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Self-sufficiency
in Oilseeds and Pulses

PRIME MINISTER SPEAKS ON PULSES AND OILSEED...



- The decline in the production of pulses due to drought during last two years was also a cause of concern. But, Brothers and Sisters, if the inflation would have increased at the same pace as it had previously increased, I don't know how the poor of my country would have survived? We have tried our best to keep it under check, but still people have lot of expectations from this government and dear countrymen your expectations are natural and I will leave no

stone unturned in achieving them. Whatever best I can do, I shall do that and keep the price of poor man's meal under check.

August 15, 2016

- Today, I specially want to thank our farmers, because, when we are facing shortage of pulses and our farmers have shifted to other crops, and rise in demand of pulses by common man, I have to say this with content that this time our farmers have increased the sowing by one and half times. I want to thank our farmers because they have come forward to solve the problem of the crisis of pulses and find its solution. We have decided the MSP for pulses and declared a bonus on it. We have streamlined the process of purchase of pulses and promoting the farmers for cultivation of pulses. This will benefit us in a big way.

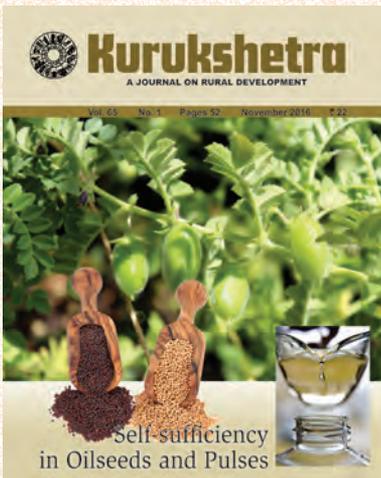
August 15, 2016

- For food-grains, pulses and oilseed, there will be one season – one rate for the farmer. Different rates for different crops for different districts have been removed. For Kharif: maximum 2% and for Rabi: maximum 1.5% premium is to be paid by farmers.

March 19, 2016

- Former Prime Minister Shri Lal Bahadur Shastri had given the slogan of "Jai Jawan, Jai Kisan," he gave the call to farmers to fill the granaries of nation, the farmers left no stone unturned to live up to his aspirations. We are now, no longer compelled to import food grains. However, my farmer brothers and sisters, dalhan (pulses) too are an important part of the diet of a common man. There is an acute shortage of indigenously grown pulses and hence the country has to import it in bulk. I appeal each and every farmer, if they have a five acre field, then use at least one acre land for cultivation of pulses and legumes so that India need not import it and pulses, which are basic source of protein are available to the poor at affordable price. Government has provided a special package to pay additional rate than the minimum support price announced to farmers for promoting pulse production in the country.

June 28, 2015



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Editorial

India's growth story during the six and half decades of Independence has been remarkable, with India emerging from an underdeveloped nation to one of the largest economies. Foodgrain production is one such area where there has been tremendous progress. Despite having very fertile land in most part of the country, India was deficient in food grain production at the time of Independence in 1947. Government of India at that time took ambitious initiatives to make the country self-reliant in cereal production which paid rich dividends and the country witnessed Green Revolution five decades ago. The Revolution catapulted the country into the world's second biggest producer of rice and wheat.

India is also a leading producer of pulses and oilseeds like soybean, groundnut and sunflower. However even though there has been increase in pulse production over the years, it has not been able to keep pace with the ever growing demand for pulses due to sharp increase in population. More and more people becoming health cautious is another reason for growing demand for proteins and hence pulses.

Pulses are usually cultivated as mixed crops along with crops such as cotton, mustard, or as catch crops between two cereal crops. Long duration of crops, susceptibility to pests and diseases, low yield as compared to other grains etc. are some of the reasons that pulses have not been preferred crop for farmers. This has resulted in India's dependency on import of pulses thereby leading to increase in price of pulses. Realising grimness of the situation, Prime Minister Shri Narendra Modi, recently urged the farmers to grow more and more pulses. Invoking former Prime Minister Shri Lal Bahadur Shastri's call "Jai Jawan Jai Kisan" Sh Modi asked every farmer to try and grow pulses on a part of his land.

The government has already taken several steps to increase pulses production and to incentivise pulses growing farmers including announcement of minimum support price (MSP) for pulses for the first time. Further, to incentivise cultivation of pulses and oilseeds, in the country Government has announced a bonus on these crops, payable over and above the approved MSP. To boost pulses production, all 638 districts of 29 states have been included in the National Food Security Mission plan as against only 482 districts of 16 states in 2013-14. The government has also enhanced allocation under this mission to boost pulses production. Under NFSM, financial assistance is given for various interventions like demonstration of improved technology, distribution of quality seeds of new varieties, integrated pest management, water saving devices and capacity building of farmers. Steps are being taken to expand the scope of National Food Security Mission (NFSM) from 2016-17 so that additional interventions for increasing production of pulses may be initiated. The grant being given through state governments for distribution of new seeds varieties has also been increased to from ₹12/- per kg in 2013-14 to ₹25/- per kg from the year 2014-15. For expansion of cultivation of new kinds of seeds, ₹7.85 lakhs mini-kits are being distributed to farmers free of cost in the year 2016-17, through State Governments.

So far as oil is concerned, India is one of the largest producers of oilseeds in the world and contributes about 6-7% of the world oilseeds production. At the same time, India is fortunate in having a wide range of oilseeds crops grown in its different agro climatic zones. Groundnut, mustard/rapeseed, sesame, safflower, linseed, niger seed/castor are the major traditionally cultivated oilseeds. Two major steps have significantly contributed to the development of this sector. One is the setting up of the Technology Mission on Oilseeds in 1986 which has been converted into a National Mission on Oilseeds and Oil Palm (NMOOP) in 2014. This gave a thrust to Government's efforts for augmenting the production of oilseeds. This is evident by the increase in the production of oilseeds from about 11.3 million tonnes in 1986-87 to 26.68 million tons in 2014-15. Most of the oilseeds are cultivated on marginal land and are dependent on rainfall and other climatic conditions. The other dominant feature which has had significant impact on the present status of edible oilseeds/oil industry has been the programme of liberalization allowing greater freedom to the open market and encouraging healthy competition and self regulation rather than protection and control. Controls and regulations have been relaxed resulting in a highly competitive market dominated by both domestic and multinational players. Efforts of the government have started yielding results with area under production of oilseeds during 2015-16 increasing by 2.1 per cent.

With Government taking steps in the right direction, we as a nation are definitely on the path to achieve self-sufficiency in oilseeds and pulses production and ushering in yellow and pulse revolution on the lines of Green and White ones.

STRATEGIES FOR ACHIEVING SELF-SUFFICIENCY IN PULSES AND OILSEEDS

Dr Jagdeep Saxena

Government of India is operating a comprehensive National Food Security Mission (NFSM) to maintain sustainable food security in the country which provides support to pulses, cereals, millets and selected commercial crops. Previously the NFSM was operative only in limited States, but the present Government extended its benefits to all 29 states and 638 districts during 2014-15. But, with reference to pulses, a major decision was taken to exclusively dedicate 50 per cent allocations for development of pulses alone. This will benefit north-eastern States and hilly States, such as Himachal Pradesh, Jammu & Kashmir and Uttarakhand. These States have appreciable potential for cultivation of pulses, but previously, the pulse farming was not getting its due share mainly due to lack of sufficient resources.

India is a proud nation enjoying self-sufficiency in foodgrain production and sustainable food security despite burgeoning population and various climatic stresses. But there is no room for complacency, because country is still facing severe challenges in pulse and oilseeds sectors. Poor productivity and low gross production compel country to resort to frequent imports for meeting the domestic demand of pulses and oilseeds. The widening gap between demand and supply often leads to skyrocketing of prices in domestic market, especially in pulses, which is a cause of major concern for general public and the Government alike. More than two years ago, the new Government took a decisive step and developed strategies for achieving self-sufficiency in pulses and oilseeds. Prime Minister Shri Narendra Modi, while launching DD Kisan Channel on 26th May 2015, urged and motivated farmers to work hard in a mission mode for achieving self-sufficiency in pulses by 2022, when India will be celebrating its platinum jubilee of Independence. Prime Minister expressed his concern over widespread protein malnutrition in the country which can be eradicated by regular and adequate supply of pulses to poor families. Referring import of edible oils, he suggested to fix-up a target for cut off imports, so that farmers can be better paid for oilseeds crops. Acting promptly on the call of Prime Minister, Ministry of Agriculture and Farmers Welfare developed a strategic roadmap for increasing per hectare productivity, cropped

area and processing facilities. Steps were also taken to make both these crops more remunerative to farmers mainly by increasing minimum support price and extending support of inputs to farmers. The Indian Council of Agricultural Research (ICAR) is supporting the endeavours through its R&D programmes, extension mechanism and expert inputs for devising future vision for these important commodities. Government of India is also supporting 'International Year of Pulses – 2016' a call given by United Nations, by organizing various activities and events among stakeholders with the objective to promote farming of pulses across the country. Similarly, an International Conference is being organized this month (12-14 November 2016) on 'Pulses for Nutritional Security and Sustainable Agriculture' in which researchers, policy planners, extension personnel, industrialists, entrepreneurs will deliberate to develop a roadmap for increasing



productivity and more importantly profitability of pulses.

Pulses : Production, Demand and Supply

India is the largest producer of pulses in the world (approximately 25 per cent of the total 80 million tonnes) and also enjoys distinction of being largest consumer (nearly 28 per cent) as well. Recently, India fetched the unappreciable position of number one importer due to frequent and large imports. According to 'VISION-2050' of ICAR – Indian Institute of Pulses Research (IDPR), Kanpur the present production of pulses hovers around 19 million tonnes, which falls short (approximately two million tonnes) of the current domestic demand of 21 million tonnes. In order to narrow down the demand – supply gap and control process in domestic market, the country resorts to import pulses to the tune of 2-3 million tonnes per year entailing significant expenditure in terms of valuable foreign exchange. The country is growing pulses in an area of about 24 to 25 million hectares of land with productivity of about 780 kg a hectare which is less than the global average and a major cause of concern. Currently, daily per capita availability of pulses is 37 gram which is considerably lower than the ICMR recommendation of 52 gram. If we dream of a healthy India in 2050, the requirement of pulses will be 39 million tonnes which necessitates an annual growth rate of 2.14 per cent. To meet the projected demand, productivity must be enhanced to a level of 1200 kg per hectare and about 3 to 5 million hectares additional area has to be brought under pulses across the country. Serious efforts are required to drastically reduce the post harvest losses as well. But the pathway to achieve the target has many inherent technical and socio-challenges and problems.

Presently, more than 92 per cent of the area under pulses is confined to unirrigated areas where farming chiefly depends on monsoon rains. Drought or drought like conditions, coupled with heat stress may reduce seed yields by 50 per cent, especially in arid and semi-arid regions. Most of the pulses are grown in low fertility and problematic soils struggling with salinity and alkalinity. In the current climatic change scenario, pulses are likely to be drastically affected by temperature extremes. Poor drainage and water logging during rainy

season may cause heavy losses to pulses, especially in pigeon pea due to low plant stand and increased incidence of diseases. Pod barmers, aphids, cutworm, powdery mildew, rust and wilt are the major pests and diseases affecting many pulses, especially lentil. According to experts, the richness of pulse legumes in nitrogen and phosphorous, makes them attractive and vulnerable to pests and diseases.

Generally, pulses are grown by resource poor farmers and treated as secondary crops with finest productivity to staple cereals and other cash crops. As a consequence, pulses are generally deprived of essential inputs, due care and latest technologies. Availability of quality seed of improved varieties is one of the major constraints in increasing productivity of pulses. Besides, till recently, farmers were not getting attractive prices for pulses which was a major cause of discouragement for pulse farming.

Efforts Towards 'Pulses for All'

The Government has launched many new initiatives and strengthened various programmes to give a round fillip to production of pulses in the country.

Government of India is operating a comprehensive National Food Security Mission (NFSM) to maintain sustainable food security in the country which provides support to pulses, cereals, millets and selected commercial crops. Previously the NFSM was operative only in limited States, but the present Government extended its benefits to all 29 states and 638 districts during 2014-15. But, with reference to pulses, a major decision was taken to exclusively dedicate 50 per cent allocations for development of pulses alone. This will benefit north-eastern States and hilly States, such as Himachal Pradesh, Jammu & Kashmir and Uttarakhand. These States have appreciable potential for cultivation of pulses, but previously, the pulse farming was not getting its due share mainly due to lack of sufficient resources. The support provided by NFSM will definitely boost pulse production in these areas and across the country.

A special attraction of nearly ₹200 crore has been made exclusively for increasing area under

pulses during various cropping seasons. Cultivation of pulses is being promoted as an inter crop with cereals, oilseeds and cash crops with introduction of suitable varieties and package of practices. Scientists have demonstrated successful cultivation of pigeon pea on bunds of rice fields. Similarly, pulse crop is being encouraged in rice fallow areas under 'Bringing Green Revolution in Eastern India' scheme. Summer Moong (green gram) cultivation is also being promoted through necessary technical support. Rice fallows in the India-Gangetic Plains offer a huge potential for expansion of the area of *rabi* pulses such as chickpea and lentil. Short duration varieties of chickpea and lentil, successfully grown after rice harvest in some States, have given reasonably high yields. Several on-farm trials have indicated that pigeon pea can be grown profitably in place of rice during the *khariif* season allowing timely sowing of wheat crop. The net economic returns under pigeon pea-wheat system were greater compared with the rice-wheat system. Availability of extra short duration of varieties of pigeon pea has opened a new avenue of its cultivation up to the elevation of 2000 meter above sea level in Uttarakhand and other hilly States. Indian Institute of pulses Research (IIPR), Kanpur has developed several profitable cropping systems such as pigeon pea-wheat, pigeon pea/rice-wheat-green gram, etc. for inclusion of pulses in various crop cycles. Pulses can also be grown profitably as inter-crop with rapeseed-mustard, sunflower, linseed and potato. Green gram and black gram have given high yields and profits when grown with planted sugarcane.

Present Government strengthened frontline demonstration program in pulses by allocating funds and facilitating better support. Under these demonstrations, extension scientists arrange ideal farming conditions at farmers' fields demonstrating scientific production technologies by adopting improved varieties, judicious use of manures and fertilisers and scientific management of pests and diseases. Necessary and critical inputs are also provided. Frontline demonstrations are arranged with the objective to demonstrate full potential of pulse crops to farmers so that they get convinced for production of pulses in their fields. During 2015-16, more than 60,000 pulse demonstrations were conducted covering 22,000 hectare of land across the country. More than 475 Krishi Vigyan



Kendras (KVKs) – Farm Science Centres of ICAR located in each rural district of the country – were involved in the process. With more allocations, 77500 demonstrations over 31,000 hectare area are planned for 2016-17. Recent reports indicate a very positive response of these demonstrations as pulse area in these districts is on the rise.

The accessibility of small holding farmers to quality seed of improved pulse varieties is constrained by both inadequate demand creation and limited supply. Hence, the seed replacement rate in pulses is considerably low. For augmenting the availability of quality seeds, present Government has launched a special project for creation of Seed Hubs across the country with a total outlay of nearly ₹ 140 lakhs. The project aims to establish nearly 100 Seed Hubs across the country in State Agricultural Universities, ICAR Institutes and KVKs. ICAR-IIPR is acting as model agency with responsibility of co-ordination, monitoring and technical support for seed production. The project has a provision of ₹50 lakhs in the first year at each Seed Hub for creating infrastructures to ensure seed production and processing as well as storage of seeds. In addition, ₹ 100 lakhs has been provisioned for each Seed hub as a revolving fund to meet various expanses during 2016-18. All the seed hubs together have been given a target of producing 51,285 quintals quality seed of different pulses during 2016-17; 71,520 quintals during 2017-18 and 92,650 quintals during 2018-19, thereby producing a total of 2,15,455 quintals of quality seeds over a period of three years. Availability of quality seeds to farmers at affordable prices will certainly help increase area and productivity of pulses.

On the Price Front

Present Government has expressed its commitment, time and again, to safeguard and protect interests of farmers and consumers alike. Hence, Government has substantially increased Minimum Support Prices (MSP) of pulses and enhanced imports to meet rising domestic demand. In addition, adequate buffer stock of pulses is also being created. Recently, Government has increased MSPs of *kharif* pulses for 2016-17 season as ₹ 5,050/- per quintal, ₹ 5,225/- per quintal and ₹ 5,000/- per quintal for *Tur (Arhar)*, *Moong* and *Urad*, respectively. The MSP includes a bonus of ₹ 425/- per quintal in each commodity. Government has also declared a bonus, over and above the MSP of ₹ 200/- per quintal for *kharif* pulses of 2015-16 season and a bonus of ₹ 75/- per quintal for *rabi* pulses of 2016-17 marketing season. A substantial rise in annual compound growth rate of MSPs of pulses is also recorded, which is attracting farmers for wide scale adoption of pulses as major crops. Government has also developed a more transparent and beneficial purchase policy for pulses. Government has given clear directives that procurement is to be done under Price Support Scheme, if market prices are below MSP and under Price Stabilization Fund, if prices are above MSP.

To safeguard interest of consumers, Government has enabled a Price Stabilization Fund with a corpus of ₹500 core with the objective to regulate and control market prices of volatile commodities, such as pulses, onion and potatoes. It has been observed that prices of these commodities skyrocket whenever supplies fail to meet the domestic demands. This unique fund provides interest free advance working capital assistance to States and control Agencies for undertaking market interventions to control market prices. Recently, Government has notified rules for controlling and fixing market prices of essential commodities by the Government authorities, which was earlier regulated by the market forces alone. Moving ahead in this direction, Government has also approved creation of a buffer stock of 1.5 lakh metric tonnes of pulses for which procurement and storage has already begun. Under the buffer stock or store of 45,000 metric tonnes of *Tur*; 5,000 metric tonnes of *Urad*; 80,000 metric tonnes of *Chana* and 20,000 metric tonnes of *Masur* will be maintained

either through procurement or imports. If market prices rise due to shortage of pulses in the market, Government will release sufficient quantities in the market to regulate the volatile situation.

