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2016 : International Year of Pulses Raising Pulses Output and Arresting Price-Rise in India

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ABSTRACT

It is a blessing in a disguise that the UN General Assembly has declared the year 2016 as the International Year of Pulses at a time when Indian consumers have to pay extremely high prices for pulses. Prime Minister of India during his recent visit to Mozambique desired to promote increased cultivation of pulses in Mozambique & supply to India through bilateral agreements. There are reports of similar efforts with Myanmar. India instead this kind of arrangement should seize the opportunity of this International Year of Pulses to harness full potential for substantially enhancing the productivity per unit of resources & output of pulses in India and farmer's income therefrom. Already Government of India has two reports on pulses, viz. Report of Expert Groups [2012] & Towards Pulses Self-sufficiency in India [2016 by National Academy of Agricultural Science. On September 16, 2016 Dr Arvind Subramanian the Chief Economic Advisor, Ministry of Finance submitted the Report on Incentivising Pulses Production Through Minimum Support Prices & Related Policies to the Government of India. The report aptly says" Enhancing the domestic productivity & production of pulses rapidly & sustainably is the only reliable way of minimizing volatility in pulses market & safeguarding the interest of farmers & consumers". The report deals with in details on important issues viz. MSP & Procurement, Other Price Management Policies, Institutions for Procurement-Stocking-Disposal and Minimizing Adverse Impact. It is in this context, this article briefly highlights the Government's initiatives to raise pulse productivity & output, current status of area under pulse, its productivity & production, imports, impact of technology already developed and aspects that need focused attention, among others.

Keywords: MSP, PDS, MHA, CAGR, HYV, NARS

I. INTRODUCTION

Pulses account for 20% of area under food grains and contribute 7% to 10% of total food output. Rabi pulses contribute more than 60% of total pulses output. Six states (Madhya Pradesh, Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka and Rajasthan) contribute about 80% of total pulse production and area. Low priority to boost pulses productivity & output through various ways & means have resulted into [i] production significantly declined by 13.11% to 17.2 million tons[MT] in 2014-15 from 19.8 MT in 2013-14, a five year low [ii] imports rose by 24,32% from 3.7 MT in 2013-14 to 4.6 MT in 2014-15 & further by 26.08% to 5.8 MT in 2015-16.

Figure 1. India is the of pulses in the world

Despite Government's initiatives since 1965 to implement nation-wide programs to step up pulses productivity, production and profitability, [All India coordinated pulses research Project (1965), intensive

pulses development project (1969), central sector national pulses development project (1985) , integrated scheme of oilseeds, pulses and maize (2002) and pulses production program in 6000 villages under the national food security mission (2007)]India has been importing annually pulses on an average 3.44 million tons(MT) amounting to Rs80.67 billion from 2007-08 to 2015-16. And yet India has been witnessing unprecedented price-rise of pulses which can be controlled by capitalizing opportunities when ample scope is available to raise the output and managing the stock and distribution system by formulating and implementing strategic action plan from the year 2016 being the international year of pulses.

International Year of Pulses

When the United Nations' General Assembly has declared 2016 as the international year of pulses, India needs to review and evaluate the strength and weaknesses of all these programs implemented from 1965 to 2014-15 and redesign policy and programs to seize new opportunities and face emerging challenges based on past 50 years' field experiences.

Details embodied in this paper, *inter alia*, reveal year to year significant variance in the area under pulses and per hectare yield resulting in lower output and substantial annual import and suggest that during the year 2016 India must initiate strategic actions for[i]) significantly improving India's technical capabilities to forecast nearer to correct season-wise estimates of area under pulses and output of pulses through investing in and better use of state-of-the-art technology and refining methods of estimation [ii] launching result-oriented campaign to transfer already proven and demonstrated technologies at farmers' fields accompanied by efficient system of linking institutional credit with on time availability of quality seeds and marketing services that can guarantee expected yield [iii] preparing road-map to achieve anticipated output of 35 MT by 2030 and 50 MT by 2050 as envisioned by the Indian Institute of Pulses Research [iv] building a need-based buffer stock with accountability for proper management incurring no wastages at all [v] keeping close watch on the crop growth in 30 pulse-exporting countries through effective coordination with the FAO and our embassies that can help India negotiate favourable terms for timely import as and when imminent [vi] putting in place efficient system to make pulses easily available in the open market throughout the year through rigorous enforcement of essential commodities Act and warranted distribution through public distribution system [PDS] or direct benefit transfer scheme crediting to beneficiary's bank account.

