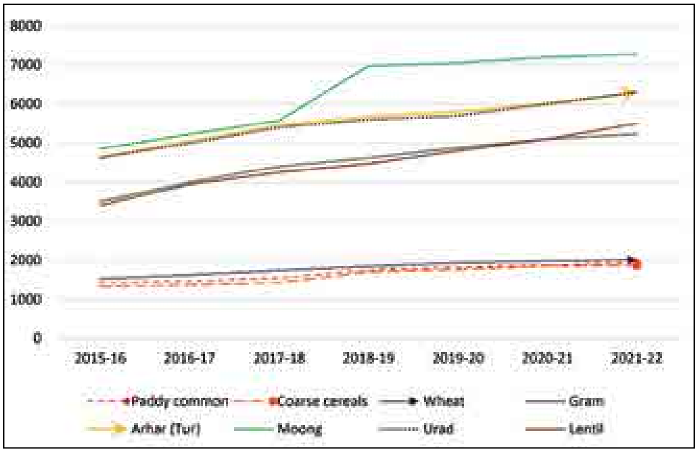

Figure 6. Minimum Support Prices of pulses *vis a vis* cereals, 2015-16 to 2021-22

Source: Ministry of Agriculture and Farmers Welfare, Government of India

4.4 Improved Irrigation and Seed Production Infrastructure

Supported by concerted efforts to converge investment in irrigation through the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), irrigated area under pulses has increased, from 19.26% in 2015-16 to 23.20% in 2020-21. Yet, pulses are still cultivated mainly under rainfed conditions. Efforts are also being made to improve seed production infrastructure. Between 2018-19 and 2020-21, the availability of certified/quality seeds has remained about 17% higher than their requirement of about 3.5 million quintals. Between 2015-16 and 2020-21, the distribution of seeds to farmers increased by 5.97% a year, as compared to a growth of only 0.51% over the previous five years.

5. EMERGING ISSUES AND CHALLENGES IN THE PULSE SECTOR

Although there have been improvements in the pulses production, there remain several challenges that need to be addressed.

5.1 Low Yield Levels with Wide Inter-state Variations

Recent years have witnessed a significant improvement in pulses productivity in India (see Table 1); however, the average productivity is 26% less than the global average. Wide variations in yield of pulses also remain across states due to differences in agroclimatic conditions, resource endowments, technology adoption, and socioeconomic constraints (Figure 7).

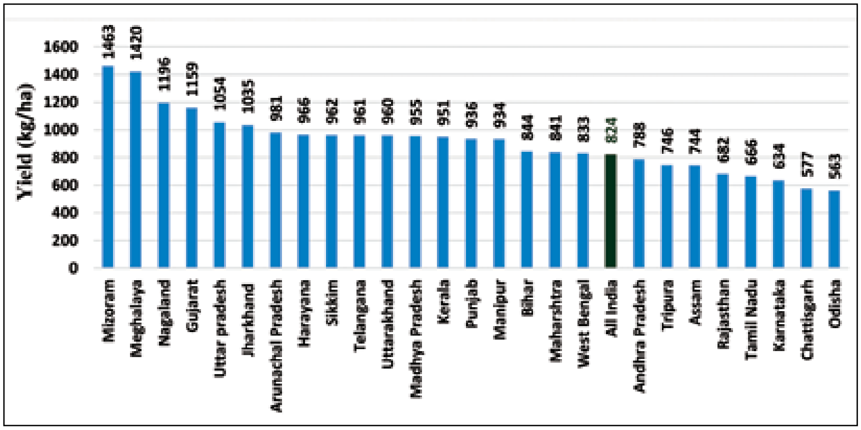

Figure 7. Inter-state variation in pulse yields, 2020/2021

Source: Estimates based on DES, MoAFW, GoI

5.3 Externalities due to Climatic Aberrations

Climatic aberrations such as droughts, floods, sudden changes in temperature and rainfall patterns negatively affect agricultural production and put a pressure on the agroecosystem. Pulses have wide adaptive mechanisms such as deep root systems, higher capacity to retain moisture, phenotypic plasticity, and the ability to fix nitrogen. These are thus considered to be key to the adaptation to, and mitigation of, climate change. Despite their relative resilience to climate change, pulses also have certain vulnerabilities. Indeed the impact of climate change is expected to be more pronounced for pulses because they are largely grown on marginal lands under rainfed conditions. Climate change can thus limit the potential of pulses to contribute to sustainable food systems. R&D is needed to develop varieties that are resilient and adaptable to the changes in agronomic practices that will be required to address climate aberrations.