Oils and Oilseeds

Edible oils occupy a unique place in Indian society, culture, dietary patterns and economy of the country. According to 'VISION – 2015' document of ICAR - Indian Institute of Oilseeds Research, Hyderabad, India is one of the largest vegetable oil economies in the world next to USA, China, Brazil and Argentina. Due to diverse agro-climatic conditions and geographical locations, farmers are able to grow all the nine annual oilseeds viz. groundnut, rapeseed – mustard, soybean, sunflower, sesame, safflower, niger, castor and linseed. Among these, castor and linseed oils are chiefly used for industrial and other applications. In India, oilseeds are the second most important crop after cereals sharing 14 per cent of the country's gross cropped area and accounting for nearly 3 per cent of the gross domestic product (GDP). Value wise, oilseeds constitutes nearly 6 per cent of the value of all agricultural products. India grows oilseeds on an area of nearly 27 million hectares with productivity of 1108 kg per hectare for the quinquennium during 2013-14. Consumption / demand of vegetable oils is increasing steadily because of the lifestyle changes in dietary pattern and increasing per capita income. According to estimates, to meet the per capita demand of nearly 17 kg per year, India will require 28.51 million tonnes of vegetable oils in 2050. In other words, country will have to produce about 94.94 million tonnes of oilseeds by 2050 from the existing production of 32.75 million tonnes to achieve near self-sufficiency in oilseeds. India needs a three-fold increase in the oilseeds production in the next nearly 35 years. Interestingly, India is also largest cultivator of oilseeds in the world and paradoxically meets into more than 50 per cent requirement through imports from various countries.

Like pulses, oilseeds also face severe challenges in terms of climatic stresses and unfavourable farming conditions, oilseeds cultivation is mainly undertaken on marginal land by resource poor farmers who are generally reluctant to provide necessary inputs for increasing the productivity.

Nearly 82 per cent of the oilseeds area fall under rainfed farming where climatic vagaries cause severe damage to crops. Studies have indicated emergence of biotic threats (diseases) which have the potential to disrupt the production patterns and regional crop preferences in a significant manner. The overall efficiency of procurement sector is also low affecting yield of edible oils from oilseeds crops. Market conditions are also not very encouraging for farmers and entrepreneurs.

Mission on Oilseeds

Present Government has launched many initiatives and took various innovative steps to enhance production and productivity of oilseeds crops.

Government has strengthened **National Mission on Oilseeds and Oilpalm** by allocating ₹3507 crore during the on-going 12th Plan period. Previously, the Mission was operative only in 14 States, but now its activities have been extended to 24 States. The Mission aims to increase seed replacement ratio with focus on varietal replacement by including high yielding and high quality varieties. Irrigation coverage under oilseeds is to be raised from 26 per cent to 36 per cent for increasing productivity. Efforts have been intensified to diversify area from low yielding cereal crops to oilseeds crops and inter-cropping of oilseeds with cereals/pulses/ sugarcane is also being promoted. Scientists have advised rise of fallow land after paddy/potato harvest for oilseeds farming to increase the area under oilseeds crops. To address the issue of quality seed supply of improved varieties, Mission is acting vigorously through technical support of ICAR Institutes and State Agricultural Universities. In fact, Mission is being implemented through active involvement of all the stakeholders. The centre and State are bearing costs in the ratio of 75:25.

A substantial portion of our requirement of edible oils is met through import of palm oil from Indonesia and Malaysia. In India, oil palm is a new crop but holds great promise due to its highest vegetable oil yielding capacity. Besides, oil palm is a perennial crop with lot of potential for area expansion under Indian conditions. Hence, the Mission has made special efforts to make available quality planting materials and provide support for

irrigation and proper management. Tree-borne oilseeds, like sal, mahua, kokum, olive, karanja, jatropa are also being supported for cultivation under the Mission.

Like pulses, Frontline Demonstrations in oilseeds have been initiated involving 300 KVKs across the country. More than 44,000 demonstrations were conducted covering nearly 18,000 hectare area during 2015-16. More than 24,000 demonstrations covering nearly 60,000 hectare area have been planned for 2016-17 and rural youths will also be involved in the process. Farmers are realizing potential of oilseeds crops through these demonstrations and are adopting these remunerative crops in large scale. In addition, Government has raised MSPs of *khari* oilseeds for 2016-17 season to make the crops more remunerative. Now MSP of groundnut-in-shell stands at ₹ 4,220/- per quintal which includes ₹ 100/- as bonus. Similarly, MSPs of soybean, sunflower seed, niger seed and sesamum have hiked to ₹ 2,775/-, ₹ 3,950/, ₹ 3,825/- and ₹ 5,000/- per quintal respectively including bonus.

Farmers' Welfare

Present Government has launched a number of schemes for the welfare of farmers by increasing profitability of agriculture through policy initiatives. These schemes also helping pulse and oilseeds farmers to raise their income level by increasing field production and productivity. 'Pradhan Mantri Fasal Bima Yojana' promises security of income to farmers despite natural vagaries at a very nominal premium. Similarly, e-VAM, a panIndia electronic trading platform assures high income to farmers through a transparent process. 'Pradhan Mantri Krishi Sinchai Yojana' is continuously expanding irrigation facilities to newer areas and also helping increase irrigation efficiency by introduction of micro-irrigation techniques. A comprehensive and nation-wide soil health card scheme is helping farmers to increase land fertility and productivity. All these schemes, initiatives, programmes and activities are helping India more towards self sufficiency in pulses and oilseeds.

(The author is former Editor of Indian Council of Agricultural Research, New Delhi. He can be reached at jgdsaxena@gmail.com)

ROLE OF PULSES IN INDIAN AGRICULTURE

Dr Virendra Kumar

Cultivation of pulse crop is a must once in a year for every farmer for maintaining soil fertility, betterment of their livelihood, increased farm income and enhancing nutritional security. After harvest of sorghum, barley, wheat and maize farmers should grow gram, red gram, green gram and lentil. Further, pulse crops should be grown along with food and cash crops in a cropping sequence. Small and marginal farmers can also increase soil fertility of their farmland by growing short duration pulse crops and applying crop residue in the soil.

Pulses occupy an important place in Indian agriculture. In India, pulses are grown over an area of 2.38 crore hectares with a total production of 1.86 crore tonnes. The average yield of pulses in India is about 735 kg/hectare. The country need to produce 40-50 lakh tonnes of additional pulses for meeting the domestic requirement and this can be possible only if we develop high yielding, short duration, drought and insect-pest resistance varieties of pulses. In the rainy season, pulses like green gram, black gram, pigeon pea and cowpea are the most important and leading pulse crops of India. Chick pea, lentil, lathyrus, field pea and kidney bean are the important pulse crops grown during winter season. However, green gram, black gram and cowpea are grown in both spring and rainy season. Pulses are generally grown in irrigated as well as rainfed area and belong to leguminaceae family. Main growing areas of pulses in India are Madhya Pradesh, Uttar Pradesh, Gujarat, Maharashtra, Karnataka and Rajasthan. Madhya Pradesh is the leading state in India in pulses, in terms of cultivated area and productivity.

Factors Responsible for Low Yield of Pulses

- Delayed sowings/plantings;
- Low seed rate resulting in poor crop stands;
- Poor weed management during crop growth
- Inefficient irrigation and rainwater management;
- Large scale monoculture and non-inclusion of pulses in cropping systems;
- Lack of consideration of previous cropping in the same field;
- Inadequate plant protection.
- Non-availability of seeds of HYVs at affordable price and at the appropriate time;
- Lack of more efficient N using genotypes;
- Imbalanced use of fertilisers;
- Poor management for secondary and micronutrient, mainly S, Zn, Mn, Fe and B.

India has already enjoyed five decades of post green revolution period. However, stable or declining pulses production created several problems like protein malnutrition and insecurity of quality food





and higher pulses cost. Demand of pulses is much higher than its availability which leads to hike in the prices of pulses which is unaffordable to consumers particularly population living in rural, hilly and tribal areas. The projected requirement of pulses by the year 2030 is estimated at about 3.2 crore tonnes. Pulses play a pivotal role in enhancing livelihood security, nutritional security, food security, soil health, farm profit and environmental sustainability. Thus pulses are premier crops cultivated in Indian sub-continent. Indian population is predominantly vegetarian. Pulses and its products are a rich source of essential nutrients like protein, minerals and vitamins. Pulses can easily meet the protein requirement of a vegetarian diet. As diet of Indians is deficient in respect of quality and quantity of protein, mixing of pulses grains with other cereals enhances the nutritive value of the food. Pulses are also a cost-effective alternate to ameliorate energy- protein/nutrient elements deficiency in the country. Several serious diseases in human beings can be prevented by regular intake of pulses.

India has only three per cent of the world's land resources and five per cent of water resources. Yet, Indian agriculture system supports 18 per cent of the world population. Since resources, viz. land, water and energy are limited, scarce, costly and having competing demand for urbanization, industrialization and meeting farming needs. Further, degrading of soil health is posing major concerns for agricultural sustainability. Low soil organic matter and imbalanced use of fertilisers are affecting pulse crops productivity. A deficient monsoon followed by a further dry spell for the past few years has affected

pulses production. The production of pulses in India has remained insufficient making us dependent on imports. The demand for these food commodities is expected to increase in future substantially. India is the world's largest producer, importer and consumer of pulses. Our annual import bill for pulses is ₹10,000 crores. Thus, there is a great need for increasing production of pulses as per capita availability of pulses is only 37 g/day as against 54 g/day required to fulfill the protein requirement. Under changing climate scenario, more emphasis shall be given on achieving the target of 2.4

crore tonnes of pulses production by 2020 so as to make the country self sufficient and reduce the burden of import bill substantially. This will be achieved through developing and spreading new improved and hybrids varieties, balanced fertilizer usage, irrigation management and timely insect and pest control in pulse crop cultivation. Emphasis may also be given on production of sufficient quantity of quality seeds of pulses through farmers participatory approach and purchasing of the seed by buyback policy. Further, pulse seed production hubs are being developed in various regions to ensure availability of quality seeds of pulses to farmers.

Table 1. Area, Production and Productivity of Major Pulses Grown in India

Pulses	Area (lakh ha.)	Production (lakh tonnes)	Productivity (kg/ha.)
Chickpea	73.7	58.9	799
Pigeon pea	36.3	27.6	760
Green gram	34.4	14.0	406
Black gram	37.0	14.0	451
Lentil	15.0	9.5	633

In the changing climate scenario, biotic and abiotic stresses have become major production limiting factors. Further, declining total factor productivity and deteriorating soil quality is a major concern for pulses production. Due to this, pulses output went down from 1.92 crore tonnes to 1.72

crore tonnes in 2014-15 leading to the crisis of unprecedented price rise in these commodities. The prices of pulses increased abnormally last year due to reduction in domestic production as well as global shortage, mainly in case of pigeon pea. Efforts to nail the hoarders and black marketeers did not yield the desired effect. During the year, the government raised the minimum support price of major pulses by ₹ 275 per quintal. With production estimates for 2015-16 still lower than the bumper crop of 2013-14, the government has decided to create a buffer stock of 1.5 lakh tonnes of pigeon pea and black gram which will be procured directly from farmers at market rates. Keeping in view the above mentioned facts, Agronomists, Plant breeder and Natural resource management scientists need to play an important role in enhancing production and productivity of pulse crops in the long run. There is a need of the best management practices to increase pulse production per unit area as the arable land is decreasing day by day due to urbanisation, industrialisation and other development activities.

Forty-five per cent of children below the age of three years are undernourished in India. A large number also suffer from protein deficiency. Pulses and pulse product are the main and chief source of protein and minerals for more than fifty per cent of our population. To address malnutrition in children, food grains of pulses must be bio-fortified with quality protein and micronutrients. Recently several national and international research institute have developed iron and zinc rich lentil varieties through molecular breeding. These varieties/technologies

should reach the farmers immediately for alleviating malnourishment in women and children. Government of India is also giving emphasis on pulse production and has allotted Rupees 500 crore in the central budget 2016-17 for increasing pulse production. Nowadays there is a great need to increase the productivity and total production of pulses with low cost and eco-friendly technologies to fulfill the demand of pulses for burgeoning population of India. Hence, low cost technologies and improved varieties/hybrids of pulses should be popularized among farming community.

Realizing the importance of pulses as a rich and economical source of protein in the vegetarian diet, the United Nations General Assembly has declared the year 2016 as the 'International Year of Pulses' (IYOP) to highlight and create awareness of the problem of hunger and protein malnutrition worldwide, seek solutions to nutritional security problem, call for changes to our agriculture and food supply systems and make the world free from hunger and malnutrition. Having a UN dedicated year will raise the level of awareness about pulses globally and the important role pulses can play in advancing health and nutrition, food security and environmental sustainability. It provides an unprecedented opportunity to raise awareness about the role of pulses in feeding the world and is the greatest opportunity to give additional research attention to pulses they deserve. South Asia already has the highest number of food insecure people with 30 crore undernourished — India accounts for 25 crore of them. According to FAO, India has 17 per cent of its population undernourished which accounts for 25 per

Table 2: Nutritional Value of Different Pulses Grown in India (Per 100 gm)

Pulses	Moisture (g)	Protein (g)	Fat (g)	Minerals (g)	Fibre (g)	Carbohydrate (g)	Calcium (mg)	Phosphate (mg)	Iron (mg)	Calory
Gram	9.8	17.1	5.1	3.0	3.9	60.9	202	312	4.6	372
Cowpea	13.4	24.1	1.0	3.2	3.8	54.5	77	414	8.6	342
Moong	10.4	24.0	1.3	3.5	4.1	56.7	124	326	4.4	348
Lentil	12.4	25.1	0.7	2.1	0.7	59.0	69	293	7.58	115
Moth	10.8	23.6	1.1	3.5	4.5	56.5	202	230	9.5	330
Pea	16.0	19.7	1.1	2.2	4.5	56.5	75	298	7.05	315
Rajma	12.0	22.9	1.3	3.2	4.8	60.6	260	410	5.1	346
Soybean	8.1	43.2	19.5	4.6	3.7	20.9	240	690	10.4	432
Arhar	10.5	19.3	4.5	3.4	7.4	55.5	280	301	12.3	335

Source: National institute of Food and Nutrition, Hyderabad

cent of undernourished people of the world, more than in entire Sub-Saharan Africa. Over the years, while the country has accumulated a huge surplus of wheat and rice, the pulses remain in short supply. Consequently, the per capita availability of pulses has progressively declined from 65 g a day in 1961 to merely 39.4 g in 2011, whereas, availability of cereals has gone up from 399.7 to 423.5g. For a country that faces persistent protein inflation and has preference for vegetarian diet, pulses are the most economical source of vegetable protein. Higher consumption of pulses will help address the scourge of pervasive malnutrition caused by protein deficiency among large sections of the Indian population.

Pulse Research and Development

Recently a large number of improved and hybrid varieties of pulses have been developed which are suitable for unconventional areas that can boost pulse production in future. Further, efforts are also going on to develop synchronous-maturity hybrids and varieties of pigeon-pea, black gram, green gram and chickpea. These technologies will enhance the productivity of pulses to meet our domestic requirements fully. So there is great need to provide such improved varieties of pulse crops to the farmers. In pigeon pea, several genotypes with early maturity, determinate growth habit and amenability to mechanical spraying and harvesting have been developed.

National Food Security Mission (NFSM) and Pulses

Government has started National Food Security Mission (NFSM) for food and nutritional security and for promotion of cultivation of pulses and other food have been grains. Recently more states covered under National Food Security Mission. Under National Food Security Mission pulses cultivation has been started in Jammu & Kashmir, Himachal Pradesh, Uttarakhand and all the North- East states. Salient points of National Food Security Mission are given below.

1. Seven Crops - Rice, Wheat, Pulses, Jute, Sugarcane, Cotton, Coarse Cereals covered under NFSM.
2. Fifty per cent NFSM has been dedicated for development of pulses.
3. Cultivation of pulses under NFSM has been started in J&K, HP, UK, and all North Eastern States.



Inclusion of Pulse Crops in Cropping System

Cultivation of pulse crop is a must once in a year for every farmer for maintaining soil fertility, betterment of their livelihood, increased farm income and enhancing nutritional security. After harvest of sorghum, Barley, wheat and maize farmers should grow gram, red gram, Green gram and lentil. Further, pulse crops should be grown along with food and cash crops in a cropping sequence. Small and marginal farmers can also increase soil fertility of their farmland by growing short duration pulse crops and applying crop residue in the soil. Thus soil biomass can also be enhanced which is the main source of energy and food for several beneficial microorganism involve in oxidation and reduction process in soil. Farmers could be motivated to think about inclusion of pulse crop in crop rotation for achieving a sustainable and prosperous harvest. Likewise, after the wheat harvesting farmers should grow green gram in their fields and after getting two picking of mature pods, the green gram crop residue should be incorporated in the soil. This enhances the soil biomass which later on decomposition supplies primary as well as secondary micro-nutrients to the succeeding crops. This increases the soil fertility and improves the soil health too. Thus the water holding capacity and water availability for crops can also be increased.

Soil Protection and Pulses

Due to soil rejuvenation qualities such as release of soil-bound phosphorous, build up soil fertility through atmospheric nitrogen fixation, recycling of soil nutrients and addition of organic matter and other nutrients make pulses an ideal crops of sustainable agriculture in the tropical and sub-tropical regions

of India. Besides, pulses have the capability to protect the soil from wind and water erosion in arid and semi arid tropics. The roots of pulse plant have *Rhizobium* nodules that work for nitrogen fixation in the soil. For better nitrogen fixation suitable species of *Rhizobium* should be applied for different pulse crops. pulses are rich source of protein and can be easily grown under rice-wheat cropping system in North-West India. Pulses improves soil fertility by fixing atmospheric nitrogen and hence the farmers need to adopt this technology in the region.