Need to Increase Pulses Consumption and Output

The consumption of pulses needs to be increased as an integral component of country's nutritional food security as they are the major sources of proteins for vegetarians. Pulses contain 22%-24% protein, almost twice the amount of protein available in wheat and thrice that of rice. Pulses supplement the staple cereals in the diets with health-sustaining ingredients viz. proteins, essential amino acids, vitamins and minerals. Pulses are nutritious and are known to reduce impact of several non-communicable diseases such as colon cancer and cardiovascular diseases and avoiding calorie catastrophe by balancing intake of carbohydrates and protein.

Farmers must be incentivised to increase area under pulses including under irrigation since it has unique features viz.[i] pulses can be grown on a wide range of soil and climatic conditions and in different farming systems, such as crop-rotation, mixed and inter-cropping system. Pulses being legumes help fixing atmospheric nitrogen into soil and release soil-bound phosphorus. They add organic matter into the soil in the form of leaf mould. Some pulses are suitable as green-manure crops. They help check the soil-erosion. All these contribute to maintain soil productivity and fertility level[ii] most pulse crops are of short duration which facilitate growing second crop on the same land in a year [iii] pulses as industrial crops provide raw material to various industries, such as pulse industry, Roasted grain industry, etc. [iv] they serve as rich source of nutritious fodder for cattle.

More importantly, pulses have low carbon emission and water needs which make them ideally suited in country's farming system. As per recent estimates, one Kg production of pulses requires 359 litres of water as against more than 1000 for soybean/groundnut and five times higher than pulses for production of one kg meat. Further, one kg of legumes emits 0.5 kg carbon equivalent as compared to 9.5 kg carbon equivalent for production of one kg meat.

Area under Pulses

India grows varieties of pulses, during monsoon and winter seasons. Pulses that are more popular are chickpea, pigeon-pea, green gram, black gram and lentil. Between 1950-51 and 2013-14, area under pulses increased by 31% from 19.0 million hectare MHA) to 25.0 MHA. The CAGR of total area under pulses was 0.08% much lower than 0.21% of total area under food grains, 0.58% for rice, 1.70% for wheat and 1.40% for oilseeds. Most farmers grow pulses in rain-fed/dry land, which yield significantly low as compared to pulses under irrigation using high yielding varieties and adequate plant nutrients. Over a period of past six decades, with the expansion of irrigation facilities farmers in the northern India have switched over to cultivation of wheat, rice and maize on a substantially larger area replacing pulses. 1960s and early 1970s witnessed significant fall in pulses cultivation due to substitution by HYV of cereals during the green revolution period in States of Punjab, Haryana and western Uttar Pradesh. Area under pulses declined by as high as 20% from 10.12 MHA to 8.16 MHA in northern India whereas in Central and Southern India area under pulses increased from 11.34 MHA to 15.01 MHA 32%) during last three decades. Chickpea, among all major pulses grown in northern India, witnessed as high as 63% decline under area from 4.98 MHA in 1971 to 1.85 MHA in 2010, mainly due to replacement by wheat. As against this, during this period the chickpea cultivation witnessed a significant swift of about 3.0 MHA from cooler and long season environment of northern India to warmer and short season environment in southern India. The effective coordination between the International Crop Research Institute for Semi-Arid Tropics [ICRISAT] and National Agricultural Research System [NARS] in the evolution and dissemination of short-duration varieties enabled farmers of Central and Southern India to expand area under chickpea and raise its productivity, production and profitability. Following six States in India contributed to 79.48% of total area and 79.35% of total production in India. Yield/hectare in Madhya Pradesh and Uttar Pradesh was appreciably higher than national average.

Table 1
Area, Production & Yield of Pulses of Six States
Triennium (2014)

State	Area '000 ha	Production '000 Tons	Yield/hectare Kg)
Madhya Pradesh	5310 (21.84)	4807 (26.36)	905 (120.66)
Rajasthan	3967 (16.31)	2286 (12.54)	576 (76.80)
Maharashtra	3489 (14.35)	2565 (14.07)	735 (98.00)
Uttar Pradesh	2365 (09.73)	2148 (11.78)	908 (121.07)
Karnataka	2345 (09.64)	1286 (07.05)	549 (73.20)
Andhra Pradesh	1850 (07.61)	1468 (08.05)	794 (105.87)
Others	4990 (20.52)	3674 (20.15)	736 (98.13)
All India	24316 (100)	18234 (100)	750

Figures in parentheses indicate % share in total area & production & % yield to average