5.4 Low Price Realization and High Instability

For majority of the farmers, selling pulses in the market is not lucrative. According to the latest NSSO Situation Assessment Survey of Agricultural Households 2019 (SAS), in 2018-19 only 2.5, 7.8, 7.8, and 28.3% farmers realized the minimum support price of moong, gram, tur and urd, respectively. Low prices are primarily because of the small marketable surpluses of individual farmers, their poor bargaining power, and limited access to formal markets. Although the government has recently started procuring pulses, its outreach to farmers is inadequate. The SAS shows that in 2018-19, only 2.5 to 6.0% of the pulse farmers sold their produce to government procurement agencies.

Pulse prices are also highly volatile. Figure 8 presents the instability index of the wholesale prices of different food commodities during 2011-12 to 2019-20. Over the last decade, the price instability has increased. High price risk discourages farmers from allocating more acreage to pulses and motivates them to opt for less-risky crops. To increase pulse production, it is thus essential to keep the prices within a fair margin and reduce price volatility.

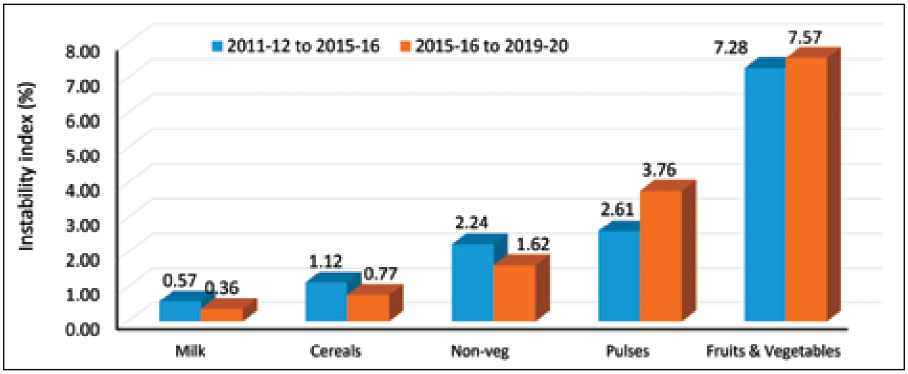

Figure 8. Instability in wholesale prices of food commodities

Source: Estimates based on data from Office of the Economic Adviser, Ministry of Commerce & Industry, GoI.

5.5 Unfavorable Profit Terms of Trade

Price alone may not incentivize farmers to grow a particular crop unless it translates into higher profits relative to competing crops. Table 6 shows the relative profitability of pulses at existing levels of yield. Although the MSP for pulses remains higher than for other crops, it does not always translate into higher profits due to low yields and higher production costs. At the existing levels of yield and MSP, crops such as wheat, rapeseed & mustard (R&M), and soybeans are relatively more profitable than gram (chickpea) and urd (black gram). This implies that pulses are less remunerative than fine cereals and oilseeds (with a few exceptions) and more remunerative than coarse cereals (nutri-cereals). Unfavorable profit terms of trade discourage farmers from cultivation of pulses.