Balanced Fertilisation

Balanced fertilizer use at the macro level in India is generally equated with a nutrient consumption ratio of 4:2:1 (N: P₂O₅:K₂O). The N: P₂O₅:K₂O ratio is as wide as 30.8:8.8:1 in Punjab, 48.2,14.9:1 in Haryana and 53.0:19.3:1 in Rajasthan compared with all India average of 6.9:2.6:1. Multiple nutrient deficiencies could be holding back the yield potential resulting in low pulse crop yields, low nutrient use efficiency and more N losses. Thus, mineral fertilisers have come to play a key role in areas with low fertility soils, where increased agricultural production is required to meet growing pulse demand. Major factor responsible for the low and declining pulse crop response to fertilisers is the continuous mining of soil without adequate replenishment to a desired extent. The continuous use of N fertilisers alone or with inadequate P and K application has led to mining of native soil P and K. Balanced fertilizer i.e., use of fertilizer nutrients in right proportion and in adequate amount are considered as promising agro-techniques to sustain yield, increase fertilizer use efficiency and to restore soil health.

Use of Bio-Fertilisers in Pulse Cultivation

Bio-fertilisers are not only eco-friendly and cost effective but also help to increase production and productivity of various pulse crops. Their method of application is easy and simple in pulse crops production. Bio-fertilisers are also easily available at various research institute at low cost. Use of bio fertilisers such as *Rhizobium*, *Azospirillum*, *Phosphate solubilising bacteria (PSB)* and *Trichoderma* also resulted in significant increase in all growth and yield parameters in pulse crops. Apart from this it has a potential role in saving of chemical fertilisers in pulse crops cultivation. Bio fertilisers such as PSB and mycorrhiza fungi significantly increases the yield and

yield attributing characters and P content in shoot in pulse crop. Similarly, the growth attributes and nutrient uptake in pulse crops also increased due to application of *Rhizobium*, PSB, *Azotobacter* and *Azospirillum* compared to control.

Table No. 3: Recommended Bio-fertilisers and Their Method of Application in Pulses

Biofertilisers	Doses/ha.	Method of application	Comments
Rhizobium spp.	500-800 gm.	Seed inoculation	Before sowing
Phosphate Solubilising Bacteria (PSB)	1-2 kg.	Seed inoculation and soil treatment	Before sowing
Azotobacter	500-800 gm.	Seed inoculation and soil treatment	Avoid bacterial culture from sunlight
Mycorrhiza	1-2kg	Seed inoculation and soil treatment	Before sowing

Plant Protection Measures

There is a great need for Plant protection measures for getting higher yield and yield attributes in pulses cultivation. Pulses are highly sensitive and susceptible to insect-pest infestation particularly at pod formation and grain filling stages. There is also a matter of concern over problems of yellow mosaic virus, pod borer and white fly in pulse crops and also need to develop varieties resistant to viruses.

Publicity and Awareness Drive

Agricultural extension has to be adequately strengthened organizationally and financially to support the chain of transfer of technology from the research institutions to farmer's fields in a cost-efficient manner. Farmers should adopt the scientific technology for sustainable yield of pulses. Advanced techniques regarding pulse crops cultivation should be disseminated to encourage farmers and extension workers for increasing pulses production in future. For this leaflet regarding pulses technology in Hindi and local language should be released and distributed among farmers. Drip irrigation and fertigation technologies may also be popularise among farmers for saving precious and costly irrigation water and other inputs in pulse crops cultivation in dry areas.



Farmers must be made aware of the adverse effects of excess and unbalanced use of agrochemicals mainly urea in pulses cultivation. For this Farmers Conference, farmer-scientist interface, Kisan Mela, field visit and meeting can be organized for quicker spread of new technologies and information among farming community. This will provide an exceptional opportunity for increasing productivity and profitability of pulses. Thus, pulses cultivation may become more profitable and productive to the farmers and consumers may get fresh, cheap and better quality pulses at lower price.

New Initiatives and Efforts

There has to be planned efforts including adequate financial investment to evolve pulse crop varieties which are high-yielding and resistant to diseases, drought, flood and salinity. Special efforts should be initiated through scientist, subject matter specialist, extension worker, NGOs and farmers to make India self sufficient in pulse production. In this connection, improved technologies for pulses cultivation should be demonstrated at different parts of the country particularly in non traditional areas by krishi vigyan kendra (KVKs) to motivate pulse growing farmers. Besides, technology support, seeds of improved and hybrid varieties of pulses must be distributed among progressive farmers and extension workers to boost pulse production.

Processing, Packaging and Storage

To overcome pulse crisis in future, emphasis may be given on farm processing and value addition of pulses and storage facilities which are needed as pulses grain are easily damaged by insects and pests. Further, moisture percentage in the pulse grains should be brought down to 9 or less after sun drying and water proof bags such as thick polyethylene bags should be used for packing and storage. These

bags should be heat sealed. In case of higher seed moisture, jute bags are recommended. Pulses seeds being hygroscopic in nature, absorb moisture from the atmosphere until the equilibrium is reached between the vapour pressure of seed and atmosphere. Therefore, efforts should be made that relative humidity in the seed storage is kept as low

as possible and any chance of absorbing moisture by the seed from atmosphere is avoided. Aeration during storage of seed is important, particularly when moisture content is low. Emphasis may also be given on pulses processing techniques, utilization centre and development of local markets for pulse produce. So that better harvest of pulses may improve the economy and living standard of small and marginal farmers.

Suggestions for Sustainable and Self Sufficient Production of pulses in future.

1. New research efforts should be initiated to achieve a breakthrough in the productivity.
2. Innovative ideas need to be implemented instead of conducting routine research and material evaluation.
3. Scientists to work for development of shorter duration, widely adaptable and biotic and abiotic stress resistant varieties to boost the production of pulses.
4. Modernization of pulse breeding programme, supporting genetic gains through transgenic technology, enhancing biological nitrogen fixation through development of super nodulating plant types and breeding short duration varieties for achieving self sufficiency in pulses.
5. Extension workers and agriculture technology information centers should work more towards development and dissemination of newer technologies.

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LONG TERM VISION FOR PROMOTION OF PULSES AND OILSEEDS

K A Badarinath

Technology adoption to sustain high yields, new high yielding varieties development, robust research, diversification into pulses are some issues flagged by the Narendra Modi Government to achieve self-sufficiency by 2025. Coupled with these, changes in Essential Commodities Act of 1955, trading in agricultural commodities, synchronising trade policy along with global linkages to push up pulses output and slap restrictions on unhindered imports also seem to be under centre's consideration.

Two biggest limiting factors in India's food cycle are pulses and oilseeds that continue to flummox policymakers and stakeholders including farmers and consumers. These two commodities have also emerged as the biggest challenge for successive governments in inflation management and forking out billions of dollars on imports.

Pulses and oilseeds have often disrupted the kitchen budgets of several families while farmers have never got a good deal to pursue cultivation in these commodities as 'profitable ventures'. The three crucial issues have not been adequately addressed over the years while the agriculture economists toyed with policy options to get over pulses and oilseeds shortage.

Concomitant issue also relates to industry lobbies that preferred India's dependence on imports of these two commodities to make a killing especially in times of shortages and spot purchases made in global markets as part of inflation management.

India's quest for achieving self-sufficiency in pulses goes back to 1990-91 when this vital

commodity became part of technology mission set up on oilseeds. Integrated Scheme on Oilseeds, pulses, Oil palm and Maize (ISOPOM) took shape in 1995-96 as part of then government's strategy to achieve sufficiency in all these four commodities.

The previous government at centre rightly made pulses as part of the Food Security Mission. However, dedicated missions over the years have not really helped India achieve self-sufficiency in pulses and oilseeds.

As per official data, pulses imports in 2015-16 have touched an unprecedented 5.8 million metric tonnes while domestic output was 16.5 million metric tonnes. One significant reason for lower domestic output in pulses during last fiscal was successive droughts country faced in preceding two years. Pulses production peaked at 19.25 million metric tonnes in 2013-14.

Renowned agriculture economist and former chairman of Commission for Agricultural Costs and Prices (CACP) Ashok Gulati has argued in favour of creating two million metric tonnes buffer stocks in





pulses as an interim measure to get over shortages, rein in prices and manage food prices induced inflation.

As per official data, pulses contributed 23.9 percent to wholesale prices inflation (WPI) as late as September 2016 thereby driving home the urgency for a comprehensive policy for tackling pulses shortage.

Based on chief economic advisor Arvind Subramanian committee recommendations, Union Cabinet has swiftly gone ahead to create buffer in pulses that include 3.5 lakh tonnes *tur dal* and two lakh tonnes *urad dal*.

Subramanian committee has pushed for “enhancing domestic productivity rapidly as the only reliable way to minimise price volatility, safeguard interests of both consumers and farmers”.

While about 80 per cent pulses production happen from 20 per cent districts spread across Madhya Pradesh, Rajasthan, Karnataka, Andhra Pradesh and Maharastra, these very areas will have to be targeted for achieving self-sufficiency under the Food Security Plan.

Providing price support to farmers, pushing up yields, managing their post-harvest produce are some of the issues that need to be comprehensively addressed by the government without delay. While pulses output reached 1,450 kilogrammes per hectare in countries like Myanmar, India continues to struggle with lower yield at 725 kilos per hectare.

Technology adoption to sustain high yields, new high yielding varieties development, robust research,

diversification into pulses are some issues flagged by the Narendra Modi Government to achieve self-sufficiency by 2025. Coupled with these, changes in Essential Commodities Act of 1955, trading in agricultural commodities, synchronising trade policy along with global linkages to push up pulses output and slap restrictions on unhindered imports also seem to be under centre’s consideration.

In the budget for this fiscal, Finance Minister Arun Jaitley announced comprehensive measures to meet domestic demand for pulses and perhaps even attempt exports in few years from now. For instance, he set aside Rs. 500 crore to enhance productivity and production of pulses under National Food Security Mission. Similarly, the government set aside Rs. 900 crores through price stabilisation fund to acquire 50,000 tonnes of pulses as part of larger procurement plan. But, experts have also pointed out that the funds set aside for pulses were inadequate. Finance Minister Jaitley had assured that “more funds would be made available” for achieving sufficiency in pulses in short term.

In sync with Arvind Subramanian Committee recommendations, gradual increase in minimum support price (MSP) on pulses over next three years has also been accepted to enable farmers realise better prices on their produce.

Oilseeds has been no different. Though India has emerged as fourth largest market for oilseeds and edible oil after US, China and Brazil, over 55 per cent demand is met through imports. Imports have surged exponentially over last 20 years from a meagre three per cent in 1992-93. Growing per capita consumption, over 1.2 billion population and stagnant domestic output at 28–30 million tonnes in edible oils year





ending October 2016 has given sleepless nights for agriculture economists and government.

While demand continues to grow in double digits annually, production has been lagging far behind pushing imports exponentially. Cooking oil imports during this oil year are expected to touch a staggering 15 million tonnes thereby reflecting the failure of technology mission on oilseeds to achieve self sufficiency in the country.

Executive director of Solvent Extractors Association of India (SEAI) has maintained that in case domestic production does not increase, imports would touch a staggering 75 per cent of demand in a few years. One strategy that SEAI has strongly advocated was that productivity will have to be enhanced by at least 100 kilogrammes each year from prevailing 1,000–1,100 kilogrammes per hectare. India's output has apparently been at an abysmally low of 50 per cent global average.

Government's action plan to achieve self sufficiency in oilseeds apparently includes pushing up the per hectare yield of oilseeds to 1,500–1,600 kilogrammes in next five years as a first step.

Genetic up-grade of oilseeds, integrated nutrient and fertiliser management, pest and disease management strategies are being seriously considered for enhancing the per hectare yield.

Deployment of post-harvest technologies, providing adequate water especially in arid and dry

zones through lift irrigation and sprinklers, soil quality testing, financing and credible marketing support for oilseeds is some of the measures that have already been initiated by the Centre in coordination with states to enhance output.

Pushing up cost-effective oil palm cultivation has been identified as another option. Oil palm trees are reportedly 6–10 times more efficient than other temperate oilseeds crops like rapeseed, soybean, sunflower or groundnut.

By placing a medium term strategy to enhance domestic oil palm cultivation and reduce dependence on imports, Narendra Modi Government has set aside ₹10,000 crore package to support farmers over next three years. Oil palm trees take three to five years for starting yield of fruit.

A radical shift from wheat and rice to oilseeds by Punjab and Haryana is also under active consideration of the Centre. Some industry experts are even pushing for weaning away at least 50 per cent of wheat land in Haryana and Punjab be set aside for mustard by 2025 as part of long term strategy on oilseeds.

In the short term, the government seems keen to slash the edible oil imports valued at US\$ 10 billion annually. Finance Minister Arun Jaitley recently signalled that government will not allow cheap imports to flood the market and disrupt the domestic edible oil ecosystem. This is also seen as an exercise to prune the edible oil import bill and re-align foreign exchange balances.

One suggestion being considered by the Centre was to enhance the import duty on vegetable oil presently levied at 12.5 per cent and 20 per cent on refined oil as a restrictive measure and provide incentives directly to oilseeds farmers.

With focus on farm sector reforms and farmers welfare, the Modi Government seems firm on achieving self-sufficiency in oilseeds and pulses. Sceptics keep their fingers crossed, given the huge let down in the past forcing the country to take recourse to imports as a state policy without building domestic capabilities.

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GOVERNMENT INCREASES MINIMUM SUPPORT PRICES OF PULSES, OILSEEDS

The Cabinet Committee on Economic Affairs (CCEA) gave its approval in June for the increase in the Minimum Support Prices (MSPs) for all *kharif* crops of 2016-17 season that became effective from October 1, 2016. In addition to that the government also announced bonus on pulses and oilseeds to incentivise their cultivation in the country, payable over and above the approved MSP.

The CACP being the expert body, its recommendations are generally accepted as such. However, to incentivise cultivation of pulses and oilseeds, the Cabinet has decided to give a bonus, over and above the recommendations of the CACP, of ₹ 425/- per quintal for *kharif* pulses, namely *Arhar* (Tur), *Urad* and *Moong*, a bonus of ₹ 200/- per quintal for Sesamum and a bonus of ₹ 100/- per quintal for other *kharif* oilseeds namely, Groundnut-in-shell, Sunflowerseed, Soyabean, and Nigerseed. There is an increasing gap between the demand and domestic supply of pulses and oilseeds and reliance on import is increasing. Government has, therefore, announced this bonus on pulses and oilseeds to give a strong price signal to farmers to increase acreage and invest for increase in productivity of these crops. The increase in cultivation of leguminous pulses and oilseeds will also have additional environmental benefits as these crops are less water consuming and help in nitrogen fixation in the soil.

The Minimum Support Prices (MSPs) for all *kharif* crops of 2016-17 season have been increased and are given in table below:

Commodity	Variety	MSP for 2015-16 Season	MSP Recommended for 2016-17 Season	Increase		Bonus
				Absolute	% age	
		Rs/ Quintal	Rs/ Quintal	Rs/Quintal	%	Rs/Quintal
Tur (Arhar)	-	4,625 (includes ₹ 200/- Bonus)	5,050 (includes ₹ 425/- Bonus)	425	9.2	425
Moong	-	4,850 (includes ₹ 200/- Bonus)	5,225 (includes ₹ 425/- Bonus)	375	7.7	425
Urad	-	4,625 (includes ₹ 200/- Bonus)	5,000 (includes ₹ 425/- Bonus)	375	8.1	425
Groundnut-in-shell	-	4,030	4,220 (includes ₹ 100/- Bonus)	190	4.7	100
Soyabean*	Yellow	2,600	2,775 (includes ₹ 100/- Bonus)	175	6.7	100
Sunflower Seed	-	3,800	3,950 (includes ₹ 100/- Bonus)	150	3.9	100
Nigerseed	-	3,650	3,825 (includes ₹ 100/- Bonus)	175	4.8	100
Sesamum	-	4,700	5,000 (includes ₹ 200/- Bonus)	300	6.4	200

*MSP of soyabean will be applicable to both yellow and black varieties

Government is focusing on improving production and productivity of crops such as rice, wheat, coarse grains and pulses under the National Food Security Mission (NFSM). For 2016-17, out of the total Central Share of Rs 1700 crore under NFSM, Rs, 1100 crore has been allocated to improve pulse production.

