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Pulses Production in India: Present Status, Bottleneck and Way Forward

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ABSTRACT

India is the still by and large vegetarian in dietary habit and heavily depends upon vegetative source to meet out its daily protein requirement. India is bound to be global leader in terms of production and consumer of pulses. Since, India is leading importer of pulses, production of pulse/ legume crops has been stagnant over the years. Consequent upon this there is widening gap between demand and supply. About 20 % of the total pulses demands are met by imports only. Apart from legumes fix atmospheric 'N' in readily available form to the upcoming succeeding crop. Associated non legume intercrop also gets benefited by 'N' transfer from legume roots up to some extent. It also contributes to sustain production system through physical, chemical and biological improvements of soil properties, as a rotation effect. The seed replacement rate is still (<30%) which lower than cereals especially wheat and rice. This paper addresses the bottleneck and focus on the way forward for improving pulses production in India, vertically and horizontally as well.

Keywords: Bottleneck, Policy intervention, Pulses scenario, Way forward,

INTRODUCTION

Pulses are the important sources of proteins, vitamins and minerals (Table 1) and are popularly known as "Poor man's meat" and "rich man's vegetable", contribute significantly to the nutritional security of the country. Currently, we are in the mid-way of self-sustaining in pulses production as we are world leader in production, consumption and import as well. India import 2-3 million tons (MT) of pulses during 2010-11, causing huge hard foreign earning. By the 2050 we will able to sustain our production and we turned to net importer to net exporter for pulses if every things goes as per plan. Another unique feature is its source of livelihood and still not a commercial business (Singh *et al*., 2013a).

Pulses Scenario in India

India is the largest producer and consumer of pulses in the world accounting for about 29 per cent of the world area and 19 per cent of the world's production. Even more importantly India is also the largest importer and processor of pulses in the world. Ironically, the country's pulse production has been hovering around 14– 15 MT, coming from a near-stagnated area of 22– 23 M ha, since 1990–91 (Singh *et al*., 2013a). Major areas under pulses are in the States of Madhya Pradesh (20.3%), Maharashtra (13.8%), Rajasthan (16.4), Uttar Pradesh (9.5%), Karnataka (9.3%), Andhra Pradesh (7.9%), Chhattisgarh (3.8%), Bihar (2.6%) and Tamil Nadu

Table 1: Nutritive value of Pulse

Constituents	Magnitudes
Protein	>20-%
Carbohydrate	55 – 60%
Fat	>1.0%
Fibre	3.2%
Phosphorus	300-500 mg/100 g
Iron	7-10mg/100 g
Vitamin C	10-15 mg/100 g
Calcium	69 -75mg/100g
Calorific value	343
Vitamin A	430-489 IU

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(2.9%). Pulse productivity which was 441 kg/ha in 1950 increased up to 689 kg/ha during 2011, registering 0.56% annual growth rate (Table 2).

Table 2: Compound growth rate achieved in pulses production in India during the period 1950-2011

Particular	Pulses
Productivity (1950)	441 kg/ha
Productivity (2011)	689 kg/ha
Overall compound growth rate (%)	1.011
Compound growth rate (%) Area	0.52
Compound growth rate (%) Production	1.27
Compound growth rate (%) Productivity	0.73

Source: Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India

Production of pulses in 2008-09 was 14.66 million tons with an average yield of 655 kg/ha. In the Year 2013-14 India produced record 19.5 MT of total pulses. Share of chickpea, pigeonpea, mungbean and urdbean to total production has been worked out about 39, 21, 11 and 10%, respectively. Lentil and field pea accounted for 7- and 5% share of total production. For meeting the demand of the growing population, the country is importing pulses to the tune of 2.5–3.5 MT every year. Strong upward trend in the import of pulses is a cause of concern, since an increase in demand from India has shown to have cascading effect on international prices, thus draining the precious foreign exchange. By 2050, the domestic requirements would be 26.50 Mt, necessitating stepping up production by 81.50%, i.e. 11.9 Mt additional produce at 1.86% annual growth rates.