5.6 Inadequate Consumption due to Poor Affordability and Lack of Awareness

Consumption of pulses is extremely inadequate, primarily because the poor households cannot afford to purchase pulses and the rich households are not sufficiently aware of their benefits. The transmission of the wholesale price

Table 6. Profitability terms of trade between competing crops, 2020/2021

Crops	Yield (kilogram/ hectare)	MSP (INR/ quintal)	Cost A2+FL (INR/quintal)	Net return at MSP (INR/hectare)
Wheat	3479	1913	920	34556
R&M	1451	4425	2317	30596
Gram (Chickpea)	1133	4865	2836	23031
Arhar (Pigeon pea)	827	5825	3621	18200
Soybeans	1040	3663	2442	12640
Urd (Black gram)	515	5767	3525	11536
Jowar	989	2533	1688	8390

Profitability terms of trade

Competing crops	Wheat-gram	R&M-gram	Soybeans-urd	Jowar-urd	Soybeans-arhar	Jowar-arhar
Terms of trade	1.50	1.33	1.10	0.73	0.69	0.46

Note: MSP = minimum support price. Source: Estimates based on DES, MoAFW, GoI.

volatility to the retail level reduces the affordability for the poor households. The rich households, on the other hand, allocate a smaller portion of their budget to pulses than do poor households and exhibit less preference for them (see Table 4). Improving affordability and creating demand for pulses and their products are major challenges in leveraging potential of pulses for improved nutritional outcomes.

5.7 Financial and Infrastructural Constraints on Public Procurement

Creation of a buffer stock of pulses through public procurement and the disposal of this stock through the open market and other welfare schemes are desirable policy interventions for stabilizing prices and improving affordability of the poor households. In the wake of rising food subsidies, however, it is challenging to allocate additional financial resources for such measures. Since the enactment of the National Food Security Act in 2013, the cost incurred on food subsidies in the form of procurement, storage, and distribution of rice and wheat has increased significantly, from INR 90,915 crores (US$ 13 billion) in 2012-13 to INR 370,000 crores (US$ 52 billion) in 2019-20 (including market borrowings and arrears). Although food subsidies are absolutely necessary for food security, these are often criticized for crowding out investment. Extending such operations for pulses thus requires rationalization and reallocation of existing food subsidies.

Pulses require more scientific storage. The existing storage infrastructure is highly inadequate for pulses and requires large-scale investment. Given the resource constraints, the trade-off between subsidies and investment needs to be optimized.

5.8 Poor Market Access and Ecosystem for Private Investment

Poor access to markets is a major challenge in the commercial cultivation of pulses. Three farm laws were enacted in 2020 but repealed in 2021 due to farmers' protests. These were: The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, The Essential Commodities (Amendment) Act and The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act. These laws were expected to improve market access by allowing sale outside of Agricultural Produce Market Committee (APMC) markets. They were also expected to create an ecosystem that was conducive to fostering private investment in market and infrastructure development. Repealing these laws has reduced the prospects of private sector participation in agriculture and food management. Alternative strategies for promoting private investment in the strengthening of pulse supply chains thus need to be developed and institutionalized.

6. APPROACHES AND MEASURES FOR SUSTAINING PULSE PRODUCTION AND IMPROVING CONSUMPTION

A multipronged approach is needed for achieving self-sufficiency in pulses. Possible approaches and specific measures are discussed below.

6.1 Technological Change

Technological change is the foremost means of addressing emerging issues such as augmentation of potential yield, improved efficiency of resources, and adaptation to changing climate. Below are some promising areas of pulse R&D.

- India is endowed with a rich genetic diversity of pulse varieties. The ICAR–National Bureau of Plant Genetic Resources (NBPGR) has a collection of approximately 70,000 accessions of different pulses, which largely remain underutilized. Existing breeding programs need to be modernized in order to effectively mine the desirable traits from the genetic pool and develop varieties/hybrids with these traits. Use of modern tools like genomics can be leveraged for reducing the time lag in varietal development.
- Major thrust of pulse-breeding programs include improving genetic potential and enhancing tolerance to biotic and abiotic stresses. In a first-of-its-kind effort, two

varieties of chickpea, viz., Pusa 10216 and MABC-WR-SA-1 (or Super Annigeri-1) have been developed in India through genomics-assisted breeding. Pusa-10216 was developed through a collaboration between ICAR-Indian Agricultural Research Institute (IARI), and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). It is tolerant to drought and Fusarium wilt, dry root rot and stunt diseases, and it gives an average grain yield of 1,447 kg/ha. Super Annigeri-1 was developed at the University of Agricultural Sciences, Raichur in collaboration with ICRISAT. It is highly resistant to Fusarium wilt, with an average yield of 1,898 kg/ha. Such efforts need to be replicated in other pulses as to improve their yield potential and tolerance to biotic and abiotic stresses.