Source: PIB

UN GENERAL ASSEMBLY RESOLUTION ADOPTING 2016 AS INTERNATIONAL YEAR OF PULSES

The General Assembly,

Noting that pulses are annual leguminous crops yielding between 1 and 12 grains or seeds of variable size, shape and colour within a pod, used for both food and feed, and that the term “pulses” is limited to crops harvested solely for dry grain, thereby excluding crops harvested green for food, which are classified as vegetable crops, as well as those crops used mainly for oil extraction and leguminous crops that are used exclusively for sowing purposes,

Noting also that pulse crops such as lentils, beans, peas and chickpeas are a critical source of plant-based proteins and amino acids for people around the globe, as well as a source of plant-based protein for animals,

Recalling that the World Food Programme and other food aid initiatives use pulses as a critical part of the general food basket,

Desiring to focus attention on the role that pulses play as part of sustainable food production aimed towards food security and nutrition,

Recognizing that pulses are leguminous plants that have nitrogen-fixing properties which can contribute to increasing soil fertility and have a positive impact on the environment,

Recognizing also that health organizations around the world recommend eating pulses as part of a healthy diet to address obesity, as well as to prevent and help manage chronic diseases such as diabetes, coronary conditions and cancer,

Believing that such a celebration would create a unique opportunity to encourage connections throughout the food chain that would better utilize pulse-based proteins, further global production of pulses, better utilize crop rotations and address the challenges in the trade of pulses,

Affirming the need to heighten public awareness of the nutritional benefits of pulses and to further sustainable agriculture,

Reaffirming that, pursuant to paragraphs 13 and 14 of the annex to Economic and Social Council resolution 1980/67 of 25 July 1980, a year should not be proclaimed before the basic arrangements for its organization and financing have been made,

Welcoming resolution 6/2013 of 22 June 2013 of the Conference of the Food and Agriculture Organization of the United Nations,

1. Decides to declare 2016 the International Year of Pulses;
2. Reaffirms Economic and Social Council resolution 1980/67 on international years and anniversaries and General Assembly resolutions 53/199 of 15 December 1998 and 61/185 of 20 December 2006 on the proclamation of international years;



UNITED NATIONS

3. Invites the Food and Agriculture Organization of the United Nations, mindful of provisions contained in the annex to Economic and Social Council resolution 1980/67, to facilitate the implementation of the Year in collaboration with Governments, relevant organizations, non-governmental organizations and all other relevant stakeholders;
4. Requests the Secretary-General to submit to the General Assembly at its seventy-third session a focused and concise report, bearing in mind paragraphs 23 to 27 of the annex to Economic and Social Council resolution 1980/67, on activities resulting from the implementation of the present resolution, which elaborates on, inter alia, the evaluation of the Year;
5. Invites the Food and Agriculture Organization of the United Nations to keep the General Assembly informed of progress in this regard;
6. Stresses that the costs of all activities that may arise from the implementation of the present resolution above and beyond activities currently within the mandate of the lead agency should be met through voluntary contributions, including from the private sector;
7. Invites all relevant stakeholders to make voluntary contributions and to provide other forms of support to the Year.

71st plenary meeting
20 December 2013

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IMPROVED AGROTECHNIQUES FOR ENHANCING PRODUCTIVITY OF *RABI* PULSES AND OILSEEDS

Dr Ummed Singh and Y S Shivay

By adopting improved agro-techniques *viz.* selection of improved and appropriate varieties, optimum time of sowing, optimum plant population, modified tillage and resource conservation techniques, balanced nutrient management, integrated and timely weed management, proper irrigation management and also following of improved cropping systems *i.e.*, intercropping and mixed cropping, etc, can boost the productivity of the *rabi* pulses and oilseeds in different agro-ecologies of the country.

Indian agriculture has made considerable progress, particularly in respect of food crops such as wheat and rice in irrigated areas; however, performance has not been so good in case of other crops particularly oilseeds, pulses, and coarse cereals. Therefore, after achieving self sufficiency in food grains more attentions are required on pulses and oilseeds production enhancement to fulfill the domestic demand. Pulses, supplemented with cereals, provide a perfect mix of vegetarian protein of high biological value. India is the largest producer, importer and consumer of pulses accounting for 25 per cent of global production from 35 per cent of global area under pulses. The productivity of pulses in India is less than half of the productivity levels in USA and Canada, as the pulses are mainly grown under rainfed in India in the areas with high rainfall inconsistency.

Pulses encompass significant contribution in nutritional security to the vegetarians. Pulses also contribute in food security by way of maintaining sustainability of agricultural production systems. The foremost role in soil health improvement is the key to sustainability. In India, *rabi* pulses contribute about 65 per cent of the total pulses production and chickpea is the most important cool-season pulse followed by lentil and pea. These food legumes are distributed in 12° to 32°N latitude but concentrated in the states of Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan, Karnataka, Andhra Pradesh, Chhattisgarh and Bihar.

On the oilseeds map of the world, India occupies a prominent position, both in regard to acreage and production. India is the 4th largest edible oil economy in the world and contributes about 10 per cent of the world oilseeds production, 6-7 per cent of the global production of vegetable oil, and nearly 7 percent of protein meal. The demand for edible oils is increasing exponentially in the country. India's vegetable oil imports crossed 14.5 million tonnes last year, worth approximately ₹66,000 crores or around US \$10 billion. Of the total import of edible oils, 60 per cent is of palmolein, with the remaining made up by soybean, sunflower and rapeseed. A wide range of oilseeds crops are grown in different agro-climatic regions of the country. During *rabi* or winter season mustard and safflower are occupies significant acreage. *Rabi* oilseeds are mainly concentrated in the states of Rajasthan, Madhya Pradesh, Uttar Pradesh, West Bengal, Haryana and Karnataka.



Since the productivity of both the pulses and oilseeds are low, therefore, adoption of improved agrotechniques has the potential to enhance the productivity level per unit land. The improved agrotechniques for *rabi* pulses (Chickpea, lentil and filedpea) and *rabi* oilseeds (Mustard and safflower) are described hereunder one by one.

Soil and Field Preparation

Rabi Pulses

Rabi pulses require well-drained, deep soil free from excessive soluble salts having sandy loam to sandy clay loam soil texture. The ideal soil pH range is 6.0-8.5 and pulses are highly sensitive to salinity and sodicity. Unlike wheat, pulses do not require very fine seedbed. The good seedbed should be free from weeds and debris. Friable but compact soils having adequate soil moisture are considered ideal. Moreover, tillage requirement depends on soil type, crop rotation, sowing methods, moisture holding capacity of the soil, weed infestation, crop type etc. For example, a rough seedbed is good for chickpea cultivation in heavy soils of central and south India. As rough seedbed allows better aeration and avoids soil compaction which might have arises of winter rains. However, on light textured soils of Northern India especially under rainfed conditions, exposing more surface area through shallow cultivation late in the evening and planking in the next morning is good practice to capture more dew in the early winter season. Generally, one deep ploughing, cross harrowing and planking ensures good seedbed. Light textured soils and un-decomposed plant debris attracts termite and cutworm. So as to avoid incidence of termite and cutworm, soil application of Quinalphos (1.5 per cent Powder) at 25 kg/ha or chlorpyrifos (20 per cent EC) at 2.5 litre/ha is recommended.

Rabi Oilseeds

Mustard can be grown under fairly heavy clay to light sandy soil; however it grows best on light loam soil. Good drainage is always preferred and these crops are more tolerant to acidity than alkalinity. Safflower require moderate to good fertile soil, fairly deep, having good moisture holding capacity with neutral pH reaction. Safflower is fairly tolerant to salinity. Under irrigated conditions heavy soils



with poor drainage must be avoided for cultivation of safflower.

Modified Tillage and Resource Conservation

The techniques of modified tillage and crop establishment practices is pacing rapid acceptance by the farmers. Under irrigated systems of Indo-Gangetic Plains where rice-wheat cropping system is being diversified through incorporation/introduction of pulses is more profitable. As pulses require less or no tillage after heavy tillage operations practices in rice or maize.

Zero tillage is a technology where the crop is sown in a single tractor operation using specially designed seed-cum-fertiliser drill without any field preparation in the absence of anchored residue at optimum to slightly wetter soil moisture regime. Zero tillage technology is able to save cost of production incurred towards land preparation and diesel consumption. Other interventions like raised-bed planting system, laser equipment aided land leveling, residue management practices, crop diversification etc. are helpful in increasing farmers' income beside saving of expensive inputs like nutrient (fertiliser), electricity bill (water) and energy (fuel).

Bed planting technology is another resource conservation technology wherein, crops are grown/sown on raised beds for conserving inputs like seed, fertiliser, water etc. Beds are usually made at 0.6-1.0 m apart, and 2-3 rows of crops are sown on the beds and irrigation water is applied in the furrows. Bed planting systems are reported to help in more efficient use of water under rainfed (in *kharif* season) as well as irrigated conditions because it

allows optimum water storage and safe disposal of excess water.

The furrow irrigated raised-bed system (FIRBS) cultivation has been shown to result in saving of seed by 25-40 per cent, water by 25-40 per cent and nutrients by 25 per cent, without affecting the grain yield production. Further, the FIRB technology reduces lodging owing to less physical contact of irrigation water with plant culm and at the same time furrow provides easy air movement. This method of planting also reduces the population of weeds on the top of bed, probably due to faster drying and lower soil moisture compared to furrows. Thus, the modified crop establishment technologies are time-saving, cost-effective, energy-efficient and eco-friendly.

Recently, research efforts made at ICAR-Indian Institute of Pulses Research, Kanpur reported that growing chickpea following maize on just reshaped raised bed fetched higher nutrient use efficiency, water use efficiency, energy use efficiency and ultimately net return over conventional tilled sown chickpea. The visuals are given here.

Rotary tillage technology is another modified tillage system wherein, a tractor-driven version of the rotavator attached to a power tiller, which pulverises the soil, places the seed and fertiliser at appropriate depth and does planking in a single operation. It also mixes the crop residue/stubble/leftover of preceding crop in the field and adds organic matter in the soil and thereby helps in improving soil health. There may be a gain of 7-10 per cent in grain yield due to adoption of this technology compared with other systems of planting. However, adoption of this technology is handicapped due to higher cost of the machine, greater horse power requirement of the tractor and difficulty to work in relatively heavy soils. Moreover, rotary tillage may be better option for increasing productivity and net returns, followed by zero/reduced tillage and conventional drill sowing.

Conservation tillage is also one of the options for saving input and improving soil quality. The concept of conservation tillage was developed based on zero tillage with minimal disturbance of soil, keeping a protective cover of plants and/or plant residues on the soil surface to reduce soil losses, encourage microbial populations, and conserve moisture and nutrients. Further, these

systems save time, and require less labour and energy compared with conventional tillage, despite greater quantity of herbicides used to control weeds. A conservation tillage system affects crop growth and development, depending on many specific factors such as soil type, climate, cropping pattern and other attributes of overall farming operations. Moreover, improvement in soil quality with prolonged conservation tillage increases the yield of crops in arid and semi-arid environments, on well drained soils in temperate regions and in crops grown in rotation. Relative gains from conservation tillage are determined by the amount of residue available for providing surface cover or for incorporation into soil, topography and internal drainage of soil, amount and pattern of rainfall, soil temperature changes caused by residue cover, availability and cost-effectiveness of herbicides, and availability of suitable machinery for seeding and fertiliser application.

Optimum Sowing Time

Sowing time is a crucial non-monetary input for achieving optimum plant stand which can use natural or external resources efficiently to convert in the economic product i.e. yield. To achieve good harvest of any crop, timely sowing is one of the important factors affecting grain yield. Selection of varieties is also dependent on sowing time of a crop. As different varieties are recommended for timely sown conditions and late sown conditions. The ideal time of sowing of chickpea in North India is Second fortnight of October to first fortnight of November, but in Central and South India it is little earlier i.e. first fortnight of October to second fortnight of October. Likewise, lentil can be sown from last week of October to second week of November. However, wide sowing window is available for sowing of fieldpea (first fortnight of October to first fortnight of November). Under dryland or un-irrigated conditions of Rajasthan, sowing of Mustard is advocated early (September to first week of October). Whereas, in the states of Madhya Pradesh, Uttar Pradesh and West Bengal mustard can be grown throughout the October. The suitable time of safflower sowing in the states of Andhra Pradesh, Telangana, Madhya Pradesh and Maharashtra under rainfed conditions is ranging from first week of September to first week of October. However, in the states of Rajasthan and

Uttar Pradesh safflower can be grown little later (Mid October to first week of November). For both pulses and oilseeds, generally it is advocated that early sowing is better under rainfed or in-irrigated conditions compared with irrigated conditions, wherein little later sowing is possible due to availability of irrigation water.

Optimum Plant Population

To achieve higher productivity, optimum plant population or adequate plant stand is the pre-requisite. Optimum plant population is the resultant of optimum seed rate and spacing. Pulses and oilseeds, being non-tillering habit have low compensatory ability to make up per plant yield loss. Therefore, maintaining optimum plant population is more important in the pulses and oilseeds having non-tillering habit. Further, low productivity of pulses and oilseeds is associated with low plant stand, as these crops are grown under rainfed conditions on residual moisture. Efforts to maintain higher plant stand under rainfed conditions leads to more inter and intra-plant competition for soil moisture and plant nutrients which are scarce. Additionally, plant population is normally determined by growth habit, plant canopy structure, sowing time, growing conditions, soil fertility status, cropping systems etc. Optimum spacing for chickpea sowing is 30×10 cm in most parts of the country. Under irrigated conditions of North West Plain Zone wider spacing (45 cm × 10 cm) is more feasible. Lentil can be sown at 30 cm × 10 cm spacing under timely sown conditions whereas; narrow spacing of 22.5 cm × 10 cm is more suitable under late sown condition. Likewise, dwarf fieldpea can be sown at 20 cm × 10 cm whereas; tall fieldpea should be sown at 30 cm × 10 cm. Further, ideal crop geometry for sowing of mustard in the states of Uttar Pradesh, Madhya Pradesh and Gujarat is 45 cm × 15 cm and in the Rajasthan, Haryana and West Bengal it is 30 cm × 10 cm. On the other hand, optimum spacing for sowing of safflower is 45 cm × 20 cm in majority of the states.

Unlike, crop geometry optimum seed rate is also important factor for influencing the crop yield. The optimum seed rate of small seeded, large seeded and extra large seeded chickpea is 65-70, 80-85 and 95-100 kg/ha, respectively. A seed rate of 40-45 kg/ha for small seeded lentil and 55-60



kg/ha for bold seeded lentil is recommended to achieve good yield. A little less seed rate is needed for dwarf fieldpea (50-60 kg/ha) compared with tall fieldpea (80-90 kg/ha). The optimum seed rate of mustard is 4-5 kg /ha and safflower is 7.5-10 kg/ha.

Improved Varieties

Adaptations of appropriate variety/hybrid have a large impact on productivity of the crop. Unlike other factors of production, varieties alone may contribute to the extent of 10-25 per cent increase in productivity as observed in frontline



demonstration carried out all over India on different pulses and oilseeds. It is always advised to farmers to use certified seeds for better harvest of yield instead of reusing the farmers' own seed year after year.

Nutrient Management

Adequate and balanced supply of nutrients to the plants holds the key to successful plant production. Nutrients are the basic need for yield enhancement of any crop. Adequate supply of nutrients either through soil or external inputs *i.e.* fertilisers, trigger the plant to produce more biomass. There are five basic principles associated with *nutrient best management practices* to be implemented at farm level. These principles are *productivity, profitability, sustainability, social acceptability* and *environmental viability*. The nutrient best management practice supports the realisation of these principles in terms of crop productivity and environmental health. Nonetheless, nutrient stewardship could be the most efficient and effective use of plant nutrients to achieve economic, social and environmental benefits with engagement from farmers and other stakeholders. Further, nutrient use efficiency is the resultant of the selection of the *right source of nutrients* for application at the *right rate*, at the *right time*, and in the *right place* (4R Nutrient Stewardship) leading to follow the techniques of site specific nutrient management. To enhance nutrient use efficiency of applied fertiliser is largely dependent on 4R nutrient stewardship.

Method and time of application of fertilisers greatly influence fertiliser use efficiency. Under rainfed conditions, it is better to apply whole quantity of fertilisers as basal by drilling. Fertilisers should be placed in deep furrows approximately 10 cm below the soil and seed must be sown adjacent to the fertilised rows. However, under irrigated conditions especially in mustard half of the N and full dose of P, K and S should be applied as basal. The remaining half N can be applied at the time of first irrigation. In pulses, full rate of fertiliser-N should be applied as starter dose; no further application of N is required. At later stages the N requirement is fulfilled by the pulses itself through biological N-fixation. Now a day's seed-cum-ferti drills are available in the market which can be used

to place the seed and fertiliser at the desired place and depth.

Weed Management Practices

The weed intensity and yield losses caused by weeds during winter season (*rabi*) are lower compared with rainy season (*khari*). Common weeds present during winter season in pulses and oilseeds include (a) Grassy weeds (Wild oat, doob grass, Gulli Danda); (b) Non-grassy weeds (bathua, khartua, hirankhuri, satyanashi, jangali matar, Jhan Khaniya, swine cress, chatri matri); and (c) Sedges (Purple nutsedge). However, weeds do not pose serious problem in safflower except when frequent rains are received during initial crop growth stages. Safflower is very susceptible to weed competition during rosette stage (=a growth stage) which lasts for 25-30 days in Peninsular India and 50-60 days or more in other parts faces prolonged winter period. Timely weeding and intercultural operations during this growth stage is very crucial for arresting weed growth. As crop-weed competition for both soil moisture and nutrients is also greatest at this crop growth stage. The weeds may be controlled by means of alteration in crop husbandry, crop rotation, intercropping, and optimisation of plant population, soil solarisation, conservation tillage, mechanical tools, allelochemicals and herbicides. Above all, herbicide measures are more demanding by the farmers'.

Improved Cropping Systems

Pulses and oilseeds are grown under different cropping systems such as monocropping, double cropping, mixed cropping, intercropping and relay cropping etc. The choice of a particular system depends on irrigation potential, rainfall pattern, rainfall distribution, edaphic factors, weather abnormalities and domestic needs etc. Cropping sequences differ according to climate and soil types. In rainfed areas it is desirable to select a crop and variety, which produce fairly a good yield under limited soil moisture conditions. Crop diversification through intercropping or crop rotation could be the best strategy to expand acreage and enhance pulses and oilseeds productivity. Some of the promising pulse and oilseeds based cropping system prevalent though out India are listed as under:

Pulses and oilseeds based intercropping systems

Zone/States	Intercropping System
Northern Plains	Chickpea + Mustard (3:1) Lentil + Mustard (6:1)
Central Plateau	Chickpea + Linseed
Peninsular zone	Chickpea + Safflower (3:1)
Haryana	Chickpea + Mustard (5:1)
Uttar Pradesh, Rajasthan	Potato + Mustard (3:1)
Uttar Pradesh	Toria + Lentil (1:1) Barley + Mustard (6:1)
Rajasthan, Uttarakhand	Wheat + Mustard (9:1)
Rajasthan	Fieldpea + Mustard (3:1)
U.P., Haryana, Rajasthan	Sugarcane + Mustard (1:1)
Madhya Pradesh	Linseed + Safflower (6:2) Chickpea + Safflower (6:2) Mustard + Safflower (6:2)
U.P. (Eastern and Bundelkhand Region); Maharashtra	Linseed + Safflower (3:1) Chickpea + Safflower (3:1)
U.P. (Eastern and Bundelkhand Region)	Barley + Safflower (6:2)

Irrigation Management

Although pulses and oilseeds in winter season are mostly grown on under rainfed areas on conserved soil moisture. Although, pre-sowing irrigation may be given if sufficient soil moisture is not there so as to ensure good germination. However, lifesaving irrigation either through check basin or sprinkler method significantly add grain yield. Of the all other methods of irrigation, sprinkler system is more efficient in terms of water use, energy use and is profitable to the farmers'. In soils that cracks, apply irrigation well before crack develops for better control. If there is provision of only one irrigation provide it before soil moisture becomes very critical for crop growth. Critical stages for irrigation water in *rabi* pulses are generally pre-flowering and pod development. However, pre-flowering and pod filling are the critical stages of applying irrigation water in mustard and safflower.