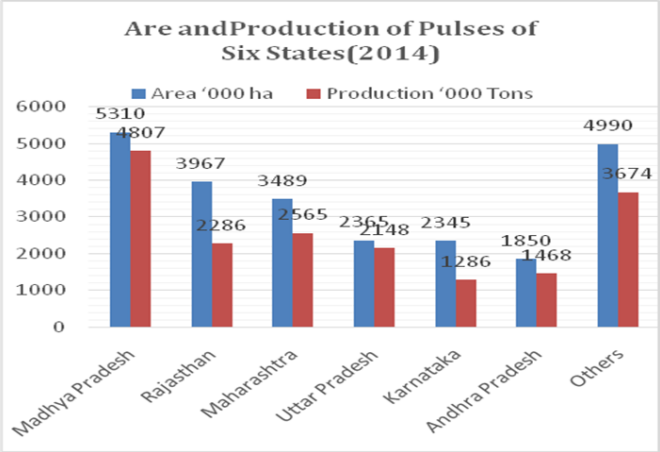

Chart 1 A

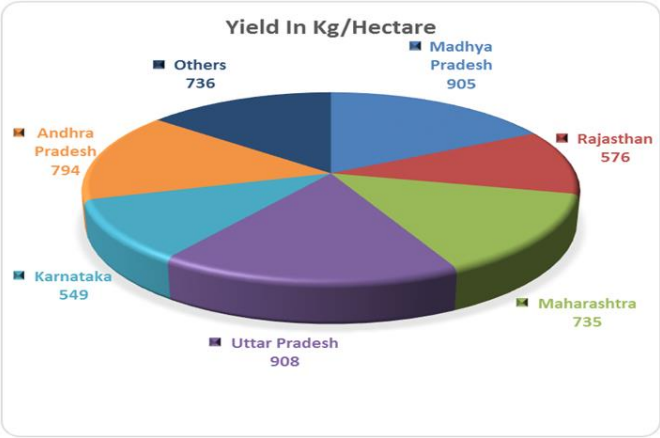

Chart 1 B

Pulses Production

During 1950-51 to 2013-14 production increased by over 100% from 8.41 million tons MT) to 19.27 MT. The compound annual growth rate [CAGR] of 0.64% of pulses output was much lower than 2.23% for food grains, 1.90% for rice, 2.75% for wheat and 1.53% for oilseeds. Among 12 pulses crops, chickpea alone had 40.52% share in total pulses production in 2009 which increased to 47.09% in 2014-15. Chickpea along with other three pulses [pigeon pea, black gram and green gram] together had 72.94% and 79.89% share in total pulses production in 2009 and 2014-15 respectively. Between 2009 and 2014-15, black gram recorded 76.47% increase in production followed by chickpea [58.93%] and green gram [42.86%] as against 1.60% by other eight pulses.

Table 2
Production and Percentage Share of Important Pulses (2009 & 2014-15)

	Production in Million Tons		% increase in 2014-15 over 2009
Pulse-crop	2009	2014-15	
Chickpea	5.60 (40.52)	8.9 (47.09)	58.93
Pigeonpea	2.48 (17.94)	3.0 (15.87)	20.91
Urad	1.02 (07.38)	1.8 (09.52)	76.47
Moong	0.98 (07.09)	1.4 (07.41)	42.86
Other pulses	3.74 (27.06)	3.8 (20.11)	01.60
Total	13.82 (100)	18.9 (100)	36.76