- Pulse crops are widely recommended as intercrop or sequential crop in a given crop rotation. It is therefore desirable, when developing a sustainable cropping system, to reduce the growing period without compromising yield. Early maturing varieties can also more successfully escape terminal stresses and adapt to new agroecologies. For some varieties, the trait of early maturation shows good potential for introgressive hybridization from wild species. The moong bean variety named ‘Virat’ matures in 52-55 days, which is world’s shortest for this species. Its release revolutionized moong bean cultivation in India. Similarly, chickpea varieties that mature in 90 to 100 days have helped expand area under chickpea cultivation in South India. Concerted efforts are required for the development of high-yielding varieties and hybrids of tur (pigeon pea) that mature in under 120 days; this will facilitate double cropping

- Nutrient content of pulses can be further improved by mainstreaming nutritional quality traits in pulse-breeding programs. Several genotypes of pulses have significantly higher nutrient content; for instance, certain genotypes of chickpea (ICC 5912) and pigeon pea (HPL 8, HPL 40) contain 26 - 27% protein, as compared to a 20 -22% in commercial varieties. Similarly, L4704 line of lentils has more than double the iron and zinc content of commercial varieties. Harnessing the potential of such traits though nutrition-sensitive breeding programs can significantly contribute to nutritional security.

- Farm mechanization is considered to be an effective strategy for addressing the labor scarcity. Several machine-harvestable varieties of pulses have been released in recent years as in case of chickpea such as NBeG 47, JG 24, Phule Vikram, Pusa Parvati, and RVG 204). Apart from developing machine-compatible varieties of pulses, modifications to planting, harvesting, and processing machinery are also required.

- Agronomic and resource-saving production technologies play a significant role in enhancing yield potential. Irrigation through sprinklers at times of severe moisture stress, for example, can increase the yield of post–rainy-season pulses up to 50%; and treatment with molybdenum to increase nodulation produces plants that are of superior quality and have up to 25% higher yield. Further thrust of R&D must include optimum irrigation scheduling, need-based application of macro- and micronutrients, and appropriate production technologies for local needs.

✦ Technological interventions should be aligned with consumer preferences and specific uses. Small-seeded varieties of chickpea and moong bean, for example, are preferred for eating in sprouted form, and the taste of new varieties is a major factor with regard to its acceptability by consumers. The market for plant-based protein is also growing steadily. The reasons for its increased popularity include ethics in terms of the reduction of environmental footprint, health benefits, and flavor; developing high-protein varieties of pulses would cater to this new popularity. To help make breeding programs successful, consumer preferences and market demand should remain central to planning. Modern tool of biotechnology such as gene editing has to be appropriately used in pulse crops targeting suitable genes for breaking yield ceiling, altering plant type and enhancing climate resilience.

6.2 Bridging the Yield Gap

A wide gap exists between potential yield and actual yield of pulses (Figure 9). Yield gaps can be attributed to: slow uptake of new technologies; suboptimum adoption of good crop-management practices; and several other factors including local biophysical and socioeconomic conditions. It is almost impossible to achieve full yield potential under field conditions. However, narrowing this gap can significantly increase India's pulse production. In its 2021-22 kharif and rabi reports, the

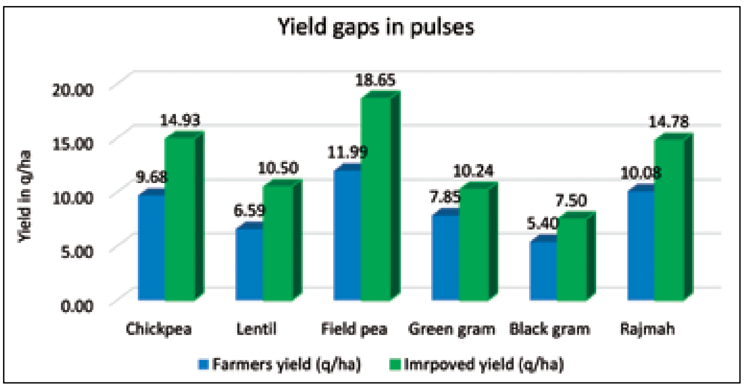

Figure 9. Yield Gap in Pulses

Source: ICAR-IIPR, Kanpur.

