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 inter-cropping 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 towards increase in 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 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 beestablished 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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