This uphill task has to be accomplished under more severe production constraints, especially abiotic stresses, abrupt climatic changes, emergence of new species/strains of insect-pests and diseases, and increasing deficiency of secondary and micronutrients in the soil. This requires a two-pronged proactive strategy, i.e. improving per unit productivity and reducing cost of production. The yield levels of pulses have remained low and stagnant, also area and total production. Number of districts harvesting more than 0.8 or 1 t/ha yield of *kharif* pulses is very less (Annoymus, 2013). Situation of *rabi* pulses is better in this regard. The gap between demand and supply has been widening and has necessitated import of pulses of 2.8 million tons in 2007-08. Perusal of data presented in Table 3 revealed that Uttar Pradesh contributes significantly to the pulses production and its share to the national pulses security is 21.8% with 3.196 MT. Other two leading states are Madhya Pradesh and Rajasthan with 19.5% and 13.6% production share of India. Only eight states contributing 90 % of total pulses production.

Table 3: State wise contribution in the Indian pulses production

State	Production (MT)	Production (%)
Uttar Pradesh	3.196	21.8
Madhya Pradesh	2.859	19.5
Rajasthan	1.994	13.6
Maharastra	1.407	9.6
Orissa	1.202	8.2
Bihar	1.041	7.1
Karnataka	0.777	5.3
Haryana	0.748	5.1
Other states	1.437	9.8
Total	**14.66**	**100**

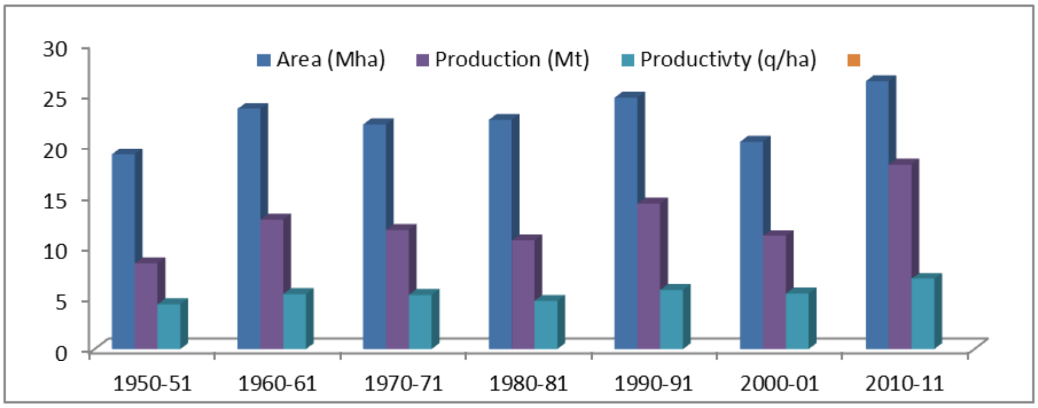

Fig 1: Decadal growth in All-India Area, Production and Productivity of pulses

Source: Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India

Data presented in Table 4 reveal the importance of individual legume crop in national pulse production. Chickpea top the list with 26.85 and 38.81 per cent share with respect to area and production in India, followed by pigeonpea and mungbean respectively. Lentil occupies only 4.94 % area and corresponding contribution in national pulseproduction is 6.96%.

Table 4: Contribution of individual Pulses in India Scenario

Name of crops	Area (Mha)	Area (% of Total)	Production (MT)	Production (% of Total)
Chickpea	5.81	26.85	5.69	38.81
Pigeonpea	3.62	16.73	3.07	20.94
Mungbean	2.98	13.77	1.61	10.98
Urdbean	3.18	14.70	1.46	9.96
Lentil	1.07	4.94	1.02	6.96
Other Pulses	6.30	29.11	1.75	11.94
Total	21.64	26.85	14.66	100.00

Relative economics of pulses in different States in India

In Maharashtra at present gram is found to provide more than 3 times of income from sorghum. Similarly in Karnataka during the recent years income from gram was found to be 58 per cent higher than sorghum. In Madhya Pradesh, income from gram increased by 65 per cent over barley and by 7 per cent over wheat. Relative economics of lentil shows almost double over linseed in Maharashtra. In Madhya Pradesh, return from lentil was 13 per cent lower than barley in early 1970's. Recent data shows economics superiority of lentil over barley by 5 per cent. In Bihar, competition seems to be taking place within pulses. Three decades back gross return from lentil was 12 per cent lower than gram, whereas now it is 5 per cent higher than gram. Gross return from pigeonpea remained higher than bajra and ragi in Maharashtra and the margin increased further by more than 30 per cent.