Commission for Agricultural Costs & Prices (CACP) has estimated that pulses production can be increased by almost 1.5 million tons if the yield gap is reduced by 25 %. To that end, the following measures can be adopted:

- Since awareness and access to information are the most important factors in bridging the yield gap, emphasis should be given to organizing awareness activities (field days, electronic and print media) and training programs to enhance the knowledge empowerment of farmers;
- Participatory on-farm trials and demonstrations of technologies should be conducted;
- Concerted efforts are needed to ensure input supplies, particularly improved seed; seed samples of newly released varieties should be widely distributed to farmers; the current seed replacement rate for pulses should be further improved by strengthening existing seed production and distribution programs;
- Since the yield gap is an outcome of the factors operating at the local level, a mapping of the pulse-growing areas in terms of yield gap should be done and concerted efforts should then be focused on identified areas with the aim of bridging the gap.

6.3 Improve Price Realization

Fair price realization along with yield enhancement can improve the terms of trade for pulses and can incentivize farmers to increase the acreage under pulses. There are two ways to improve price realization: first, expand outreach of public procurement and ensure MSP to pulse farmers, and second, provide market-led fair prices to farmers by improving the marketing infrastructure and ecosystem. The government has recently geared up pulse procurement for open-market operations and for supply to welfare schemes. Such measures should be supplemented with concerted efforts to improve marketing infrastructure and to provide an ecosystem for accelerating private sector participation. Market-led fair price realization is preferred over the government-backed MSP system for sustaining pulse production.

6.4 Minimize Production and Price Risk

Pulse crops are largely cultivated on marginal lands under rainfed conditions; these crops thus have a large production risk, which further translates into high price volatility. Stabilizing yield and reducing price volatility should be key components of an overall strategy to achieve self-sufficiency in pulses. The following measures should be considered for this:

- As pulses can sustain stressful conditions, farmers usually apply suboptimum levels of inputs and inadequately follow recommended agronomic practices. Pulses, however, should be promoted as "commercial crops" and farmers should be educated about the optimum use of inputs, particularly at critical growth stages. This would improve both the level and the stability of pulse yields.
- Adoption of varieties tolerant to biotic and abiotic stresses should be scaled up.
- Farmers can insulate themselves from the risks of natural hazards and calamities by insuring their crops; pulse crops can be offered additional concessions on a premium basis under the Pradhan Mantri Fasal Bima Yojana (PMFBY); monetary benefits from the ecosystem services supplied by pulses can be taken as a basis for offering additional concessions on insurance premiums.
- Fluctuations in production are the main source of price volatility in pulses. An estimate shows that pulse production in India can vary by 10% from normal levels, year to year; thus, market prices should be substantially stabilized by maintaining a buffer stock of about 10% of annual pulse production and by performing open-market operations such as purchasing during surplus production and selling during deficit production. Central sectoral schemes such as the price stabilization fund (PSF) and the price support scheme (PSS) should be strengthened and leveraged.
- The storage capacity of pulses in the country should be improved in both the public and private sectors. The storage of pulses can be improved by leveraging technologies such as passing pulses through low-intensity radiation. This would reduce inter-seasonal and inter-year price fluctuations.

6.5 Improve Consumption and Raise Demand for Pulses

Increases in production need to be effectively absorbed into direct and indirect uses. At the same time, demand is the major driver for accelerating production. As the current level of pulse consumption is less than the recommended norms, efforts should be made to increase consumption, with the aim of improved food and nutrition security. The following measures can be considered:

- The PDS and other welfare schemes such as MDM and ICDS can be revamped to include pulses; making pulses available at concessional prices would improve their affordability to poor households and would increase intake. Providing subsidized pulses through welfare schemes, however, entails the risk of replacing market purchases; therefore, the nutritional and other welfare effects of such measures should be reviewed periodically;

- Constant efforts should be made to ensure that retail prices remain moderate by effectively implementing open-market operations and making supply chains efficient;
- The nutritional benefits of pulses should be promoted, particularly among wealthy households that do not have income constraints yet consume inadequate amounts;
- New pulse-based recipes and value-added products should be invented and marketed in order to increase popular demand.