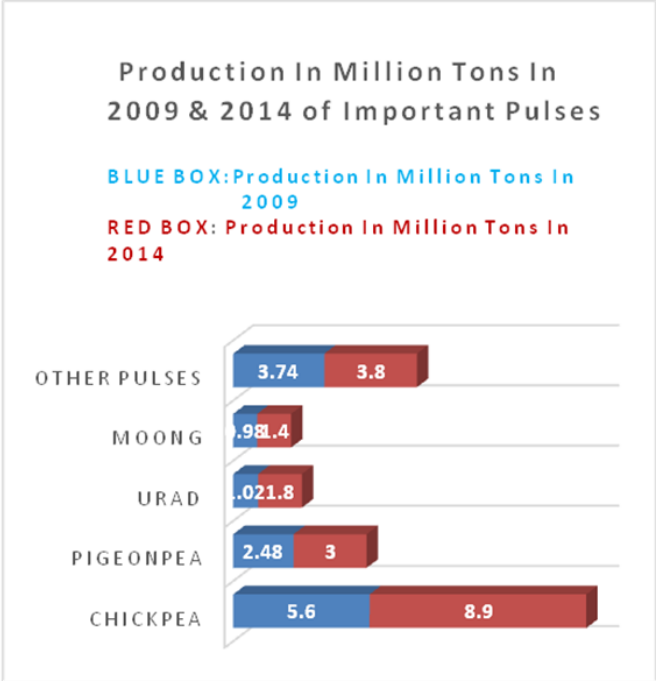

Chart 2

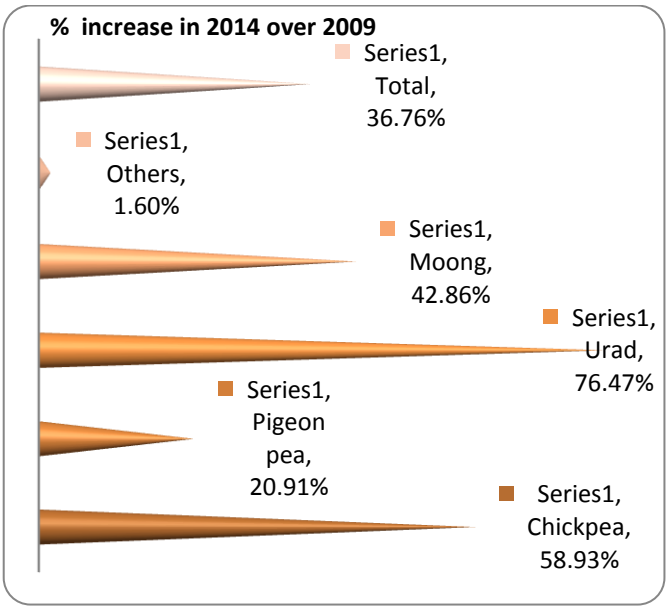

Chart 3

Yield per Hectare

During 1950-51 to 2013-14, the yield per hectare increased by 46% from 441 kg to 764 kg but 0.64% CAGR of yield was much disappointing. The CAGR of pulses yield for five decades 1950-2000) was abysmally low at 0.5% which significantly improved to 2.4% during 2000-01 to 2013-14. Per hectare yield of monsoon pulses ranges between 393 kg and 512 kg whereas the yield of winter pulses varies between 654 and 756 kg. Low yield accompanied by declining area reflected on total output of pulses. According to Dr

Swaminathan, the average yields of most pulse crops are about 500 kg/ha in India whereas crops like pigeon-pea which are grown in Australia from seeds obtained from India yield over four tonnes per hectare. The potential of Indian seeds of pigeon-pea should be fully harnessed through further researches in improving technology. Per capita net availability of pulses has been reduced considerably from 51.9 gram/day in 1971 to 41.9 gram/day in 2013 as against requirement of 80 gram/day as recommended by the World Health Organization.

Import of Pulses

Pulses are often considered poor man's protein but with the urbanization and rising income of middle class in the country since a decade pressure on protein foods including pulses has increased significantly resulting into price rise when domestic supply is constrained. India, in order to meet the growing domestic demand, imports significant quantity of pulses. Imports ranged from 13.51% to 29.71% of domestic production between 2007-08and 2015-16. Average annual import was 3.44 MT costing Rs,80.67 billion. Imports are from 30 countries but major ones are Canada, Myanmar, USA, Russia and Australia. India exported 0.30 million tons during 2013-14. India has been the important pulse-processor country for some pulse- exporting countries which have inadequate processing facilities. Also, India imports large quantity of pulses viz**.** desi chickpeas, pigeon-pea, green gram, black gram and kidney bean from Myanmar. Myanmar offers to India wide varieties of pulses with qualities similar to those produced in India and with advantage of low freight rates, and relatively fast delivery. Canada and Australia supply dry peas and kabuli chickpeas to India, each supplying about one-third of India's pulses imports. Other kabuli chickpeas supplying countries are Mexico, Turkey and Iran. Nepal and Syria account for the largest share of India's lentil imports. The import of pulses is increasing and now exceeds 3.6 million tonnes. A study by Associated Chamber of Commerce in India has indicated that India may have to import 10 million tonnes of pulses to balance demand and supply. India cannot afford to import 3.44 million tons of pulses annually when the country has the significant scope to improve the productivity, production and profitability as demonstrated by the ICRISAT and National Agricultural Research System (NARS.)