Major Bottlenecks in Pulses Production

Participatory rural appraisal (PRA), a widely adopted methodology to prioritized list of researchable issue, has been conducted by several workers to identify the important cause of such low productivity (Ali *et al.* 2012 and Reddy, 2009). PRA techniques revealed several factor responsible for extremely low productivity related to inputs and their efficient management (Singh *et al.*, 2012). Substantial increases in the production of lentil in the IGP can thus be achieved by fine tuning management aspects and thereby increasing total system productivity and sustainability (Ramakrishna *et al.*, 2000; Reddy, 2009 and Singh *et al.*, 2012).

Unfavourable weather conditions

Poor soil and agro-climatic conditions not only compel late sowing of legumes, leads to reduced length of growing period but also necessitate to sustain cold injuries at early vegetative phase which freeze all biological activities for prolonged period. A sudden rises in temperature after that, not only induces forced maturity but simultaneously invites several biotic stress viz., diseases and insects pests (Ali *et al.*, 2012; Reddy, 2009 and Singh and Singh, 2008). Traditionally r*abi* pulses sowing were delayed up to last week of November and some time under extreme circumstances it goes up to the first fortnight of December, obviously due to reasons already explained. However, optimum sowing time of lentil is first fortnight of October (Singh *et al.*, 2011 and Ramakrishna *et al.*, 2000). However, few winter legumes including lentil are also grown as a paira crop in the eastern India, which helps in timely planting of the crop even before, the paddy has been harvested (Singh and Singh, 1995).

Abnormal soil conditions

In general, pulses crop prefer neutral soil reactions and are very sensitive to acidic, saline and alkaline soil conditions. Indian soils especially, north -western soils having high pH contrary to eastern and north eastern part which are characterized as acidic soils. Due these soil conditions deficiency of micronutrient is pronounce up to acute shortage level. Acute deficiency with respect to zinc, iron, boron and molybdenum and that of secondary nutrients like sulphur particularly in traditional pulse growing (Singh *et al.*, 2013d).

Agronomic constraints

Improper sowing time, low seed rate, defective sowing method, insufficient irrigation, inadequate intercultural, sowing under *utera* without proper management are major agronomic constraints (Ramakrishna *et al.*, 2000 and Reddy, 2009). Consequent upon delayed planting, early encounter with severe cold, growth and development of lentil crop gets hampered for a considerable period. Subsequently plants get comparatively less time to complete their lifecycle which, by and large forces maturity (Ramakrishna *et al.*, 2000). For stance, in Eastern India, normal sown lentil is a medium duration (130-150 days) crop, while under late sown conditions it is forced to complete its life cycle in 105±5 days (Joshi, 1998; Ramakrishna *et al.*, 2000; Reddy, 2009; Singh and Singh, 2008 and Singh *et al.*, 2012). Typically, late sown rabi pulses especially lentil and chick pea undergoes three distinct phases and considerable degrees of phenological modifications are bound to happen. Eventually, lentil crop during its early seedling phase grows slowly due to its energy invested in the initial establishment (Singh *et al.*, 2002 and Singh *et al.*, 2012). However, in mid-phase, very insignificant growth and development is observed. This poses serious threat to realization of yield potential due to cold injuries. This phase is very important for creating source of channelizing the energy at later stage. In the last and most important phase lentil faces heat injury, resulting in early onset of reproductive phase, causing imbalance in resources and inputs, biotic stress and forced maturity (Joshi, 1998; Dixit *et al.* 2009; Reid *et al.*, 2011 and Singh and Bhatt, 2013).An earlier study revealed that area under pulses in mostly predetermined, but as the irrigated area increases, pulses are relocated to rainfed areas and their area is replaced by cereals or some cash crop (Singh *et al.*, 1995). In India, the irrigated area under pulses was only 12 per cent, while under wheat and paddy; it was more than 60 per cent of the total area (Reddy and Reddy, 2010).