6.6 Procurement, Trade Policies, and Other Measures

Production, consumption, and trade activities are closely linked; hence should be addressed collectively to attain self-sufficiency in pulses. The production basket, for instance, is dominated by gram, whereas yellow pea makes up the predominant share of pulse imports. Diversifying the pulse production basket based on local demand can effectively reduce dependence on imports. The following measures can make the pulse sector more competitive and efficient:

- Relative increase in MSP in favor of pulses is an effective instrument for incentivizing farmers to grow pulses; pulses, in other words, can be given a higher hike in MSP than competing crops. As pulses offer various ecosystem services, the economic benefit of those services can be used as criteria justifying bonuses on the MSP of pulses.
- Without procurement, the MSP works only to anchor prices, and it benefits traders at the expense of farmers (Roy et al. 2022). An announcement of MSP, therefore, should be backed up by effective procurement. As individual farmers have low marketable surplus, promoting and engaging farmer producer organizations (FPOs) in procurement operations can address the problem of scale; the provisions of FPO promotion in NFSM–Pulses can be leveraged.
- The public procurement of pulses should be supplemented by concerted efforts to make the pulse supply chain profitable for the private sector. Another way to make the pulse sector more competitive and efficient is to reduce production costs by raising yields and using resources more efficiently. This would improve India's comparative advantage in terms of producing pulses domestically rather than importing them from other counties. In the long run, the approach of market-led development is preferred over MSP-backed supports.
- At times, improvement in infrastructure such as irrigation, roads, and access to markets has a crowding-out impact and pushes neglected crops like pulses

to marginal lands (Negi et al. 2021). Improvement in terms of trade and better promotion of pulses as a "commercial crop" can address this issue. Promoting pulses as an intercrop can also be a desirable strategy for harnessing their complementarity potential. Developing varieties that are suitable as intercrops without yield penalty is necessary.

- Given the dominance of only a few crops (such as gram) and only a few states in total pulse production, efforts can be directed to diversifying toward other pulses (such as yellow pea) and toward minor pulse-producing states. Broadening the pulse basket and the production base should take demand conditions into account.

7. MEASURES RECOMMENDED TO ACHIEVE AND SUSTAIN SELF-SUFFICIENCY IN PULSES

Attaining self-sufficiency in pulses requires additional production of about 2.4 million tons. Outlined below are specific short-term and long-term measures for achieving this target.

7.1. Short-term Measures

- Map spatial variation in yield gap of pulses and identify hotspots of high yield gap. Prioritize those areas under NFSM–Pulses for interventions such as demonstrations and seed distribution. Bridging the yield gap by 25% can improve pulse production by 1.5 million tons.
- Diversify the pulse production basket toward crops like peas, which constitute the largest share of pulse imports. Provide incentives to growers of such crops in the form of, for example, higher MSP and larger procurement. Impose the tariff and non-tariff barriers that are necessary to promote domestic production.
- Stabilize pulse prices by maintaining a buffer stock of about 10% of the total production and effectively undertaking open-market operations.

7.2. Long-term Measures

- Aggressively support advanced technological developments for improving yield potential coupled with building tolerance to biotic and abiotic stresses.
- Make pulses attractive to the private sector by improving competitiveness and efficiency in production, improving storage and other infrastructure, and providing conducive ecosystem for market.

- Create awareness about the benefits of pulses for the nutrition and for a healthier ecosystem. Inventing new pulse-based recipes and value-added products would create demand to absorb the increasing production.
- Additional grants to states for expanding area under pulse cultivation as is being done for forest area.
- While fixing MSP for pulses, their ecosystem services and high risk in production may be embedded besides cost of cultivation.
- Prioritize market-led growth over an approach that uses MSP-backed support.

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