In the recent years water crisis is being faced even in river rich states too. Moreover, water crisis will be more in the future time to come. Micro irrigation systems refer to low pressure irrigation systems that spray, mist, drip or sprinkle water. Micro irrigation includes all methods of frequent water application, in small flow rates, on or below the soil surface. Therefore, applying irrigation through sprinkler (overhead or micro) not only saves water but also boost crop yield and enhancing nutrient use. Additionally, the volume of water is applied directly to the root zone in quantities that approach the consumptive use of the plants. Through good management of the micro irrigation systems the root zone moisture content can be maintained near field capacity throughout the season providing a level of water and air balance close to optimum for plant growth. In addition, nutrient levels which are applied with water through the system can be controlled precisely. During the dry season in humid areas, or in arid climates, micro irrigation can have a significant effect on quality and quantity of yield, pest control and harvest timing.

Conclusion

We can conclude that by adoption of improved agro-techniques viz. selection of improved and appropriate varieties, optimum time of sowing, optimum plant population, modified tillage and resource conservation techniques, balanced nutrient management, integrated and timely weed management, proper irrigation management and also following of improved cropping systems *i.e.* intercropping & mixed cropping etc can boost the productivity of the *rabi* pulses and oilseeds in different agro-ecologies of the country.

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SUSTAINING PULSE PRODUCTIVITY IN INDIA THROUGH TECHNOLOGICAL AND POLICIES INTERVENTIONS

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Breeding effort needs to be directed towards development of climate resilient, short duration (50-55 days), high yielding, yellow vein mosaic virus resistant moong bean varieties for cultivation as cash crop in a short window of rice-wheat cropping system. Similarly, early maturing (100 days) lentil, chickpea and pigeon pea (110-120 days) would increase production and fetch additional income to the farmers.

Pulses have long been considered as the major, economic and 'nutri-rich' source of protein for vast majority of the poor and vegetarian people in India. Content of protein in pulses ranges from 18 per cent to 25 per cent. So, consumption of pulses in appropriate quantities (70g/day; WHO) can keep protein malnutrition at bay. Besides benefitting health of the consumer, the pulses enhances soil fertility and quality by fixing atmospheric nitrogen, adding organic matter, releasing soil-bound phosphorus and recycling valuable nutrients in the soil (Saxena et al 2008). Considering global importance of protein-rich pulses towards maintaining food and nutritional security, and to sensitise people for its enhanced production and consumption, the United Nations General Assembly has declared 2016 as the 'International Year of Pulses'.

Major pulse crops grown in India include red gram or pigeon pea (tur/arhar), chickpea or gram (*chana*), black gram (*urad* bean), green gram (*moong* bean) and lentil (*masur*). A number of other pulses (minor pulses) including rajmash, cowpea, horse gram, moth bean, lathyrus, etc. are also grown across the country. In fact; India is the largest producer and consumer of pulses in the world. The major contributing states towards pulses production in India are Madhya Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, and Andhra Pradesh.

It accounts for 33 per cent of total pulses acreage with a share of 25 per cent and 27 per cent in production and consumption, respectively. In recent time, there has been substantial increase in area and production of pulses in the country. During 2015-16, the area and production under pulses has rose to 23.37 million hectare (mha) and 17.33 million tonnes (mt) from corresponding 23.29 mha and 14.66 mt during 2009-10. However, it fell short in meeting the domestic requirement of pulses (about 22 mt), leading to import from other countries. During 2015-16 alone, 5.8 mt of pulses costing more than ₹ 5,000 crore were imported. The huge gap of demand and supply of pulses often result in high volatility of prices, inflation and black marketing. For attaining self-sufficiency by 2020, and to address the menace of malnutrition through consumption of pulses, the projected need for



pulses will be 26.5mt. However, with the present level of yields, it is highly unlikely that it will be able to meet the demand. Therefore, there is a pressing need to increase production and productivity of pulses in the country.

Being a crop of marginal environments with limited inputs and minimum management, pulses yield always remains at low. However, average yield of a few pulses has seen some increase (about 65 per cent); it has raised up to 728 kg/ha during 2014-15 from 441kg/ha during 1950. However, it needs further increase which can happen only through technological and Government policy interventions.

Constraints to Pulse Production

In India, pulses are primarily grown in marginal land with low fertility, affected acidity or salinity and so on. Further, it is grown under rain-fed with un-assured irrigation leaving fate of the crop in the hands of rain-God. It subjects the crops to forced drought and heat stresses leading yield reduction to the tune of about 50 per cent, particularly in arid and semi-arid zones. Weed is a common menace in the pulse crops. With little or no management, the weed grows heavily competing with the crop for nutrients and sunlight. It eventually culminates in production of poor crop with pitiable yield. Poor management leads to poor growth of the plants making these vulnerable to both biotic and abiotic challenges. The abundance of nitrogen (N) and phosphorus (P) in legumes enhances vulnerability to various insect pests and diseases. Pigeon pea and chick pea are worst affected by insect-pests, pod borers, in particular. Uneven crop field with improper drainage system leads to water logging condition, which affects crop growth and yield. It is more serious in states with heavy downpour, viz., Bihar, UP, Bengal, MP and Jharkhand where water logging leads to poor plant stand and possible occurrence of Phytophthora blight disease in pigeon pea leading to serious loss of the yield. Reduction in yield may also occur due to post harvest losses. Under scenario of climate change the pulse production may be considerably affected by unpredictable weather conditions such as untimely and excess rains, abrupt rise in temperature, etc.

Technological Intervention

Besides other factors, cost-benefit ratio guides area put under cultivation of a crop. For example, with the development of irrigation facilities in

Northern India, area under profit earning crops like wheat, rice, mustard, potato, *rabi*-maize, etc. has spiked up replacing pulse crops. Due to poor profit earnings as against competitive crops, cultivation of chickpea has seen shifted from North towards central and South India. Area under pulse crops in North India has seen decrease by about 20 per cent as against 25 per cent increase in Southern part of the country during last three decades. Possibilities for further increase in chickpea and pigeon pea area do exist in Karnataka, Andhra Pradesh, Maharashtra, and Gujarat through limited replacement of *rabi* sorghum and bringing rice fallows under chickpea cultivation. For that matter, chickpea, pigeon pea varieties having extra early maturity, higher yield, resistance to wilt disease and amenable to mechanical harvesting is needed. A scientific intervention through introduction of chickpea varieties viz. JG 11, KAK 2, JAKI 9218, and Viharin the Southern part of our country, Andhra Pradesh and Telangana in particular, has resulted in 2.4 fold increase in yield (Gaur *et al*, 2012). Appropriate production technologies coupled with mechanisation of fields operation and proper management of pod borers might enhance the yield further.

Expanding Horizon of Pulse Crops

Success story of chickpea in southern India has inspired to think for taking pulses crops to newer or non-traditional areas for its cultivation. Diversity in plant type and maturity duration makes the pulse crops suitable candidate for fitting in different cropping systems. For example, pigeon pea can have four different options for expansion of its area, (i) fitting early or extra early duration varieties in wheat-rice cropping system, (ii) by replacing rice with pigeon pea under irrigated conditions in the states of Punjab, Haryana, and western part of UP, (iii) promoting *rabi* pigeon pea in the states like Orissa, West Bengal, Bihar, Gujarat, and eastern UP, and (iv) by encouraging pigeon pea-soybean intercropping and pigeon pea-cotton, sorghum, pearl millet inter cropping. It was estimated that about one million hectare area (mha) can be increased under pigeon pea cultivation by these intercropping approaches. Further, as pigeon pea could fix about 40-50 kg atmospheric nitrogen to the soil through the process of biological nitrogen fixation and fallen leaf residues, it could improve soil quality and

reduces nitrogen requirement for the succeeding crop. Singh *et al.* (2005) has shown that pigeon pea-wheat system offers more net economic return than rice-wheat system.

Breeding effort needs to be directed towards development of climate resilient, short duration (50-55 days), high yielding, yellow vein mosaic virus resistant *moong* bean varieties for cultivation as cash crop in a short window of rice-wheat cropping system. Similarly, early maturing (100 days) lentil, chickpea and pigeon pea (110-120 days) would increase production and fetch additional income to the farmers. Popularisation of *urad* bean or *moong* bean as summer crop just after the harvest of *rabi* crops under irrigated areas in the Indo-Gangetic plains, and growing after harvest of *kharif* paddy in the states of Orissa, Karnataka, Andhra Pradesh and West Bengal would also increase production. Use of lathyrus as relay crop after *kharif* rice, growing of lentil after rice, and intercropping of pigeon pea with maize, sorghum, sugarcane, etc. have the potential of increasing area and yield of pulse crops.

Hybrids are generally better yielder. So, plant breeders are trying to produce hybrids in all the crops including pulses. Two hybrids *viz.* ICPH 2671 and ICPH 2740 have been released by the International Crop Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad. More efforts are needed to be made for development of hybrid with higher yield and adaptability.

Farmers and the consumers have their own choice of preferences. Therefore, while attempting to develop new varieties/hybrids of crops, preference of the farmers and the consumers are to be taken in to consideration. There is special demand for extra bold seeded Kabuli chickpea, therefore, MNK-1, PKV Kabuli4-1 have got its own market. Similarly, extra-bold seeded lentil (IPL406), green seeded field pea (IPFD1012), etc. have demand in the market.

Integrated Pest and Disease Management (IPDM)

Pulses are infested by numerous insect pests and diseases. The IPDM tends to use multipronged (from biological/mechanical to chemical) approach to reduce the losses due to pest and disease.

Integrated Pest Management technology has potential to reduce the economic losses up to 90 per cent. Use of *trichoderma* is being popularised to control diseases. Crop specific IPDM modules are already there in place. We need to refine and popularise these modules for wider applicability.

Integrated Nutrient Management

Judicious application of required fertilisers is an important factor to cut input cost and maximising the productivity. Farmers traditionally use N, P and somewhat K ignoring micronutrient such as zinc (Zn), sulphur (S), boron (B) and molybdenum (Mo) etc. The deficiencies caused by these micronutrients should urgently be addressed using soil health status and area specific recommendations of different fertilisers. Soil Health Cards being issued to farmers across the country that provides information on fertility status of soil at mega scale is milestone in adequate utilisation of fertilisers.

Popularisation of Bio-fertilisers and Bio-inoculants

Legumes have inherent property to fix atmospheric nitrogen with the help of host specific Rhizobium bacteria. When legume seed is treated with Rhizobium in combination with phosphatic fertilisers may increase the yield by 15-20 per cent over un-inoculated one. So, seed inoculation with Rhizobium culture before sowing is to be popularised.

Adopting Ridge and Furrow System of Planting

Most pulse crops are sensitive to water logging and cause severe losses. Ridge and furrow provide plants an opportunity to escape this abiotic stress these methods and make cultural operation more comfortable

Biotechnological Approaches

About 2.5 mt of pulses worth in crores are lost annually due to insect pest damage. To combat the damage caused by insect pests varieties with multiple resistant are being developed to simultaneously control a number of pests. Transgenic pulses against pod borer are being developed in pigeon pea and chickpea. Terminal heat and drought stress are the major impediments in *rabi* pulses and adversely affect

by forcing maturity thereby reducing grain yield. Biotechnological tools may be helpful in designing the crops to overcome these stresses.

Pulse Seed Systems of India

Seeds of improved varieties have always played a crucial role in increasing the production and productivity in any crop. Despite a long list of varieties (> 500) of improved pulses have been released for cultivation, only dozens of them are popular among the farmers in pulse crops. Resource poor farmers have not yet realised their impact of improved varieties at their fields in most of the states of India. Inadequate demand creation and limited supply makes the accessibility of improved quality seed of pulses difficult to small and marginal farmers. This situation is also accentuated by lack of favourable and adequate policy support and improved infrastructures along with regulatory frameworks and lack of synergy among national seed production organisations and policy making institutions at par with major cereals like rice wheat sugarcane, etc.

The vast gap between the needed quality seeds and its availability in the country is a matter of serious concern to all of us. The seed replacement rate is very low (2-5 per cent), as compare to the required (10 per cent) due to reuse of seed from last harvest by the farmers. Use of contaminated, low seed multiplication rate and frequent high demand for a particular varieties suited to narrow agro-ecologies and needs of consumers are some of the important issues to be addressed immediately. The breeder seeds requirement of chickpea by the year 2025 would be 4,487.2 quintals (qt) followed by 59,838.3 qt of foundation and 7,48,000 qt of certified seeds. Requirement of pigeon pea foundation seeds would be around 49.4 qt breeder seeds, 2,201 qt of and 91,740 qt of certified seeds (Reddy, 2005). Pulse seed sectors do not attract private seed companies because of low profit margin. Informal sectors (or farmers to farmers) contribute more than 95 per cent of lentil seed in India (Materne and Reddy, 2007). The situations of other pulses are very much similar in India. Therefore, proper seed policy is needed for production and distribution of quality seeds to the growers at affordable prices.

Policy Intervention

In order to increase area, production and yield of pulse crops, the policy of the Government

should be supportive and encouraging to the farmers. It should bear components that would motivate and establish confidence in the farmers to take up challenges of experimenting with newer crops and grow in large areas. One of such important issue is minimum support price (MSP) of crops. It gives assurance to the farmers of purchasing its produce at a remunerative price, which in turn encourages the farmers to produce more. Every year, concerned department of the Government declares MSP for every crop including pulses. Often, such MSPs are found at lower than market price. Moreover, unlike paddy and wheat, procurements of the pulses are not found in order, at times there may be no purchase at all. Therefore, the small and marginal farmers cannot gain much from their produce due to their poor bargaining power. So, the MSP should be kept at sufficiently high or competitive level and procurement should be ensured so that poor farmers also get attracted to it and take up pulses production in a big way. The MSPs announced for the major pulses are shown in Table 1.

Table 1. Minimum Support Prices for Pulses (Rs/quintal)

Pulses	2014-15	2015-16	2016-17
Kharif Pulses			
Tur (Arhar)	4350	4625*	5050^
Moong	4600	4850*	5225^
Urad	4350	4625*	5000^
Rabi Pulses			
Gram	3175	3425#	Not available
Lentil (Masur)	3075	3325#	Not available

Note: # Additional bonus Rs, 75 per Quintal, *Includes bonus Rs.200 per Quintal, ^ Includes bonus of Rs.425 per Quintal.

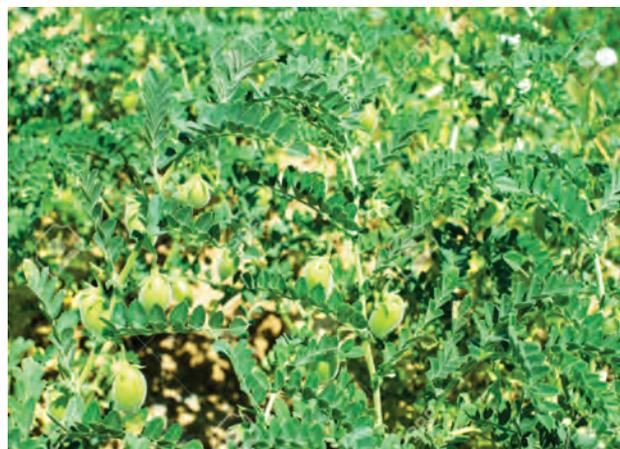
Source: CACP.

Risk is especially associated with cultivation of pulses due to unpredictable weather and biotic and abiotic stresses. There is much greater volatility for pulses across all indicators of yield, production, acreage, retail price and wholesale price, etc. Price of pulses is also dependent on the exim policy of the Government. Therefore, there is a crying need to provide a price premium

for pulses cultivation. An expert committee led by the Chief Economic Advisor, Government of India to review MSP of pulses has recommended enhancement of MSP of *tur* to ₹ 7,000/q for the year as against the current MSP of ₹ 5050 (including ₹ 425 as bonus). Other pulses have also got similar attention in enhanced MSP. They have also given very crucial recommendation regarding creation of new institution as a Public Private Partnership (PPP) to compete with and complement existing institutions for procurements and facilities for storage of stocks of pulses. Such initiatives are expected to leave positive effect in the field of pulses production.

In a study, Dr. Ramesh Chand (Niti Ayog, Government of India) has shown that government provides fertiliser subsidy of ₹6,897 to paddy as against ₹2,878 to pigeon pea (*tur*). Similarly, groundwater subsidy given to paddy and pigeon pea is ₹5,000 and ₹ 1,500, respectively. Adding up all the relative externalities, it was shown that there is a substantial benefit of ₹13,240 per hectare on growing pigeon pea instead of paddy. Further, there is lesser negative external factors *viz.* air quality deterioration by burning of straw and emission of greenhouse gases, etc. from pigeon pea. Therefore, the MSP policy must reward and incentivise the pulses production. One way of achieving this is to allow the MSP for cereals to grow slower than inflation. Secondly, to make *tur* competitive with paddy in Punjab and Haryana, MSP can be increased to about ₹125/kg. The increase in MSPs based on rainfed and irrigated conditions will also improve incentivisation of pulse production in fallow land of eastern states. However, to achieve this, good quality seed of HYVs, better agricultural technology and extension services should be availed to the farmers.