Table 3
Production and Net Imports of Pulses in Million Tons (2007-08 to 2015-16)

Year	Production	Net Imports	Year	Production	Net Imports
2007-08	14.80	2.00 (13.51)	2012-13	18.30	3.80 (20.76)
2008-09	14.60	2.90 (19.86)	2013-14	19.80	2.70 (3.64)
2009-10	14.70	3.60 (24.49)	2014-15	18.40	3.90 (21.19)
2010-11	18.20	2.60 (14.28)	2015-16	17.50	5.20 (29.71)
2011-12	17.20	3.30 (19.19)	Average	17.05	3.44 (20.19)

Figures in parentheses indicate % of net imports to production

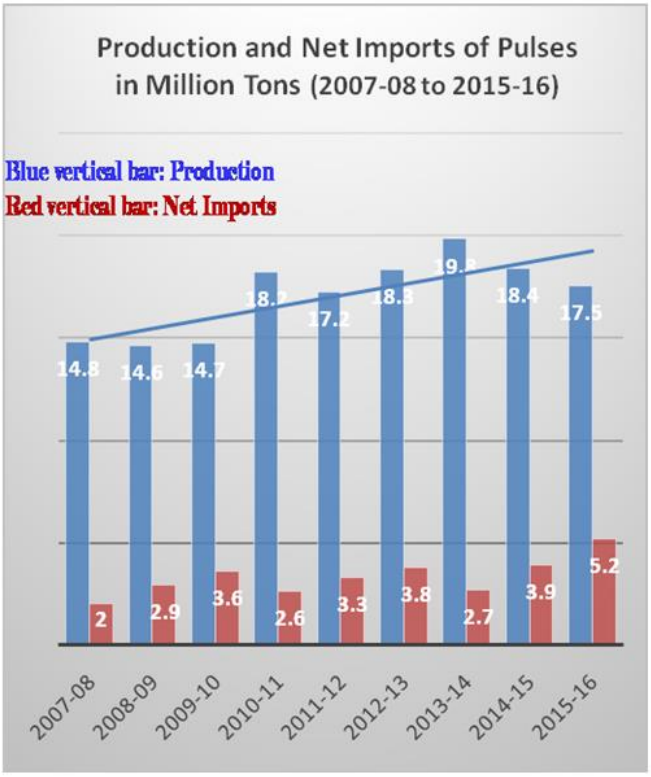

Chart 4

Low Productivity and Production

Factors responsible for low productivity per unit area and resources and output, *inter alia*, include [i] around 84% area under pulses is rain-fed with soils relatively of

low fertility Between 1966-67 and 2012-13, irrigated area under pulses increased from 9% to 16% as against from 38% to 59% for rice and 48% to 93% for wheat [ii] drought and heat stress influence 50% reduction in seed yields particularly in arid and semi-arid regions of the country [iii] soils growing pulses have high level of salinity and alkalinity in semi-arid tropics and Indo-Gangetic plains [iv] poor drainage leading to water logging during rainy season **i**n States of Uttar Pradesh, Bihar, West Bengal, Chhattisgarh, Madhya Pradesh and Jharkhand causes substantial yield losses in pigeon-pea in particular. Farmers use their own saved seeds and practically use no phosphatic fertilizers. Green revolution pushed pulses cultivation in marginal and sub-marginal lands resulting in declining productivity [v] pulses being rich in nitrogen and phosphorus content are easy victims of insects, pests and diseases which severely reduce the productivity of chickpea, pigeon-pea and lentil [vi] **w**hile small and marginal farmers more often prefer growing staple cereals for home consumption, resourceful farmers prefer growing cash crops on larger area rather than pulses. [vii] inability of small, marginal and tenant farmers to access institutional credit and technical services which discourage them to purchase and use seeds of high-yielding varieties and plant nutrients [viii] only three crops paddy, wheat and sugarcane)have captured 70% subsidies provided for seeds, fertilizers, irrigation and pesticides, leaving insignificant share for pulses growers [ix] unattractive and cumbersome claim settlement procedure of crop insurance scheme [x] minimum support prices [MSP] for pulses do not benefit pulses growers because of low concern of national agricultural marketing federation [NAFED] and small farmers' agri-business consortium [SFAC] to procure pulses. In the years to come, the grain yield is likely to be much more affected by extreme temperature under the impact of recent global climate change.

Ineffectiveness of Minimum Support Price

The NAFED and SFAC are responsible to procure pulses under MSP but unfortunately they procured insignificant quantity 1% to 4% of output against 28% to 30% of cereals during (2012-13 to 2014-15) despite MSP for pulses in last five years were higher than rice and wheat. Procurement was insignificant amounting to 6.56 lakh tons during July 2013- June 2014 reflecting no impact of higher MSP. The expert committee has aptly observed that despite MSP are announced for 23 commodities substantial benefits accrue to wheat and rice growers in selected states leaving pulse-growers often receiving prices much below MSP. Absence of efficient marketing arrangement and production constraints created huge gap between demand and supply resorting to imports.