Input quality and availability related constraints

Timely availability of quality chemical fertilizers continues to be a problem in many pulses growing area. Inadequate availability of gypsum or pyrites as a cheap source of sulphur remains a serious impediment in many states/regions (Singh *et al.*, 2013d).Nutrient requirement of legumes are much lower than cereals mainly because of biological nitrogen fixation and relatively low productivity levels although legumes crops respond favourably to higher doses of fertilizer nutrients than generally applied or even recommended (Singh *et al.*, 2013e). Availability of pesticides (including herbicides) in most of the states has been comfortable but their quality in terms of effectiveness and eco-friendliness has been an issue in spite of a well-designed regulatory mechanism put in place (Singh *et al* ., 2012c).

Varietal constraints

Lack of high yielding varieties, low harvest index, high susceptibility to diseases and insect pests, flower drops, lack of short duration varieties, intermediate growth habits, poor response to inputs and

Instabilities in performances are the few of the varietal constraints needs immediate attention (Singh *et al.*, 2013e and Ramakrishna *et al.*, 2000).

Pests and diseases

Although legumes crops are prone to many insect pests and seed borne diseases, a major cause of concern as its incidence, if not controlled, devastates the crop. *Fusarium* wilt is wide spread in legumes growing regions. In addition, heavy damage to legumes grain is caused by pests during storage. Legumes are in general pest free crop under normal condition if proper crop rotation is follows. However Pod borer, Aphids and Wilt *(Fusariumlentis)* aremajor insects and disease pests (Singh *et al.*, 2013b and Singh *et al.*, 2013g). Hence the control measures of all three are listed in Table 5.

Table 5: Important diseases and insets pests of major pulses

Crop	Disease	Insect pests
Chickpea	*Fusarium* wilt, *Ascoochyta* blight, *Botrytis* grey mould and stunt virus	Pod borer and cut worm
Pigeon pea	Sterility mosaic virus, *Fusarium* wilt, *Phytophthora* stem blight *Alternaria* leaf spot and powdery mildew	Pod borer and pod fly leaf tier
Urd and Mung	Yellow mosaic virus, *Cercosora* leaf spot, powdery mildew, leaf crinple virus and root rot	white fly, Jassid and pod borer
Lentil	Rust, wilt Sclerotinia blight, collor rot	Pod borer
Field pea	Powdery mildew, rust, downy mildew, wilt	Pod borer, stem borer , leaf minor

Blue Bull trouble

Legumes are vulnerable to attack by Blue Bulls in the Indo-Gangetic Plains. Because of the widespread menace particularly in Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan and Chhattisgarh the potential area suitable for taking legumes crops is left uncultivated by the farmers. There is no viable strategy available in the country to effectively the menace.

Technological constraints

A legume is grown under varied agro-climatic conditions (soil types, rainfall and thermal regime) in the country. This calls for region specific production technology including crop varieties with traits relevant to prevailing biotic and abiotic stresses. Even biological fertilizers and pesticides used should be based on strains isolated from regions with similar agro-climatic conditions for them to be effective. Our research and development programme in pulses has yet to appreciate and address this issue adequately. Production technology for a legumes crop has to be soil type/region specific (Singh *et al*., 2012a) equally applicable for tillage and seeding device/gadgets.

Infrastructural Constraints

Rainfall received during maturity of *kharif* pulses, causes losses in yields and grain quality when farmers usually do not have p*akka* and covered threshing floor. Farmers also lack awareness and means for safe storage of grain/seed of pulses. Many areas are approachable only during fair weather. Warehousing facilities are either inadequate or inaccessible (Anonymous, 2013 and Singh *et al*., 2013a).

Credit, Marketing and Policyconstraints

Farmers engaged in cultivation of legumes are mostly small and marginal. A majority are in areas with poor banking infrastructure. They have poor resource base and lack risk-bearing capacity. They therefore either lack access to credit or turn defaulters. Delivery of credit to such farmers is also not hastle-free. There is lack of marketing network in remote areas. Procurement of produce by a dedicated agency is virtually non-existent or in-effective. System of regulating quality of inputs though in place in all the states, needs to be made more effective. Delivery of improved technology, inputs, credits need to be stream lined through appropriate policy interventions. Benefit of crop insurance need to be extended to pulses farmers (Anonymous, 2013 and Singh *et al*., 2013a).