There is an urgent need to make the quality seeds available to the farmers at right time and prices. Village level seed production unit will give great impetus to this. One hundred fifty 'Seed Hubs' are being established by ICAR for production of quality pulse crops seed in coordination with ICAR-IIPR, Kanpur along with State Agricultural Universities (SAUs) and Krishi Vigyan Kendras (KVKs). In strategic support, the production units are also supposed to be established for improving accessibility of quality bio-fertilisers and bio-pesticides through different Government institutions.



Storage insect pest infestation start right from the field which make storage of pulses difficult at room temperature. Improper drying (>8 per cent) worsens the situation. Therefore, properly dried with moisture percentage below 8 per cent should be preferred for storage to avoid losses. Investment is needed for construction of proper seed storage facilities for making quality seed available at large scale; particularly in coastal areas and states those receive high rainfall.

Pradhan Mantri Fasal BimaYojana ensures farmers protection against crop loss. This needs to be popularised among the pulse growing farmers so as to give them assurance about compensation against crop failure. At a very nominal premium (2 per cent of sum insured for all *Kharif*, and 1.5 per cent for all Rabi crops), the farmers can insure their crop and live happily. Proper implementation of this scheme will certainly help the farmers to grow more pulses. Similarly, Pradhan Mantri Krishi Sinchai Yojana can be of great support to the farmers for boosting pulse production and productivity.

Conclusions

Pulses are important for the large masses of our country. To meet the ever increasing demand, there is no alternative but to take up technological approaches supported by policies to increase production of pulses. It will help improving quality of life of the poor and large vegetarian population of our country.

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MANAGEMENT OF FERTILISERS AND IRRIGATION FACILITIES IN PULSES AND OILSEEDS

Sandip Das

India must give thrust on expanding irrigation network and rational use of fertiliser for augmenting output of oilseeds and pulses so that our imports dependence in these two agricultural commodities could be reduced significantly.

India's quest for self-sufficiency in pulses and oilseeds goes back to early 1990s when both the agricultural commodities were incorporated in the technology mission on oilseeds by the government. In 1992, and 1995-1996, oil palm and maize were added to the mission, which was renamed as the Integrated Scheme on Oilseeds, Pulses, Oil palm and Maize (ISOPOM). Subsequently, in 2007, ISOPOM's pulses component was merged with the government's flagship programme National Food Security Mission. However, we still import huge volume of pulses and oilseeds for meeting rising domestic demands resulting in huge outflow of precious foreign exchange.

Pulses: Significant Rise in Import

In the financial year 2015-16, imports of pulses touched a new record of 5.8 million tonnes (mt), against the domestic production of around 16.4 mt. Pulses production peaked in FY14, touching 19.25 mt, but declined subsequently due to deficient monsoon rains received in 2015 and 2016. However our annual pulses consumption has been more than 22 mt thus implies that a large quantity of pulses is imported. The

import bill for pulses also soared from ₹ 3,160 crore during 2001-02 to more than ₹ 12,000 crore in the last fiscal.

Besides being largest producer of pulses in the world, we also consume a large quantity of pulses. We are also the biggest importer in terms volume as well. According to agriculture ministry data, pulses account for around 20 per cent of the area under food grains and contribute around 7-10 per cent of the total food grains production in the country. Though pulses are grown in both *kharif* and *rabi* seasons, the *rabi* pulses contribute more than 60 per cent of the total annual production. The area under pulses has increased from 19 million hectare (mh) in 1950-51 to 25 mh in 2015-16, indicating an increase of around 31 per cent whereas the output of pulses during the same period has doubled.

However, India's output of pulses and oilseeds have been stagnant (SEE TABLE) as majority of our farmers growing these two critical agricultural commodities belong to small and marginal groups having lower marketable surplus and limited holding



capacity. The pulses production is also concentrated in a few states. About of 80 per cent of the production comes from 20 per cent of districts. Mostly these districts are in Rajasthan, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh.

Focus on Irrigation Expansion and Optimum Fertiliser Use

In the absence of proper procurement facilities, often Indian farmers are in many cases forced to resort to distress sale. The pulses are grown mostly in rainfed regions with inadequate irrigation facilities thus impacting the yield. Another key factor impacting the lower yield in pulses and oilseeds are inadequate as well as unscientific use of fertiliser.

An agriculture ministry official said due to inadequate irrigation facilities results in moisture stress which leads to reduction in productivity. “Sub-optimal moisture in the soil at the time of sowing leads to poor germination and plant stand. High emphasis should be given on water conservation so that the pulses received required irrigations. Micro-irrigation or sprinkler irrigation needs to be promoted for pulses,” the official said. The domestic pulses prices having ruling at higher level for last many months. Research by International Food Policy Research Institute (IFPRI) shows that including pulses in Public Distribution System is an expensive policy with only a small impact. “The only meaningful way to make pulses affordable is to increase their production in India,” the report had stated.

After remaining stagnant at 13-14 mt annually for four decades, production of pulses is expected to

Out of pulses and oilseeds (in million tonne)

Year	Pulses	Oilseeds
2006 – 7	14.2	24.2
2007 – 8	14.7	29.7
2008 – 9	14.5	27.7
2009 – 10	14.6	24.8
2010 – 11	18.2	32.4
2011 – 12	17.0	29.7
2012 – 13	18.3	30.9
2013 – 14	19.2	32.7
2014 – 15	17.1	27.5
2015 – 16	16.4	25.3

Source: agriculture ministry, crop year-July-June



reach a record level of around 20 mt this year because larger areas under *kharif* pulses. “We need to build on this momentum to raise production to at least 25 million tonnes by 2020. This is an entirely achievable goal,” an agriculture ministry official said.

Officials in agriculture ministry agree that for the bridging the gap between demand and supply of pulses, the production needs to increase to around 26 mt by 2020. “This is possible with the convergence of potential of technology available, policy support for research and development to create enabling environment for farming community to grow more pulses with adequate amount of farm inputs,” the official said.

Ashok Gulati, former chairman, Commission for Agricultural Costs and Prices (CACP) noted that India’s pulses output would go up significantly only if farmers in Punjab, Haryana and other irrigated regions – who grow paddy, wheat and sugarcane – take up its cultivation. At present, pulses are only grown in largely in marginal lands prone to moisture stress. “Even with drip and improved cropping technologies, we cannot expect dramatic production increases from Vidarbha, Marathwada or northeast Karnataka, especially in the face of repeated monsoon failures,” he said.

Besides another key advantages of growing pulses is because it helps in nitrogen fixation in the soil. This natural process replaces the need to add nitrogen fertilisers in pulse crops, which mean pulse crops use half the energy compared to others. When soil is fertilised with nitrogen in the form of manure, fertiliser, or crop residue, soil micro-organisms convert some of this nitrogen into nitrous oxide, which is a powerful greenhouse gas.



Oilseeds: Import Rising, Domestic Output Stagnant

The demand for edible oils is increasing exponentially in the country. India's vegetable oil imports crossed 14.5 million tonnes (mt) last fiscal. The value of imports was around ₹66,000 crores or around US \$ 10 billion. More than 60 per cent of the edible oil-related imports are of palmolein from mostly Malaysia and Indonesia, with the remaining made up by soybean, sunflower and rapeseed. Ironically until 2007-08, India's edible oil production exceeded its imports.

India's adverse agro-climatic zones are favourable for growing oilseeds crops, which include seven edible oilseeds -- groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower and niger and two non-edible oilseeds -- castor and linseed. Oilseeds cultivation is undertaken across the country in about 27 million hectares mainly on marginal lands, of which 72 per cent areas depend on rains in the absence of any irrigation facilities.

Oilseeds is raised mostly under rainfed or semiarid conditions and important for the livelihood of India's small and marginal farmers. The production of oilseeds has increased from 24.35 million tonnes in 2004-05 to 25.3 million tonnes in 2014-15. The oilseeds yield which was 885 kg per hectare in 2004-05 increased to 1,037 kg per hectare as per the agriculture ministry data.

The highest production and yield of oilseeds were achieved during the year 2013-14 *i.e.*, 32.75 million tonnes and 1,167 kg per hectare per annum,

respectively. The production and acreage of oilseeds has continuously increased from 2011 to 2013-14. However, area, production and yield has been declined during 2014-15 as the production of soybean in major producing states in Madhya Pradesh and Rajasthan has been adversely affected due to late monsoon at the time of sowing, insufficient rain during crop growing phase and untimely rain during pod maturity stage.

The domestic demand for vegetable oils and fats has been rising rapidly at the rate of six per cent per year but domestic output has been increasing at just about two per cent per annum. In India, the average yields of most oilseeds is extremely low compared to other countries of the world. Cultivation of oilseeds in India is in high risk regions where there are uncertain returns on the investments.

Oilseeds cultivation in the country is predominantly dependent on rainfall and this leads to a higher magnitude of instability in production of oilseeds especially in Rajasthan, Madhya Pradesh, Gujarat and other states. Often, the marginal lands are earmarked for cultivation of oilseeds crops. Such inherent disadvantages ensure that a level-playing field is not provided to the oilseeds crops even when these are being compared increasingly with their competing crops in terms of production, productivity and profitability.

In a bid to boost palm tree plantation, the irrigation potential in oilseeds growing areas could be harnessed. According to a scientist with ICAR, an oil palm tree requires from 200 to 300 litres of water per day. "It is necessary to irrigate the plantation under taken and use available water resources judiciously. If irrigation water is limited and land is of undulated terrain, drip irrigation will be helpful to oilseeds crops," the ICAR scientist said.

Many agricultural experts have recommended measures to improve oilseeds production:

- Promote oilseeds cultivation in areas where there is assured irrigation.
- Widen the scope of research, technology diffusion and institutional intervention to re-

energise the oil sector. Also increase public research spending in oilseeds crops for development of biotic and abiotic stress tolerant varieties.

- Develop newer high yielding varieties of groundnut and mustard.
- Provide incentives to private sector participation in processing and value addition in oilseeds crops.
- Ensure availability of inputs such as fertilisers, and pesticides and credit and extension services.
- Implement market reforms and policies, such as contract farming and public-private partnership in production and processing, to ensure a competitive market for oilseeds and edible oil along with adequate protective measures to avoid unfair competition from the international markets.



Economic Survey Advocates Increasing Irrigation and Efficient use of Fertiliser

The Economic Survey - 2015-16 tabled in Parliament earlier this year had stated that the all India percentage distribution of net irrigated area to the total cropped area during 2012-13 was only around 34 per cent. There is regional disparity in irrigated farming, with net irrigated area to total cropped area at more than 50 per cent in the states of Punjab, Tamil Nadu and Uttar Pradesh, while it is less than 50 per cent in the remaining states. "There is scope for increasing the coverage of irrigated area across the country to increase productivity in agriculture," the survey noted.

Along with expansion of irrigation facilities, the economic survey also points out the need to arrest the declining trend in efficient utilization of irrigation potential and also reverse it in the next two three years. The survey has suggested that a larger share of funds available under the Mahatama Gandhi National Rural Employment Guarantee Act and other employment generating schemes need to be deployed for creating and maintenance of community assets including desilting and repair of tanks and other water bodies that are used for irrigation.

Bringing Efficiency in Fertiliser Subsidy

For efficiency use of fertiliser subsidy, the survey had stated that there is a need to rationalise fertiliser subsidy in an input, crop and region neutral format and minimise diversions. The survey noted that soils across the country show deficiency of micro nutrients like boron, zinc, copper and iron in most parts of the country, which limits crop yields and productivity. According to agronomic trails conducted by the Indian Council of Agricultural Research, the micro nutrient deficiency can be overcome if there is expansion of the use of organic fertiliser. Moreover, it is cheaper for small farmers to adopt and use organic composting and manure. This can help improve and retain soil fertility. "With 67 per cent of Indian soil characterized by low organic carbon, there is great scope for enhancing the use of organic fertiliser while growing pulses and oilseeds," an official said.

Need to Incentivise Production

Recently the Chief Economic Advisor Arvind Subramanian in a report on pulse had recommended hike in minimum support prices (MSP) for key pulses besides suggesting creation of an institution through public-private partnership for procurement of lentils from farmers. It also suggested elimination of export ban on pulses and stock limits. A former CACP chairman said, the government must form a high level committee to boost oilseeds production so that the country's dependence on the large imports could be curbed.

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CHALLENGE OF SELF-SUFFICIENCY IN PULSES AND OILSEEDS

Arvind Kumar Singh

On the occasion of Green Revolution's Golden Jubilee while the achievements were hailed, concerns were also expressed on weak points in pulse and oilseeds cultivation. India led in pulse production prior to Green Revolution. Slowly the acreage under pulses shifted to cultivation of cash crops like soybean, sugarcane and cotton. Though the situation has changed somewhat in recent times owing to promotional efforts made but there is a long way to go.

In the wake of Green Revolution India has been able to prove the doomsayers wrong regarding their forecast of an imminent food crisis. But pulse and oilseeds production remains our weak area. Though some progress has been made on both fronts in recent years, much has to be done to achieve self-sufficiency in their production at the level of farmers, agricultural scientists and policy makers. Challenges are almost similar for both crops. We have to spend huge amounts of precious foreign exchange to import pulses and oilseeds.



Ironically India is the largest producer of pulses in the world. At the same time it is also the largest consumer. Worldwide production of pulses is 800 lakh metric tonnes out of which India contributes one fourth. On the other hand India consumes 28 per cent of worldwide production of pulses so there is naturally a demand and supply gap. Fourteen varieties of pulses including *chana*, *arhar*, *khesari*, *khesari* and *masur* are grown in India which is the largest grower of *chana* and *masur* in the world. During recent years, cultivation of *rajma* and soybean have also gained in popularity. Changing food habits have also pushed the consumption of pulses in India.

In a country like India where majority of the population is vegetarian, importance of pulses cannot be overemphasized. But their cultivation is also significant as these crops restore the health of soil. It is why United Nations is observing 2016 as the International Year of Pulses. Awareness is being created among world community regarding use of pulse crops. Indians have traditionally been aware about the importance of pulses which have been integral part of their diet. Protein content in pulses is between 22-24 percent which is 2.3 times higher

when compared with cereals. These also contain sufficient amount of carbohydrates, vitamins, minerals, iron and other nutrients.

Production of pulses in 1951 was 84 lakh tonnes. It rose to 110 lakh tonnes in 1960s and 147 lakh tonnes in 2009-10. During last five years the growth has been relatively better. In 2013-14 the production peaked to 193 lakh tonnes but again fell to 172 lakh tonnes in 2014-15 due to bad weather. Production in 2015-16 is estimated at 180 lakh tonnes but our imports have shot to 45 lakh tonnes. Still there has been an overall growth in the productivity during the last decade. But it has failed to keep pace with the growing demand which is estimated to be 235 lakh tonnes for the current year while the production hovers between 170-180 lakh tonnes. There has been an annual growth in demand of nine lakh tonnes. That is why it is not easy to control consumer prices and our country has to spend precious foreign exchange to import 40 to 45 lakh tonnes of pulses every year.

Green Revolution is an Indian success story. Wheat production has gone up from 110 lakh

tonnes in 1966 to 950 lakh tonnes currently while paddy production has grown to 1,040 lakh tonnes from 210 lakh tonnes during the same period. Today we are exporting several agricultural products. Now, the stress is on Rainbow Revolution. White Revolution, Yellow Revolution and Blue Revolution have also been quite successful but somehow pulses could not become part of any revolution. On the occasion of Green Revolution's Golden Jubilee while the achievements were hailed, concerns were also expressed on weak points in pulse and oilseeds cultivation. India led in pulse production prior to Green Revolution. Slowly the acreage under pulses shifted to cultivation of cash crops like soybean, sugarcane and cotton. Though the situation has changed somewhat in recent times owing to promotional efforts made but there is a long way to go.

Some nutritionists believe that our daily requirement of pulse is 100-110 grams while ICMR (Indian Council of Medical Research) puts it at 53 grams minimum. In American and European countries people get their protein from meat. In 1961 per capita availability of pulses was 69 grams which has come down to 37 grams in 2009. Per capita availability of wheat has gone up to over 180 grams today. Pulses are used in majority of our dishes. *Dal-roti*, *dal-chawal*, *rajma-chawal*, *idli-sambhar*, *chhola-bhatara* all contain a portion of pulses. Pulses are used in making all sorts of *namkins* and *besan* as well which has pushed up their consumption. Still we cannot deny our dependency on pulses for protein.

Madhya Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Rajasthan are major pulse growing states in India. Together they contribute 77 per cent of total production. Gujarat, Chhattisgarh, Bihar, Odisha and Jharkhand are the major contributors of remaining 23 per cent. Crop wise *chana* contributes 41 per cent, *arhar* 15 per cent, *khesari* 10 per cent, *khesari* nine per cent, *lobia* seven per cent, *masur* and *khesari* five per cent each of the total production. *Rajma*, *Kulthi*, *khesari*, *guar* and other pulses are grown in specific areas.

Our pulse productivity per hectare is 700 to 780 kilograms while the world average is 869 kilograms. It is 1,845 kg in America, 1,814 kg in Canada, 3,850 kg in France, 3,462 kg in Britain,



1,089 kg in Australia and 1396 kg in China. Our total demand will shoot up to 390 lakh tonnes by the year 2050. To meet this demand the production must grow at the rate of 2.14 per cent annually. This is a challenging task which demands bringing 40 to 50 lakh hectare fresh land under pulse cultivation and raise productivity simultaneously.