Demand by 2030 and 2050

According to Indian Institute for Pulse Research, by 2030 and 2050 demand for pulses would be around 32 MT and 50 MT respectively. This would need additional 3.0 to.5.0 MHA area and productivity per hectare to increase to 1361 kg and 1500 kg respectively. In fact, India needs to produce 40 MT of pulses annually in order to meet per capita consumption requirement of 80 grams/day of pulses as recommended by WHO against present consumption of 27.2 grams/day/capita for 1,282 million people. This can be achieved by encouraging farmers to adopt following promising cropping systems which researchers have evolved and successfully demonstrated their economic benefits to farmers. .

Chickpea in Rice-fallows

Agriculture universities in States of Chhattisgarh, Jharkhand, Orissa, West Bengal and eastern Madhya Pradesh have established that short-duration varieties of chickpea and lentil can be successfully grown after rice harvest that can yield 1000 to 2500 kg/ha. Also, farmers preferred *kabuli*varieties (ICCV 2, KAK 2 and JGK) in most areas as they fetch high market prices. More recently, a heat tolerant chickpea variety JG 14 has been found highly adaptable to late-sown conditions in the rice fallow area in above states. India has been one among four countries in the prosperous agricultural Indo-Gangetic plains of South Asia raising rice in about 14.3 million hectares which, however, remain fallow during the winter season. Winter pulses, particularly chickpea, lentil and grass pea can be successfully raised on these rice-fallows which can optimally utilize the available land resources and enhance output of pulses.

Pigeon-pea in Rice-Wheat cropping system

Experiments on research stations and field trials on farmers' fields during 1999-2002 using extra-short duration pigeon pea varieties, viz. ICPL 88039, in States of Haryana and Western Uttar Pradesh confirmed that

pigeon pea can be grown profitably in place of rice during the monsoon season (sown in late-May and harvested in late October or early November) allowing timely sowing of wheat crop. Pigeon pea yields were 1500 to 3000 kg/ha with an average of 2000 kg/ha. As pigeon pea adds nitrogen through biological nitrogen fixation process accompanied by leaf fall (contributing about 40-50 kg N to the system), the succeeding wheat crop needs less nitrogenous fertilizers. The net economic returns under pigeon pea-wheat system were higher as compared to the rice–wheat system. Continuous rice–wheat cropping system being followed for several years in the Indo- Gangetic plain region of India has impacted adversely on soil fertility and increased incidence of pests and diseases posing a serious threat to the sustainability of the rice-wheat cropping system. The inclusion of legumes in rice–wheat cropping system promises to restore soil fertility and reduce other associated problems.

Pigeon-pea at high altitudes

Extra-short duration pigeon pea can be successfully cultivated up to the elevation of 2000 metres above sea level in Uttarakhand. A pilot study along with several on-farm trials across different elevations in Uttarakhand during 2007-08 by agricultural research institute and the department of agriculture, Uttarakhand showed that pigeon pea variety '(ICPL 88039) can be grown successfully in low and medium hill regions. It proved to be highly adaptable in regions with high elevations and yielded 1,800 kg/ ha of grains. As the long duration of cold and frost can severely damage the foliage and flowers of pigeon pea, its cultivation should be confined only to regions with low and mid hill regions. Farmers' willingness to cultivate extensively extra-short duration pigeon pea cultivar ICPL 88039 in Uttarakhand can be profitably capitalized.

Application of Micronutrients

Legumes fix atmospheric nitrogen. Arrangement needs to ensure provision of quality Rhizobium inoculum. A recent study by ICRISAT indicated that soils in many states in India are deficient in micro-nutrients such as boron, sulphur, zinc and magnesium. Application of small quantities (0.5 to 2 kg /ha) has resulted in 40%-120% increase in grain yield. Under a mission to boost productivity of rain-fed agriculture through science-led interventions in Karnataka the improved management practices (including application of micronutrients) have increased the yield by 31%-57% in green gram, 26%-38% in pigeon-pea and 27%-39% in chickpea during 2010-11. Similarly, in 2011-12 black gram and green gram grain yields increased by 33%-42% in response to improved management practices as compared to farmers' traditional management practices.Hence, it is necessary to [i] replicate these studies in different agro-ecological regions and [ii] through massive demonstrations make farmers aware of the importance of micro-nutrients and improved management practices and make available micronutrients in remote areas to enhance productivity and production of pulses**.**

Pulses Under Irrigation

Pulses often experience severe moisture stress since they are largely grown in rain-fed conditions. Soil water is limiting the growth and yields of cowpea, pigeon-pea, and chickpea in particular. Field studies suggest that application of small quantity of water as supplemental irrigation to rain-fed pulses during critical stages of growth can substantially improve yield. Studies have shown that by increasing the availability of soil moisture from 150mm to 300mm increases yield by 100% to 3520 kg/ ha. Studies have shown yields in chickpea and lentil increased linearly with the amount of water applied. Since there is significant scope for providing supplemental irrigation systematic efforts need to be made to educate, incentivise and encourage farmers to adopt drip/sprinkler irrigation system.