Realizing potential productivity in pulses and way forward

Indian agriculture is endowed with the second largest cultivable land area in the world, the largest number of varied agro climatic conditions, 270 days of sunshine, 1120 mm of annual rainfall, rivers crisscrossing the country, 7000 km long coast line, extra ordinary bio-diversity, and abundant labour force (Singh and Kumar, 2009). Since pulses are invariably subjected to abiotic stresses leading to sub-optimal nutrient uptake, farmers tend to use low doses of fertilizer nutrients. Further, nutrient use is unbalanced and seldom based on soil-test values. However, wide spectrum of agro-climatic conditions, favourable thermal regime for almost year round cropping and availability of generally adequate rainfall point to the fact that there is a vast untapped potential for improving productivity of pulses and bringing additional area under pulses. There is overwhelming scientific evidence suggesting a vast gap between farmer's yield of pulses and front line demonstration plot yield. There is need to promote high yielding varieties along with selection of suitable varieties for different agro climatic conditions. Further use of disease and pests resistance varieties is highly advocated under present climate change scenario (Anonymous, 2013). Methods and techniques which can be potentially used for improving pulses production can be classified in two group i.e. (A) Vertical Approach (B) Horizontal Approach and (C) Policy intervention

A. Vertical Approach

In this, possible methods and technique were discussed which helps to achieve more production without expanding crop area, here focus on to improve productivity of crop per unit area. Following vertical approach can be efficiently and effectively utilized for increasing pulse productivity

(i) Promotion of sequential cropping intercropping and utera cultivation of pulses

There are a good number of promising intercropping systems for pulses developed by Agricultural Research Stations. Promising intercropping for different pulse producing States are given in Table 6. Farmers in rainfed states (Gujarat, Madhya Pradesh, Chhattisgarh, Maharashtra, Karnataka, and Andhra Pradesh) are familiar with some of them as they have been practicing them in traditional ways. The approach to be followed by the rainfed states should include: a) Identification of districts and promising intercropping systems for each agro-climatic zone and setting of area coverage targets. b) Conduction of field demonstrations on intercropping with farmer's active participation and comparing returns with sole cropping system. c) Ensuring availability of seed of pulse varieties recommended for intercropping. d) Demonstration of suitable seeding devices (animal drawn and tractor drawn) for simultaneously planting of main and intercrop components. e) Seed-minikits of pulses may be given to farmers opting for intercropping only. f) KVKs at districts level should be involved in training of farmers and field demonstration of production technology (Singh *et al*., 2013e and Anonymous, 2013).

Sequential cropping

- Summer oilseed and pulses
- Rabi pigeon pea
- Summer mung bean + pigeon pea
- Late sown chickpea in irrigated area
- Pulses in rice fallow

Intercropping System

- Cereal+ pulse (Barley /Wheat + Lentil/ Gram)
- Oilseed+ pulse (Mustard /linseed + lentil/ Gram)
- Pulse +pulse (Gram +Lentil Field pea)
- Sugar cane +Pulse (Moong / Urd)

Table 6: Promising intercropping for different pulse producing States

Intercropping systems	States
Soybean + Pigeon pea	Madhya Pradesh, Maharashtra
Pearl millet/sorghum + Pigeon pea	Karnataka, Andhra Pradesh, Gujarat, Maharashtra
Groundnut + Pigeon pea	Gujarat
Groundnut/ Sorghum/ Pearl Millet + Urdbean	Bihar, Maharashtra, Madhya Pradesh, Karnataka,
Mungbean/ Cowpea	Gujarat, Uttar Pradesh, Rajasthan
Sugarcane + Cowpea/ Mungbean / Urdbean	Uttar Pradesh, Maharashtra, Karnataka AndhraPradesh, Tamil Nadu
Cotton + Mungbean / Urdbean /Cowpea	Punjab, Haryana, Madhya Pradesh, Gujarat, Andhra Pradesh, Maharashtra

(ii) Seed replacement/multiplication strategy

Opportunities for increase in crop productivity exist in the form of new varieties of seeds developed for recording higher yields (Singh *et al*., 2012b). Main issue relating to promotion of quality seeds is the availability of seed of promising varieties to the farmers in adequate quantities and in time. Use of good quality/certified seed in pulses has generally been low. Seed replacement Rate (SRR) estimated for the year 2006-07 was only 10.41%. Efforts made through various Government Sponsored Programmes such as Integrated Scheme of Pulses, National Food Security Mission, (NFSM), Seed Village Programme etc have been successful in raising SRR of pulses to 22.5% by the year 2010-11(Anonymous, 2013).