Pulse cultivation is faced with myriad problems. Once pulses were grown in irrigated areas prior to Green Revolution but have now been shifted to rain fed areas which accounts for 84 per cent pulse production. Both organic and inorganic factors ranging from insects, high temperature and lack of irrigation are responsible for low productivity. They make pulse cultivation a risky proposition. Development and acceptance of new breeds is also very limited.

Total acreage under pulse cultivation today is 247 lakh hectare t as against 225 lakh hectare t in 1970-71. The crop area has failed to keep pace with the growing demand. In northern states about 25 lakh hectare t area has shifted to cultivation of other crops. Realising the graveness of situation new steps are being taken. During the 6th meet of BRICS Agriculture and Land Development Ministers on 16th September 2016, it was reiterated that all possible help will be extended to India for increasing production of pulses.

Indian Institute Pulse Research was established at Kanpur in 1993 which has pioneered research in the field. In 2011-12 a programme was launched as part of National Food Security Mission to speed up production of pulses which made some headway. Still new varieties have been slow to develop and

slower to reach the fields from the lab as compared to other crops. Indian agricultural scientists have developed some new varieties of *masur*, *Kabuli chana* and non-toxic *khesari*. *Arhar* is the most popular pulse in India which accounts for 85 per cent of total production and consumption of it worldwide. We have to import it from Myanmar.

Khesari could be another alternative to raise availability. Due to presence of toxins it was banned in several areas for cultivation but development of new varieties can tackle the issue of toxicity. The agricultural ministry has entrusted International Centre for Agriculture Research in Dry Area with the work to develop new variety. Some low cost techniques have also been developed.

Khesari contains 32-34 per cent of the proteins which is higher than any other pulse. It is a great fodder for animals and increases soil fertility to nitrogen fixation. It is good source of antioxidants and reduces the risk of heart diseases and cancer. First *khesari* hybrid Pusa 24 was launched in 1973-74 then Indira Gandhi Agriculture Institute, Raipur launched Prateek in recent years which takes just 110-115 days to mature. Another variety Ratan has been developed by Indian Agricultural Research Institute with yield of 636 kg/hectare. Another variety has been developed by Mahatiwada, Raipur, which takes just 95-100 days and is fully safe. Large scale cultivation can provide a source of cheap protein to the poor as it costs between ₹35-58/kg. Ironically there is no prohibition on cultivation of *Khesari* but there is ban on its sale.

The pulse problem has entered even in our parliament and the government has been forced to initiate several steps. Under National Food Security Mission, the government has earmarked a budget of ₹1,700 crores. For 2016-17 out of which 1,100 crores, are meant for development of pulses. Both long and short term strategies have been made. Support prices of *arhar*, *khesari*, *khesari*, etc. have been increased substantially. About 7.85 lakh mini kits have been distributed to farmers and support from Krishi Vigyan Kendras has also been enlisted. Agriculture ministry have targeted a production of 240 lakh ton for the year 2020-21. A seed hub is also being created to increase availability of quality seeds.

In recent times scientists have succeeded with grading of Chana and Arhar genome. This

has opened the door of new possibilities in development of new high yielding varieties. Crop insurance and buffer stock has been introduced to tide over uncertainties. Prime Minister Narendra Modi has reiterated his determination to attain self-sufficiency in production of pulses and achieve a protein revolution which is indicative of future course.

Oilseeds Production

Like pulses, oilseeds also faces a plethora of challenges. Though India ranks among leading producers of oilseeds in the world which is close to 10 per cent. Majority of oil seed production comes from rain fed areas due to insect infestation and other problems, farmers don't take interest in cultivation of oilseeds. Major oilseeds crops are mustard, ground nut, sesame, sunflower, soybean, flax seeds, castor, etc. Mustard accounts for 28.6 per cent of total oilseeds production. Our total consumption of edible oils is between 180- 190 lakh tonnes annually. Between 50-60 per cent of this requirement is met through imports bulk of which is in the form of palm oil imported from Indonesia and Malaysia.

Madhya Pradesh is the major oil seed producer in India which contributes 22 per cent. Other leading states are Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Uttar Pradesh. Ten top oil seed growing states account for 93 per cent acreage and 96 per cent production. Rest of state's contribution is negligible. Mustard is the major oil seed crop which has a productivity of 1,950 kg per hectare worldwide but in India it is just 1185 kg per hectare. We are regularly spending precious foreign exchange on import of edible oils. While in 2012-13, our net edible oil import was 110.17 lakh tonnes. It jumped to 127.31 lakh tonnes in 2014-15. The government has launched a National Oilseeds & Oil Palm Mission to increase production and tackle the situation. With growing population consumption has also been increasing, therefore a proper strategy and enhanced support price is required.

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POST-HARVEST MANAGEMENT OF OILSEEDS AND PULSES

Naleen Kumar

The extent of losses that takes place at different stages of post-harvest chain differs from grain to grain. Also, the extent of loss may fluctuate considerably depending upon weather conditions, varieties, locations and the processing and storage techniques employed. Reliable data on the true level of post-harvest losses are not available. However, according to rough estimates total post-harvest losses in case of pulses are in the range of 25-50 per cent.

India is self-reliant in many crops, but we still rely on imports for others such as oilseeds and pulses. This is an alarming situation especially because these crops along with vegetables are the primary source of nutrition and protein for a large section of population. This shortage also contributes to inflation at almost regular basis.

The government is well aware of this grim status and that is why 50 per cent of allocation under National Food Security Mission (NFSM) has been set aside for pulses. Also, the Prime Minister has made a personal appeal to the farmers to grow more and more pulses. In the same spirit National Mission on Oilseeds and Oil Palm (NMOOP) is being implemented to increase production and productivity of oilseeds including area expansion of oil palm. In this scenario, it becomes important that farmers also make their contribution by following the best practices for post-harvest processing of oilseeds and pulses, ensuring minimum possible losses to the harvested crops.

Post-harvest System

The harvesting generally does not take place until the grain has reached its optimal maturity. Crops left standing un-harvested start to show diminishing quantitative and qualitative returns through shatter losses and attacks by insects, mould, birds and rodents. It is therefore important to complete harvesting as soon as possible.

After the harvest, it may be necessary to dry the crop before the subsequent threshing operation. The grain, then, must be cleaned and dried, so that it can be stored or undergo further processing. Finally, the grain is sent from the place of storage to market for sale to consumers, to small-scale food processors, to commercial mills or to other agro-food industries. The processed products are then sent to consumers through wholesalers or retailers. The sequence and interactions of these operations constitute a complex system called the post-harvest system.



Since the major oilseeds and pulses are seasonal crops, the produce from one harvest period must be stored for gradual consumption until the next harvest. Also, seed must be held for the next season's crop. In addition, we cannot forget that in a free market the value of any surplus crop tends to rise during the off-season period enabling growers a good profit, provided that it is in a marketable condition. Therefore, the principal aim of any post-harvest system must be to maintain the crop in prime condition as long as possible and value addition to make it more readily usable and economically more remunerative.

Oilseeds and pulses, like almost all other agricultural commodities, before it reaches the consumers, go through a number of post-harvest processing operations to get rid of various types of contaminations or undesirable matters. It is necessary to remove dust and contaminants from harvested crops, which can include insects, vegetable material, such as bits of straw, chaff and weed seeds. These can fill up pore spaces within the crop, inhibiting air movement and adding to any possible spoilage problems. The crop must therefore be clean.

Next, after cleaning, comes drying and storing processes. One of the most critical physiological factors in successful grain storage is the moisture content of the crop. High moisture content leads to storage problems because it encourages fungal and insect problems, respiration and germination. Therefore drying of oilseeds and pulses is an important operation. It refers to removal of moisture from grains and other products to a predetermined level. Drying makes the food grains suitable for safe storage and protects them against attack of insects, moulds and other microorganisms during storage. Sun drying is a traditional method of drying of crops and grains.

Another major factor influencing spoilage in storage is temperature. Grains are biologically active and respire during storage. One of the products of respiration is heat, and reducing the temperature of the crop can help to diminish the rate of respiration, thereby lengthening the storage life by lessening the possibility of germination. Another major temperature effect is on the activity of insect and fungal problems. With lower temperatures, the metabolic rate of insects and fungi decreases and

consequently so does the activity causing spoilage. A damp or warm spot in grain will increase the rate of respiration. In addition to heat, another product of respiration is moisture. The heat and moisture from such a 'hot spot' can spread by convection, encouraging moulds and bacteria, which in turn respire and give off more heat and moisture. Therefore, it becomes a self-generating process. Insect activity also increases with a rise in temperature.

Post-harvest Losses

Seeds of poor quality, inappropriate farming practices and insect infestation in the field can obviously cause loss of produce even before the harvest. From the harvest onward, the grain undergoes a series of operations during which quantitative and qualitative losses may occur, known collectively as post-harvest losses. In economic terms, sum of the losses in quantity and quality of the products inevitably leads to loss of money. Some of these losses result from poor management of post-harvest systems.

The following table indicates the type of losses that take place at various stages of post-harvest system:

Stage of Operation – Type of Losses

Late harvest	:	Shattering losses, losses due to attack of birds and other pests
Insufficient drying of grain	:	Losses due to development of moulds and insects
Improper threshing	:	Broken grains and threat of insect development at later stage
Poor storage	:	Losses caused by combined action of insects, moulds, rodents and other pests
Improper milling	:	Broken and powdering loss
Transport	:	Quantitative loss
Defective packaging	:	Quantitative and qualitative loss

The extent of losses that takes place at different stages of post-harvest chain differs from grain to grain. Also, the extent of loss may fluctuate

considerably depending upon weather conditions, varieties, locations and the processing and storage techniques employed. Reliable data on the true level of post-harvest losses are not available. However, according to rough estimates total post-harvest losses in case of pulses are in the range of 25-50 per cent.

Estimated post-harvest losses of pulses –

Stages	–	Losses (%)
Harvesting	–	1.0 - 3.0
Handling	–	1.0 - 7.0
Threshing	–	0.5 - 5.0
Drying	–	1.0 - 5.0
Transport	–	0.5
Primary Processing	–	1.0
Storage	–	5.0 - 10.0
Milling	–	15.0 - 20.0
Total	–	25.0 - 50.0

The quality of pulses can be ascertained on the general principle according to which grains must be 'wholesome, sound, odorless and of market quality'. The criteria of quality vary widely and involve the exterior aspect, such as, shape, size, smell and taste. A clean wholesome product is of primary importance in marketing.

Cleaning, Drying and Storing Oilseeds

Cleaning and storing the oilseeds correctly following harvest will preserve the quality of the seed and also maintain that quality through to the finished oil.

Reasons for Cleaning Oilseeds

- Weed seeds present at harvest may interfere with the extraction of oil in the press
- Weed seeds may add unwanted taste or chemicals to the pressed oil
- Dirty seed will wear components more quickly than clean seed
- Stones or other objects picked up at harvest or during handling will damage pressing equipment

Oilseeds should be cleaned either before or following storage and before reaching the mill. If a large quantity of foreign material (weed seeds, seed pods, chaff) is present, seed should be cleaned



before storage as the trash contained in the stored pile may be a starting point for molds and heating.

Most oilseeds harvested will need to be dried to some extent for both storage and pressing. Even when moisture content of the seed is acceptable for storage, most seed do not press well in the mill unless their moisture content is about 7 – 9 %. Often this drying is done before storage so handling of the seed is minimized. When dried before storage, seed may be moved directly from the storage bin, through a cleaning process, into the oilseeds press.

Storing oilseeds is more difficult than storing pulses or cereal grains as they are more susceptible to quality deterioration and have limited insect control options. The decision to store oilseeds requires a planned approach, careful management and a suitable storage system.

After seed has been dried to the proper moisture content for storage, they continue to respire and respond to temperature and moisture conditions in the storage container. Oilseeds that will be stored need to be kept at moisture content that does not encourage heating within the seed pile or the growth of molds, bacteria or fungi. Growth of mold or bacteria may make the oil pressed from seed unfit for human consumption. If the seed is to be sold, contaminated seed will have a lower economic value than good seed. Problems with moisture occur when outside temperatures are dropping in the winter, not as temperatures increase in the summer.

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PULSE AND OILSEEDS PRODUCTION ON ARID LAND

Ratnajyoti Dutta

India's coordinated research development programme of three and a half decades for developing oilseeds and pulses varieties has realised that any productivity enhancement scheme needs to focus on arid areas of states like Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh and Karnataka. The research programme has achieved many milestones in developing high yielding seed varieties in the irrigated areas.

India is self-sufficient in grain production but the two natural sources of protein are still short in supply. The country has achieved self sufficiency in grain production through the Green Revolution of the sixties. The first revolution has catapulted the country into the world's second biggest producer of rice and wheat and also a leading producer of pulses and oilseeds crops like soybean, groundnut and sunflower. But a contrast exists, as the country happens to be the world's leading importer of pulses while shortage in oilseeds production makes the county the world's top importer of edible oils. Demands for pulses and oilseeds exceed supplies due to increasing population and higher economic growth.

Realising the huge challenge to feed the growing population in future, the government has been focusing on raising agricultural production for food crops in non-traditional areas. This approach includes raising farm productivity in the Eastern Region. Some farm scientists are terming this approach as the Second Green Revolution that aims

at ensuring substantial increase in food production, to eliminate poverty and hunger from our society.

The drive to ensure higher production includes a sustained focus on achieving higher productivity for pulses and oilseeds so that dependence on overseas purchases decline progressively in the near future. To promote higher degree of self-sufficiency in these two crop varieties, the government has been running focused programmes to raise productivity during the last couple of years. The National Food Security Mission (NFSM) has been aiming at higher productivity in pulses since 2012, while the National Mission on Oilseeds and Oil Palm (NMOOP) targets raising self-sufficiency in production of oilseeds including oil palm.

The NFSM is under implementation for increasing overall food grain production by 25 million tonnes including 4 million tonnes of pulses. Under the programme, the pulses component has been extended to 622 districts of country's 27 states including the North-Eastern states. The priority can



be understood from the fact that nearly half of the mission allocation is earmarked for pulses.

The NMOOP is under operation since 2014-15 in 27 states for raising productivity and production of oilseeds including area expansion of oil palm.

Both these missions include strategies to raise production and productivity levels in rain-fed areas, particularly the arid belts where irrigation facilities are inadequate. Financial aid is extended to organise cluster demonstration and Front Line Demonstration (FLD) of improved technologies, supply of quality seeds including seeds mini-kits of new varieties, production inputs like soil ameliorants, micro nutrients, bio-fertilisers, plant protection chemicals including bio-agents, farm machineries and water saving devices.

An overview of India's demand-supply scenario reflects an average annual gap of 4 million tonnes of pulses for the last three years as demand of 22 million is higher than 18 million tonnes of domestic supplies.

The supply gap in various pulses varieties such as *tur*, *gram*, *urad*, *moong* put pressure on the food inflation as these varieties fall under the category of essential items for mass consumption. The government has allowed imports of *tur* and other pulses from Mozambique for five years until 2020-21 to douse off the sentiment of supply shortage in domestic markets. Private traders buy pulses time to time from Myanmar, Australia, the United States, Canada and Russia. A similar reflection of supply falling short of demand is visible for oilseeds production which is averaging 28.5 million tonnes for the last three years.

The insufficient oilseeds production makes India the world's top cooking oil buyer with 11-12 million tonnes annual imports, making for the supply gap of 21 million tonnes of consumption in a year. These imports make edible oil the third biggest item in the country's imports basket after crude oil and gold.

Pulses and oilseeds are predominantly grown in rain-fed condition where the scope of irrigation facilities is limited. Even if water is available, the supply is prioritised for major food crops such as

wheat and maize or cereals as these commodities get precedence for household consumption and being fodder for animals.

"Production of pulses and oilseeds can definitely go up when we enhance productivity by adopting a multipronged research approach with cutting edge technologies," said J S Sandhu, Deputy Director General (Crop Sciences), Indian Council of Agricultural Research (ICAR). Production of pulses and oilseeds can be enhanced by raising productivity by putting thrust on the use of hybrid seeds, wider application of technologies like phytotron and doubled haploid.

India's coordinated research development programme of three and a half decades for developing oilseeds and pulses varieties has realised that any productivity enhancement scheme needs to focus on arid areas of states like Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh and Karnataka. The research programme has achieved many milestones in developing high yielding seed varieties in the irrigated areas. The general wisdom in the country's scientific fraternity is that any perceptible development in productivity for pulses and oilseeds has to come from arid regions through application of cutting edge technologies in developing drought resistant seed varieties.

Pulses Production

Year	Estimated production	Total availability/consumption	Shortfall/import
Pulses			
2012-13	18.34	22.18	3.84
2013-14	19.25	22.91	3.66
2014-15	17.15	21.79	4.64

Source: Agriculture Ministry, GoI (In Million Tones)

Edible Oil

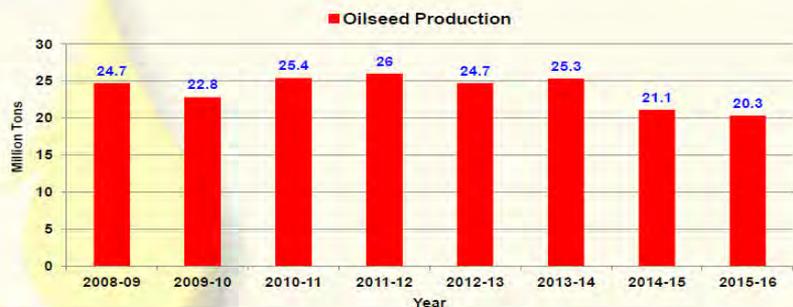
Year	Domestic availability	Export & Industrial use	Total availability/consumption	Shortfall/import
2012-13	10.06	00.84	19.82	10.61
2013-14	10.90	00.71	21.17	10.98
2014-15	9.80	00.59	23.06	13.85

Source: Agriculture Ministry, GoI (In Million Tones)



Oilseeds Production (Trade Estimate)

Oilseeds production is stagnant and hovering between 20 to 25 million tons.