Andhra Pradesh State Shows the Way

Farmers in southern India started growing short-duration and wilt resistant chickpea varieties in rain-fed rice-fallow lands. Andhra Pradesh, a State once considered unsuited for chickpea cultivation due to its warm and short-season environment, has now ushered in *chickpea revolution* because of growing early maturing chickpea varieties. During 2000-09, the state increased area five times under chickpea from 102,000 hectares to 602,000 hectares and raised yields 2.4 times per hectare from 583 kg/ha to 1407 kg/ha, synergic effect of which was nine times increase in the output from 95,000 tons to 8,84, 000 tons. Between 1991 and 2010 average increase in yield of two major pulse crops viz. chickpea and pigeon-pea was as high as 81% to 100% in Andhra Pradesh recording substantially higher increase in yield than national average yield increase.

The attributes to such a phenomenal rise in the output included, *inter alia*[i] development and on time availability of high-yielding, short-duration, *Fusarium*wilt resistant varieties suited to short-season and warmer environments of southern India [ii] motivation and willingness of a large number of farmers to adopt improved varieties and easy access to production technologies [iii] successful commercial cultivation by mechanizing field operations and efficient management to minimize incidence of pod-borer infestation [iv] availability of grain storage facilities to farmers at local level at affordable cost.Andhra Pradesh has now the highest average yield of 1400 kg/ha with more than 80% of the chickpea area under improved short-duration cultivars.

Findings that Need Focused Attention

When already proven and demonstrated technologies as mentioned above are available there is greater need now than before to increase the productivity and production of pulses and arrest abrupt price-rise by focusing attention on following.

Campaign: Launching a massive "Grow More Pulses Campaign" to motivate and incentivize farmers to [i] include chickpea in rice-fallows, pigeon-pea in rice-wheat cropping system and pigeon-pea at high altitudes [ii] bring more area under pulses, raise pulses under irrigation, use high-yielding varieties of pulses and adopt efficient crop production technologies including application of micronutrients [iii] disseminate the technology along with putting in place a farmer-friendly mechanism to make them available on time quality critical inputs including institutional credit and insurance cover at affordable prices among farmers.

Implementation of recommendations: Impact & effectiveness of implementation of recommendations of the Report of Experts on Pulses [2012] need to be evaluated to identify gaps between achievements & expectations and initiate remedial measures. Similarly, recommendations of the Report on Towards Pulses Self-sufficiency [2016] & the Report of Dr. Arvind Subramanian [2016] need to be forthwith implemented & half yearly monitored, & reviewed and discussed in the Parliament once in a year.

Research: Adequate financial and other resources must be committed to research and development efforts exclusively for pulse-crops in proportion to currently provided to cereals and cash crops.

Improved varieties with drought tolerance: Since pulses are raised under rain-fed conditions the development of drought tolerant/resistant varieties of pulses can provide long-term solution against adverse effects of recurrent droughts in one or the other part of the country every year. Economic returns on financial investment in research on evolving/breeding crop varieties drought-proof or drought-tolerance) would be higher compared to spending huge amount of financial and other resources on drought management programs and strategies every year.

Researches need to be intensified to [i] match crop maturity period with soil moisture availability as a part of major strategy to avoid drought stress. Hence, emphasis in crop improvement programs has to be to develop high-yielding, short-duration strains which escape terminal drought. These short duration varieties can facilitate farmers to include them in a given cropping system [ii] develop varieties with significant amount of diversity in maturity-durations of pulse crops that can facilitate their cultivation in different locations and under different production systems to increase production.

Seed Production and distribution: In order to partially guarantee sustenance livelihood to rising numbers of small and marginal farmers who are often more vulnerable to shocks of crop failure and create an impact of the potential economic benefits of research on evolving drought-tolerant varieties of pulses on rural economy, a well-organized institutional infrastructure in each agro-ecological region would be required for multiplication and distribution of seeds of drought-tolerant varieties to meet farmers' demand on time.