(iii) Adoption of best agronomic practices

Opportunities for increase in crop productivity exist in the form of better crop management practices that make the pulses cultivates of more efficient (Singh *et al*., 2013e). Agronomic practices that have major impact on productivity of pulses include tillage, crop geometry, plant population, planting method and time, nutrient and water (rainwater and irrigation) management, seed treatment (with fungicides) and crop-specific bacterial cultures, weed management and plant protection (Singh *et al*.,2012c). Crop-specific recommendations based on applied and adaptive research findings generated in different agro-climatic regions are developed by Zonal Agricultural Research Stations (Singh *et al*., 2013c).

(iv) Balance nutrient management

Wide spread deficiency of zinc and sulphur in major pulse growing states and boron deficiency in acid soils of eastern and north eastern states has necessitated use of sulphur containing fertilizers and zinc sulphate as a source of zinc. Sulphur application @ 20-40 kg/ha (through gypsum, SSP) at sowing and zinc sulphate @25-50 kg/ha once in two years effectively address the problem and tend to maximize crop productivity (Singh *et al*., 2013d). Correction of Soil pH has a major role in nutrient and water use efficiency and consequently on crop yield. Use of gypsum in western states and liming in eastern and parts of southern states is must. Nitrogen requirement of pulses is much higher than that of cereals. However, most of the requirement is met through biological N-fixation. Minimization of magnitude and duration of moisture stress (Patel *et al*., 2014). Weed infestation of pulses has been observed to cause heavy yield losses in legumes pluses, a number of cost-effective herbicides are available in the market that can be promoted for optimizing pulses production (Singh *et al*., 2014b).

(v) Use of Plan Growth Regulators

Growth and development of legume plant is comprehensively controlled by plant growth regulators (PGRs). To provide momentum to the vegetative growth auxins plays a vital role especially under low ambient temperature and cold rhizosphere regime (Singh and Bhatt, 2013).

(vi) Efficient Pest Surveillance and management practices

In the era of climate change, it is important that region specific advisories are issued for guiding pulse growers on pest control. This calls for an effective pest surveillance mechanism to be put in place at district level. National Centre for Integrated Pest Management (NCIPM) has come out with a model for pest surveillance in cotton, pigeon pea, chickpea and other crops and tested the same in Maharashtra state. The model is being demonstrated in some selected NFSM-pulses states. The model has met with notable success. It is therefore suggested to adopt the model with defined priorities (Anonymous, 2013).

(vii) Better extension for adoption of improved pulse production technique

Improved and better pulse production technique to be disseminated have to be not only region/agro-climatic zone-specific but should also match the resource-base of the farming community (Singh *et al.*, 2014a). Innovative ways of institution building that aggregates the produce of scattered legumes farmers and links them up with the businesses for better quality of inputs and for efficient marketing of the produce need to be found. Similarly, extension strategy to be followed should take into account the prevailing socio-economic status of farmers (Singh *et al.*, 2014b).

(viii) Mechanization in pulses

Legumes are grown in different agro climatic regimes and soil conditions can vary. In many soils mechanisation is essential to raise productivity. Adoption of deep ploughing, ridge planting, line sowing, inter-culture operations etc besides, mechanization contributes to timeliness of operations, reduces cost of production and improves resource (water, energy and inputs) use efficiency (Singh *et al.*, 2014a and Patel *et al.*, 2014). Considering small holding of the farmers, custom hiring of the machines is the only viable option for increasing the reach of Farm mechanization. In this context, example of 'Haldhar' program of Madhya Pradesh Government is a good practice that subsidizes the farmers to the extent of Rs. 2000/- per hectare for deep ploughing of their lands (Anonymous, 2013 and Singh *et al*., 2013a).

(ix) Post-harvest handling of grains for reducing losses

Mechanical threshing needs to be promoted by providing incentives for purchase of threshers. Procurement of pulses grains by Govt. authorized organizations will considerably reduce the need for storage at farmer level. Small Dal-mills should be popularized and promoted through various incentives. Private sector should be encouraged to establish' Dal Mill's in rural areas/districts with large acreage under pulses on the pattern of sugar mills. Private companies need to be involved in processing, packing and marketing of pulses. The public sector procurement agencies are severely handicapped for funds and expertise in this area (Anonymous, 2013 and Singh *et al.*, 2013a).