In last two years, situation has worsen due to failure of monsoon, resulted in to lower production.

Application of modern technologies for dry land farming will make the developed seed varieties suitable to withstand any aberration in climatic condition, marked by frequent wide rainfall variations during the monsoon. India's agriculture is heavily dependent on the annual monsoon rains that occur during June-September summer season, coinciding with *kharif*. After the monsoon rains withdraw from the Northwest Region- mostly arid belts, from September, winter crops like mustard and various pulses varieties are sown from October.

A late withdrawal of the monsoon in September is considered beneficial to *rabi* crops. If varieties can be developed that could withstand any moisture stress due to climatic aberrations, then perceptible increase can take place for pulses and oilseeds production.

In any year when monsoon fails, supply shortfall in pulses and oilseeds widens, resulting in higher degree of imports and food inflation, giving jittery to policymakers. India's scientific community holds that the research level in developing technology driven seed varieties for arid land prevalent in India is at par with the level of research worldwide. In the arena of global research on developing new pulses and oilseeds varieties for arid region, no major breakthrough has been achieved so far.

Experts advocate adopting the strategy of cross learning to spread the knowledge of scientific research gained in rice and wheat to arid zone farming for pulses and oilseeds. Genomic information about

the development of rice and wheat varieties needs to be used in dormant varieties of pulses and oilseeds for developing new varieties for the arid condition.

They hold application of cyst genetic technique to identify rice and wheat varieties for arid condition, and then use the identified genes to develop new varieties in pulses and oilseeds for such a condition. So far, nothing concrete has happened in this latest field of study.

Institutional farm research is now focused on, to understand the nuances of this technique.

They favour tracing out genes from wild species of pulses and oilseeds varieties that are left behind in the process of evolution to develop new varieties along with available varieties at farmers' fields that can withstand climatic variation.

Some experts advocate use of hybrid technology to raise the productivity of pulses and oilseeds varieties. The application of hybrid technology in parent varieties can raise existing productivity levels by 20-25 per cent. Wider application of the government programmes like Soil Health Card scheme, Pradhan Mantri Krishi Sinchai Yojana (micro irrigation) can cut input costs in arid region.

In BRICS Agriculture Ministers' Meet in September, Agriculture and Farmers' Welfare Minister Radha Mohan Singh highlighted India's commitment to reduce input cost through the initiated government sponsored schemes.

A multi-prone strategy involving genomics, cross learning experience, phytotron, doubled haploid, hybrid technology along with soil health improvement programme and a life saving irrigation shot can ensure at least one and half times increase in the current level of productivity.

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TREASURE OF NUTRITION: PULSES AND OILSEEDS

Nimish Kapoor

Pulses and oilseeds not only add taste to our traditional dishes but also bring many health benefits if used properly. Pulses with high fiber and low fat content are not only a good source of protein but also contain carbohydrates, vitamins, lysine, phosphorus, calcium, iron and other trace minerals. While non-vegetarians depend on meat, fish and poultry for their supply of protein and nutrients, vegetarians rely on pulses to fulfill their requirement of nutrients.

Pulses and oilseeds have traditionally been an integral part of Indian diet. Dishes like *rice-dal*, *sambhar-dosa*, *dal makkhani*, *dal-bati*, *chhola-bhatura*, *dhokla*, *namkins* of several types and many more are all based on pulses and have been recognized internationally as authentic Indian dishes. Pulses and oilseeds not only add taste to our traditional dishes but also bring many health benefits if used properly. Pulses with high fiber and low fat content are not only a good source of protein but also contain carbohydrates, vitamins, lysine, phosphorus, calcium, iron and other trace minerals. While non-vegetarians depend on meat, fish and poultry for their supply of protein and nutrients, vegetarians rely on pulses to fulfill their requirement of nutrients. Amino acids present in pulses yield high quality protein in good measure. Chana (Bengal gram), Arhar or Tur (pigeon pea), Urad (black gram), Moong (green gram), Lobia (cluster beans) and Rajma (kidney beans) are major pulse crops sown in India while Til (sesame), Moongfali (peanuts), Soorajmukhi (sunflower), Arandi (castor), Alsi (flaxseeds), Sarson (mustard) and Soyabean are major oilseeds crops cultivated.

Pulses have a place of pride in vegetarian diet as they contain 22 to 26 percent protein which is unmatched in other vegetarian eatables. A healthy adult needs 50 to 56 grams of protein everyday which strengthens muscles, repairs cells and tissues. It is found in all cells, tissues, muscles and organs of our body. Protein is made of amino acids which are the building blocks of our bodies. As the amino acids cannot be stored in our bodies we need a protein rich diet on daily basis for good health.

Due to high fiber content physicians believe that pulses are good for heart. In addition they contain high levels of magnesium and folate which help in blood circulation and absorption of oxygen and nutrients. Soluble fibers found in pulses help in bringing down cholesterol levels which in turn reduces the possibility of heart diseases. These soluble fibers also regulate digestion and stabilize blood sugar levels. Fibers relieve constipation as well. Iron found in pulses helps fight anemia. Protein found in pulses also boosts our immune system. In addition to the benefits they bring to human body their plants help in nitrogen fixation in the soil and thus increase its fertility.

Full of Protein and Nutrition

Arhar or Tur, the commonly consumed pulse in India has been cultivated in our country for almost three thousand years. It provides nutrients such as protein, carbohydrates, iron, folic acid, calcium, magnesium, potassium and B vitamins to our body. Cholesterol free Arhar dal is a major source of protein and fiber in Indian diet. The folic acid found in Arhar





dal is beneficial for the health of pregnant women. Researchers have proved folic acid reduces the risk of brain and spine diseases. It is also a good source of carbohydrates which provides energy to our body as these are converted into glucose after digestion and energize our body, brain and nervous system. Fibers found in Arhar prevent constipation, heart and cardiovascular diseases, stroke, cancer and type 2 diabetes.

Moong dal is considered the most nutrient rich pulse. A good source of protein it is also loaded with fibers, antioxidants and phytonutrients. It was regarded for its medicinal properties in India as early as 1500 BC. It increases the immune system of the body and contains vitamins A,B,C,E along with potassium, magnesium, phosphorus, iron and calcium in good quantity. Dieticians recommend Moong dal because of its low calorie and sodium content. It is the most easily digestible pulse which lowers bad cholesterol as well. Pregnant women are also advised to consume it.

Sprouted Moong contains iron, potassium folate and vitamin C and is a good source of protein. The enzymes generated in the process of germination help the body in digestion of protein. With low glycemic index it is an ideal diet for diabetics. 28 grams of sprouts contain 7 grams of protein which is equivalent to one boiled egg. It also helps in expelling toxins from the body.

Like Moong, Urad is also consumed as *sabut*, *dhuli* and *chhilka*. Ayurveda recommends this pulse for its nutritional value and strength giving properties which should be consumed after a *tadka* with *desi ghee* and *hing*. It contains starch, iron, fat and

phosphoric acid. A good source of carbohydrates, vitamins, and calcium it has a very high iron content which is several times greater than red meat and increases bone marrow. Black Urad considered heart friendly as it reduces cholesterol and regulates blood circulation. People suffering from gout, asthma, piles and paralysis should avoid it.

Chana whether black or Kabuli is considered a high value diet. It contains sufficient amounts of carbohydrates, protein, fat, calcium, magnesium, iron and vitamins A, C, B6, B12, D and fibers. It regulates digestion and bowels movement and is hailed as a brain tonic. Chapatis made by adding gram flour are considered a healthy diet for diabetics. It relieves constipation.

Masoor, whether *sabut*, *dhuli* or *chhilka* is rich in protein, carbohydrates, calcium, phosphorus, iron, sodium, potassium, magnesium, iodine, aluminum, copper, zinc and vitamin D. It increases blood, removes weakness and improves digestion.

Lobia is a great diet for growing kids. In addition to being a good source of protein, potassium, magnesium and copper, it contains the highest amount of fiber. It also has vitamin A, B12, D and calcium. It lowers bad cholesterol and improves digestion. The black part on a Lobia seed is a potent antioxidant. It is a good diet for weight management, diabetes and even cancer.

Rajma-chawal is a favourite dish of many in this country. High content of iron in Rajma provides strength and regulates circulation of oxygen in the body. Folate found in Rajma enhances the capacity of brain while magnesium helps alleviate symptoms of migraine. Rajma also contains vitamin K which is a known antioxidant. It strengthens nervous system and brain and also fights cancer. Molybdenum found in it expels toxins from the body.

Oilseeds

Oilseeds are the source of all vegetable oils. India is the third largest grower of oilseeds in the world. These are of two types- one with small seeds such as flax, mustard and sesame and the other with large seeds such as peanuts, sunflower and soyabean.

Sesame or Til is considered to be the oldest oilseeds in the world which was first cultivated about 5000 years ago. Two types of til are grown in

India- white and black. The word til finds mention in Sanskrit scriptures. Atharvaveda mentions *tarpan* by til and paddy. Ayurveda recommends til as a remedy for mental weakness and tension. Til oil as well as seeds are extensively used both internally and externally. It is a good hair tonic that relieves symptoms of constipation and piles as well.

Soyabean is also known as golden bean because the variety of amino acids found in soyabean is not found elsewhere in any vegetable product. As these amino acids are only available in meat, soyabean is also considered 'non-vegetarian diet of vegetarians'. Even though soyabean is a legume and hence closer to pulses family, the oil found in it in abundant quantity qualifies it as an oilseeds. Dieticians are of the view that consuming 50 grams of soyabean per day brings down cholesterol by 3 per cent. Researchers believe that it's cholesterol lowering properties are akin to medicines. It contains 20 per cent oil and 40 per cent protein which is very rich in lysine. In addition it contains vital minerals and vitamins.

Mustard oil is being used in India for centuries as a trusted cooking medium and massage oil for body parts. Its oil has analgesic and anti-inflammatory properties which prevents skin diseases as well. Green leaves of mustard are consumed as vegetable and raw seeds are used in spices. Oilcakes are a nutritious meal for the cattle. The vitamins found in mustard oil boost body's metabolism. Glucosinolate present in mustard oil inhibits formation of cancerous tumors in the body.

Groundnut/Peanut or moongfali is a major oilseeds crop which is a cheap source of protein as well. Its protein content is higher than meat, eggs and fruits by 1.3, 2.5 and 8 times respectively. 100 grams of peanuts contain as much protein as found in 1 liter of milk while 250 grams of roasted peanuts contain more vitamins and minerals than meat in the same quantity. Groundnut oil has a very balanced supply of fatty acids which controls weight and is useful in lowering cholesterol and prevention of heart diseases and cancer besides aiding digestion. It contains sufficient quantity of vitamin E and is recommended for diabetics for maintenance of insulin levels.

Sunflower or soorajmukhi seeds yield high quality edible oil while the defatted oilcake is used as chicken feed. The oil is used as bio diesel as well.



Vitamin C found in sunflower oil has heart friendly properties vitamin E lowers cholesterol and prevents blockage. Rich in both mono and poly saturated fats it is a healthy cooking medium. Magnesium found in it strengthens the bones.

Flaxseed or alsii is temperate crop. Omega 3 fatty acid found in it is useful in reducing inflammation and regulating heartbeats. It also prevents veins from hardening. Some studies have found it useful in cancers of breast, colon and prostate and also in regulating blood sugar levels but any overdose should be avoided.

Castor or Arandi seed yields about 40 to 50 percent oil which is a type of triglyceride. It is not used as a cooking medium but the oil has medicinal and industrial usage.

While in their pure form pulses and oilseeds are vital for our health, their adulteration is a major cause of concern and we need to be aware of it. Metanil Yellow is a prohibited color widely used for coloring pulses in India which is very harmful for our nervous system. A few drops of hydrochloric acid will turn the colored pulse pink. Similarly Arhar dal is mixed with harmful Khesari. Mustard oil is adulterated with palm oil which can be checked by keeping it in fridge as it has a high freezing point.

Health benefits of edible oils mentioned above are based on latest research and Ayurvedaic principles. It is advisable to contact your physician before using them for therapeutic purposes or replacement of medicines.

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SWACHHTA PAKHWADA UPDATE



The Ministry of Drinking Water and Sanitation (MDWS) observed its second Swachhta Pakhwada from October 1st-15th, 2016, demonstrating that the government sector is leading by example to clean up the country and promote hygiene and sanitation among its employees. As part of the Swachhta Pakhwada, MDWS launched a nationwide audio-visual campaign featuring Swachh Bharat Mission brand Ambassador Amitabh Bachchan. The versatile actor was featured in 3 creatives that will be a part of the radio/television campaign to promote behaviour change by stressing the importance of making and using toilets.

Among the many activities carried out by MDWS in the Ministry premises, was a massive cleanliness drive on October 7th at various places in Delhi. The activity was led by the Secretary, MDWS with all senior officers joining in. The Ministry has also developed a Village Swachhta Index by which Gram Panchayats (GP) carry out a self-rating exercise based on various cleanliness parameters. The MDWS has issued instructions to all States to kick start the activity at the earliest. Further, IMIS has been enabled to capture information and mobile application for citizen rating has been made available.

The Village Swachhta Index was developed based on a large scale study during which around 70,000 households were surveyed to understand their perception of cleanliness. Villages will arrive at a Swachhta score based on the percentage of households having access to safe toilets and using them in their village; litter lying around the households and in public places; and stagnant waste water around the households.

In addition, MDWS has put in place guidelines, templates and forms for organizing Gram Sabha meetings, and collecting data to help them arrive at the Village Swachhta Index. Citizens are also encouraged to download the SwachhApp to view status of Swachhta and rate cleanliness in any village of India. On 6th October a poetry and poster competition was held for the staff of MDWS and on 14th October, a competition was organized to select the cleanest section office in the MDWS.

During the same fortnight, the Ministry of Panchayati Raj held capacity building programmes for elected representatives and functionaries of Panchayati Raj Institutions for achieving total sanitation. On the other hand, the Ministry of Rural Development under the MGNREGA programme has adopted 50 villages across 8 States for implementing solid and liquid waste management activities, replicating the Tamil Nadu model.

This time, Swachhta Pakhwada was implemented by MDWS together with the [Ministries of Rural Development and Panchayati Raj](#). MDWS plays a convening and coordinating role for the drive around the year. It has a responsibility to make sure that Pakhwada activities are innovative, far reaching and sustainable. That said, the success of Swachhta Pakhwada would depend on involvement of all people at every level of governance; so that all citizens see the government in action and be inspired to do the same. It is hoped that these activities will be embraced by the government and private sector so that sanitation will remain high on the nation's priority on a regular basis, contributing to its progress and well being of its people.

Ministry of Culture

All protected historical monuments of Archaeological Survey of India (ASI) have been declared 'Polythene Free Zones'. Advisory has been issued to all State Governments/UTs to support ASI in keeping monuments polythene free up to 300 meters from the protected boundaries of the monuments. This information was given by Dr Mahesh Sharma, Minister of State (I/C) for Culture and Tourism while briefing the media persons on the various initiatives of Ministry of Culture and Ministry of Tourism during Swachhata Pakhwada 16th – 30th September, 2016. He was addressing a joint press conference on "Swachh Bharat Mission" along with Shri Narendra Singh Tomar, Minister for Rural Development and Drinking Water & Sanitation recently. He informed that Ministry of Culture has sanctioned Rs 350 crores to provide facilities like protected boundaries, toilets and disabled friendly access in all ASI Protected Monuments. Work has been awarded to PSUs like WAPCOS and TCIL. They have been directed to complete the work in the current financial year 2016-17.

STUDENTS ARE OUR REAL CHAMPIONS: SARVESHWAR BHURE

Swachh Bharat Mission-Gramin (SBM-G) is about behaviour change, not construction of toilets. If there is behaviour change, construction will follow automatically, said Kabirdham Zila Panchayat in Chhattisgarh CEO Sarveshwar Bhure.



Having worked with the mission for about two years, Bhure and his team

have strived to take forward the mission through social mobilisation and collective effort. In this regard, they have identified with the community, engaging with them as much as possible before conducting door to door surveys.

Currently, they have a volunteer base of over 200 enthusiastic individuals. Further, they have involved people from all segments of society – religious leaders, caste leaders and other interest groups, seeking their support in talking about swachhta and sanitation issues to the community at large.

“This has certainly helped and the results are amazing,” Bhure confirmed during the Collectors’ conference held recently at the national capital that witnessed the presence of Swachh Bharat Mission ambassador and cricketing legend Sachin Tendulkar.

However, he pointed out that students have been the real champions. On July 15, as many as 1.38 lakh students from 1,738 schools in the district participated in a letter writing exercise in which they appealed to their parents to build a toilet in their home. It was a humble attempt to protect the dignity and pride of vulnerable girls.

The results were far greater than anticipated, with 48,000 families committing to build toilets. Further, during a three-month period, 96 Panchayats from one block were made open defecation free (ODF). Bhure also informed that sanitation coverage in the district has increased by 25 per cent.

As far as festivals are concerned, the SBM leaders have linked every celebratory occasion with Swachhta – be it Holi, Rakhi or Diwali, in an effort to take forward the sanitation message. The administration has also actively engaged self-help groups who help with awareness building, motivation and on occasions even masonry work.

“We have more than 100 women who are skilled in construction of toilets,” Bhure says. At the rate at which activities are being carried out, Kabirdham is set to be made ODF by December 2016. “Work is in progress in every village; so most things are in place,” he added.



GOODS AND SERVICES TAX (GST)

Single tax regime to be adopted by Centre, 29 States and 2 Union Territories.



GST

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Benefits of GST

- Single tax to replace multiple levies of Centre and States.
- Mitigation of cascading of taxes.
- Uniformity of tax rates and structures.
- Easy and reduced cost of compliance for taxpayers.
- Seamless transfer of input tax credit.
- Improved competitiveness.
- Greater transparency in tax administration.

Single Tax to replace multiple levies, right from manufacturer/supplier to consumer.

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