Field surveys show that in recent past a number of improved varieties of pulses have been released for cultivation. However, resource-poor farmers in many locations/states have yet not been motivated to cultivate them. This is because of the fact that a large number of small-holders are not aware of these high-yielding varieties on one hand and on the other most knowledgeable farmers have no easy and reliable access to quality seeds of these varieties. This, therefore, necessitates launching a campaign to create awareness/demand among farmers as also an action-

plan to make available quality seeds to farmers at affordable price and on time. For this investment in financial and human resources is a must to create need based institutional mechanism to create demand of seeds from farmers and cost-efficient seed delivery system and simultaneously augmenting the production of required amount of quality seeds breeder, foundation and certified seeds) under the supervision of the seed regulatory body. Effective coordination is called for among various village PRIs, departments of the State and Union Government.

The seed replacement rate by improved strains in India varies from 14% in chickpea to 35% in soybean, indicating that a majority of the farmers still use their own saved seeds. This is attributed to factors viz. among others [i] low seed multiplication rate of legumes [ii] easy access to reuse grains as seeds from previous harvest [iii] lack of inadequate demand for specific varieties in different agro-ecological regions that suit to consumers' needs [iv] seed production is mostly confined to potential areas with better infrastructure facilities of seed processing, quality control, storage and skilled workers.

Thus, a strategic action-plan would simultaneously be necessary to motivate farmers to switch over to using these seeds by replacing the use of traditional/home preserved seeds in next three years. Programs need to be designed and popularized to ensure availability of quality seeds of drought /pest-resistant and high-yielding varieties accompanied by post-harvest technology that can motivate farmers of all sizes of landholdings to allocate fairly reasonable area and resources under pulses.

Acknowledging the importance of quality seeds in crop production as a *sine qua non* the Government has established National and State Seed Corporations which have been implementing seed production projects to enhance seed availability of improved varieties to farmers. They need to be strengthened and made efficient to serve the cause of farmers as the informal seed sector is still the dominant player. For example, despite India being the leading global lentil producer, more than 95% of lentil seed in India comes from the informal sector. The situation is similar in respect to other pulses too. Since private companies find pulses-seed business not profitable, accredited seed companies engaged in production, processing and marketing of seeds of other crops can be encouraged to include pulses in their business and create effective demand among pulse-growing farmers. These companies should have easy access to breeder and foundation seed and institutional credit and encouraged to expand their capacities. This should help them put in place appropriate marketing strategies including delivery systems targeting remote areas and small farmers. While research institutes and state agricultural universities have been playing a significant role in evolving high-yielding varieties of pulses and development of seed sector, Public-Private-Partnership mode can facilitate to increase the availability of breeder and foundation seeds to meet the current and emerging needs of seed producer-companies.

In fact, it is time to thoroughly understand and critically assess the current status of formal and informal seed sector, its strength comparative advantages and complementarity) and weaknesses in addressing the issue of the delivery of quality seeds to farmers, particularly small and marginal farmers.

Area Expansion: Additional area of 2.5 MHA can be brought under pulses through adopting [i] cropping system like green/ black gram as catch crop in summer season under cereal-based cropping system [ii] inter-cropping with short-duration pulses mung, urad, cowpea) in sugarcane, millets, cotton etc.[iii] new cropping system such as pigeon-pea-wheat in northern region, rice-lentil in eastern region and urad-rice in southern peninsula.

Mechanization: As the currently available varieties of pulses are not suited to mechanical harvesting pulses are harvested manually. In developed countries, such as Australia, Canada and USA, pulses like chick pea, lentils etc. are harvested mechanically which have distinct advantages. In India, with continuously increasing labour cost, farmers find manual harvesting of pulses very expensive and they would like to increasingly opt for mechanical harvesting. The farmers in Andhra Pradesh are anxious to switch over to chickpea cultivars suited to mechanical harvesting and they voice their demand for evolving and supplying such varieties. Therefore, research should focus to reduce cost of cultivation substantially by promoting the use of post-emergence herbicides in controlling weeds by developing herbicide-tolerant cultivars. This is necessary since pulses in general are sensitive to herbicides which compel manual weeding to control

weeds. Research, therefore, needs to be pursued to evolve herbicide-tolerant cultivars that offer opportunity of controlling weeds through need-based applications of herbicides. Weed management through application of herbicides can be economical and facilitate zero-tillage or minimum tillage methods.

Marketing: Potential of markets should be harnessed through [i] value chain approach right from the production at farm level and encompassing post-harvest, processing, packaging, transportation) to marketing for small and marginal farmers to reduce losses/wastages and increase income [ii] better price discovery and transparency for which facilities have been created for electronic trading of pulses in few Agricultural Produce Markets in States of Karnataka, Andhra Pradesh and Telangana and [iii] recently envisioned National Common Market in India.

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