(x) Expansion of irrigation using resource conservation technologies

Pulses crops are invariably grown under moisture stress which leads to sub-optimal productivity levels. Scientific scheduling of irrigation, an estimate of quantity of water to be applied and deployment of water saving irrigation methods can lead to enhanced yield, higher water and nutrient use efficiency and larger area coverage under irrigation. Use of sprinkler irrigation has enormous potential for saving irrigation water and expanding area under irrigation. The method has gained popularity in many districts with limited water resources. Drip irrigation attention of the policy makers, administrators, social workers, as it has assumed social, economic and ecological dimensions. Fertigation hold promise for widely spaced crops like pigeonpea. These devices can expand irrigation area by 30-50 (Anonymous, 2013 and Singh *et al.*, 2013a).

(xi) Managing blue bull effectively

The damage caused to pulses crops by blue bull has been on the rise in the extent and magnitude. The problem has become so acute that area of pulses in general and summer mungbean in particular has witnessed drastic reduction in the states of Punjab, Haryana, Rajasthan, Uttar Pradesh and Gujarat. Although, the problem has been in existence for decades, no socio-economically viable control measures have been evolved and implemented. Pulse growers continue to suffer heavy economic losses. The issue is very serious and warrants (Anonymous, 2013).

B. Horizontal Approach

Efficient utilization of rice fallow lands and replacement of low productivity crops with pulses

The area left un-cropped after *kharif* rice is estimated to be around 11.65 million ha. The area is primarily rainfed and exists in the states of Bihar, Madhya Pradesh, Chhattisgarh, Orissa, Eastern Uttar Pradesh, West Bengal and Jharkhand. About 25% of this area has potential for supporting a *rabi* pulses after rice depending on soil type and depth. Thus, the 3 to 4 million ha additional area can be brought under *rabi* pulses. Assuming an average productivity of 600 kg/ha, the area can produce 1.8 to 2.4 million tons of pulses. Farmers need to be encouraged through various incentives and region specific extension strategy for cultivation of pulses in the identified districts. Necessary technological back up in terms of suitable short-duration varieties, nutrient application rates and other agronomic practices should come from local research stations. SAUs/KVKs may be mandated to conduct field demonstrations on pulses in rice fallow lands and train field staff and farmers participating in demonstrations. About 5 lakh ha area of upland rice, 4.5 lakh ha area of millets and 3 lakh ha area under barley, mustard and wheat can be brought under *rabi* pulses. Rabi pulses such as lentil and chickpea should replace mustard, barley and wheat. If possible, harvested rain-water should be used for rabi crop establishment (Anonymous, 2013 and Singh *et al*., 2013a).

C. Policy intervention

Regarding stock limits, the concerned Food and Supply Department of State Government who is implementing pulses control order need to be approached. Different states have different license requirements and stock limits imposed on pulses. Only Madhya Pradesh does not have a stock limit imposed on domestic pulses. Gujarat has done away with control order license but has a stock limit. Due to these reasons, none of the big trading companies deal in domestic pulses. Applying through the right department in every state for EC license as well as obtaining the EC license is a complex and time consuming exercise. States like Delhi are not issuing Pulses Dealer license for over one year. All channel partners have to also apply for licenses. Generally, the official time limits vary from 1-2 months, while the actual time taken is much longer. New methods for marketing should be devised to supplement some of the shortfalls in specific pulses crops. For example, Yellow Dal is being aggressively promoted by Ministry of Consumer Affairs through publicity campaign (Anonymous, 2013 and Singh *et al*., 2013a).

CONCLUSION

Best agronomic practices (BAP) and their different components shown potential to excel under change climate condition, there is need to adopt the all the component of advocated technology as a unit not to choose few of them at will, which were leading to several complication soil health hazards and poor response of technology. Thesesteps may be taken on priority basis for improving pulse productivity (1) Encouraging accelerated adoption of present technology for bridging the yield gap (2) Institutional support to boost seed replacement rate and quality production as well (3) strengthening of life-saving irrigation in pulse growing pockets (4) Guaranteeing availability of critical inputs viz., seed fertilizer, pesticides (5) Gradual mechanization for pulse production (6) Public–Private partnership for sustaining chain and to minimizing post-harvest losses (7) Policy support for value chain for pulse .

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