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Strategies to Improve Pulse Production in Rajasthan, India

Hanuman Prasad Parewa[1], Vijay Singh Meena[2], Ummed Singh[3], Anirudh Choudhary[4]

Author's Affiliation: [1,4]Assistant Professor, College of Agriculture (Agriculture University, Jodhpur), Sumerpur, Pali, Rajasthan 306902, India. [3]Professor & Dean, College of Agriculture (Agriculture University, Jodhpur) Mandor, Jodhpur, Rajasthan 342304, India. [2]ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, Uttarakhand 263601, India.

Abstract

Pulses constitute an essential part in the Indian diet due to their vital role in nutritional security and ameliorative properties. Due to high nutritional properties (~ 20-25% protein, 55-60% carbohydrates, high calcium and iron content) they are considered important food crops. India is the largest producer and consumer of pulses worldwide. It was reported that in 2016-17 the Rajasthan state occupied highest total pulses area 57.45 lakh hectares which has less productivity (595 kg/ha) and production (34.16 lakh tonnes) as compared to national average Cultivation of pulses in marginal and sub-marginal and less fertile lands, non-availability of good quality seed, adoption of local varieties, negligible application of manures and fertilizers, erratic rainfall, prolonged dry spell, insect and pest attack and problems in safe storage are the major constraints in pulse production. Pulse production in the state can be improved by following suitable agro-techniques, replacing local varieties with high yielding pest and disease resistant varieties, expanding it's cultivation to non-traditional area with suitable transfer of technical knowledge, introducing it in the existing cropping systems, developing region specific high yielding cultivars, creating adequate and good storage facilities. This article focus on trends and growth rate, constraints and strategies to improve pulse production in Rajasthan.

Keywords

Pulse Crop; Constraints in Production; Strategies

Introduction

Pulses significantly contribute major role in food production by stirring the soil through biological nitrogen fixation (BNF) and improving physico-chemical conditions of the soil. Rajasthan is the biggest state of India constituting ~ 10% of total geographical area and ~ 6% total population of India (GOI, 2012). Approximately 60-70% population of the state is directly involved in agriculture/farming and allied activities for their livelihood. Agriculture in the Rajasthan is primarily rainfed covering country 13.27% of available land (Swain et al., 2012). India is the largest producer and consumer of a wide variety of pulses in the world which is dominated by tropical and sub-tropical crops such as chickpea, black gram, pigeon pea, green gram and lentil. These are high in protein, fiber and also suppliers of high quality carbohydrates, minerals and vitamins (Table 1).

The pulses are the ideal supplements for cereals due to their high nutritional quality (protein 20-25%) and essential amino acid (lycine) content and in general, pulses are recognized as an essential part of Indian diet. These are one of the cheapest and good sources of protein in balance diet. The present emphasis on soil health, environmental quality and economic consideration, has stimulated a paradigm shift in cropping pattern leading to pulse based cropping system. Any cropping system can become compatible and complete only when a pulse crop is included in it. The availability of pulses (per capita/

Corresponding Author: Hanuman Prasad Parewa,
Assistant Professor,
Department of Soil Science & Agricultural Chemistry,
College of Agriculture (Agriculture University, Jodhpur),
Sumerpur, Pali, Rajasthan 306902, India.
E-mail: haniparewa@gmail.com

day) has declined considerably from 60.7 g in 1951 to 43.0 g in 2016. (http://dpd.gov.in)

The pulses production has virtually stagnated with area and production over the last 27 years (average 458 kg/ha) in Rajasthan. The reason is that pulses are mainly grown as a residual crop on marginal lands, after diverting the better-irrigated lands for higher yield-higher input crops like wheat and mustard. Farmers are not motivated to grow pulses because of yield and price risk probably due to lack of effective procurement. Pulses face various abiotic (climate related) and biotic (pest and insect related) stresses. They are more susceptible to pest and insect attacks than cereals. Lower production (as compared to demand) and lower stocks in both domestic and global markets have led to a steep rise in prices of pulses. The pulse cropping system on account of their important role in nutritional security, soil reclamation and soil sustainability. They have ability to fix atmospheric N in the root nodules of their deep root system and add substantial amounts of nutrient rich biomass in the rhizosphere soil and thus keep the soil healthy and productive. Looking into the importance of pulses in nutritional security of the country and stagnation of its production, it becomes necessary to find out constraints and possible strategies to overcome the pulse production constraints in Rajasthan. Hence, this paper focuses on constraints and strategies to increase pulse production in Rajasthan. Moreover, the vagaries of general challenges in agriculture sector of the state are listed below:

- Deterioration of soil health including inadequate and imbalanced use of chemical fertilizers, multinutrient deficiencies, acute lack of organic matter content, inadequate soil microbial population etc.
- Frequent droughts leading to decline in productivity and reduced performance of many crops.
- Strengthening of comprehensive technology based developmental approach to promote pulse production in the dryland region of the state is the big challenge.
- Low productivity, unfavorable prices and practically very meager value addition, distress sales, rising cost of cultivation.
- Lack of up-scaling of farm-validated modern technologies and agricultural innovations.
- Lack of integrated farming approach.
- Lack of efforts for stabilization of sand dunes in hyper arid zone of the state and lack of suitable agro-technologies and agro-forestry for greening the desert area.

Table 1: Nutritive value of Pulses (Singh et al., 2015)

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

Trends and growth rate of pulse production in Rajasthan

It is evident that the actual productivity of different pulses in Rajasthan is considerably lower as compared to their potential yield as well as national average. One of the most important reasons behind low productivity of pulses in Rajasthan is that these are generally grown in poor and marginal lands with minimum inputs. Many farmers still use old varieties and grow their home-saved seeds. Farmers also do not use pre-emergence herbicides to control the initial weed growth. This leads to heavy investment on manual labour and also decreases economic yield. From 1990-91 to 2016-17, the total acreage, production and yield under pulses has almost been fluctuating but for 2016-17 (57.45 lakh ha) the maximum growth rate in area and production was observed which might be due massive awareness campaign in conformity with International year of Pulses (Fig. 1). The percent change in area, production and productivity of pulses in Rajasthan during 1990-91 to 2016-17 is presented in Table 2 and Figs. 2-3.

Table 2: Percent change in Area, Production and Yield of pulses in Rajasthan during 1990-91 to 2016-17 {Area (000′ ha); Production (000′ Tons); Yield = (kg ha-1)}

Year	Area	Change in (%)	Production	Change in (%)	Yield	Change in (%)
1990-91	3682.8	-	1718.8	-	467	-
1991-92	2830.7	-23.14	916.90	-46.65	324	-30.62
1992-93	3440.7	17.73	1457.9	37.11	424	23.58

1993-94	3328.0	-3.28	1071.1	-26.53	322	-24.06
1994-95	3601.9	7.60	1965.5	45.50	546	41.03
1995-96	3573.9	-0.78	1455.8	-25.93	407	-25.46
1996-97	3760.0	4.95	1844.6	21.08	491	17.11
1997-98	4389.4	14.34	2634.9	29.99	600	18.17
1998-99	4643.8	5.48	2444.2	-7.24	526	-12.33
1999-2K	2473.1	-46.74	890.90	63.55	360	-31.56
2000-01	2374.8	-3.97	731.50	-17.89	308	-14.44
2001-02	3357.3	29.26	1426.1	48.71	425	27.53
2002-03	1802.9	-46.30	484.50	-66.03	269	-36.71
2003-04	3860.9	53.30	2278.5	78.74	590	54.41
2004-05	3571.1	-7.51	1337.4	-41.30	375	-36.44
2005-06	3444.6	-3.54	898.10	-32.85	261	-30.40
2006-07	3207.6	-6.88	1481.3	39.37	462	43.51
2007-08	3869.9	17.11	1552.8	4.60	401	-13.20
2008-09	3672.5	-5.10	1826.4	14.98	497	19.32
2009-10	3501.0	-4.67	713.70	-60.92	204	-58.95
2010-11	4710.0	25.67	3216.0	77.81	683	70.13
2011-12	4451.1	-5.50	2360.0	-26.62	530	-22.40
2012-13	3245.6	-27.08	1956.6	-17.09	603	12.11
2013-14	4197.7	22.68	2490.9	21.45	593	-1.66
2014-15	3362.3	-24.84	1951.8	-27.62	580	-2.24
2015-16	3866.7	13.04	1990.2	1.93	515	-12.62
2016-17	5745.6	32.70	3416.8	41.75	595	13.45

Source: Indian Institute of pulse research, Kanpur (http://iipr.res.in/pdf/4.10_270615.pdf) and Directorate of Agriculture, Rajasthan, Jaipur, http://www.agriculture.rajasthan.gov.in

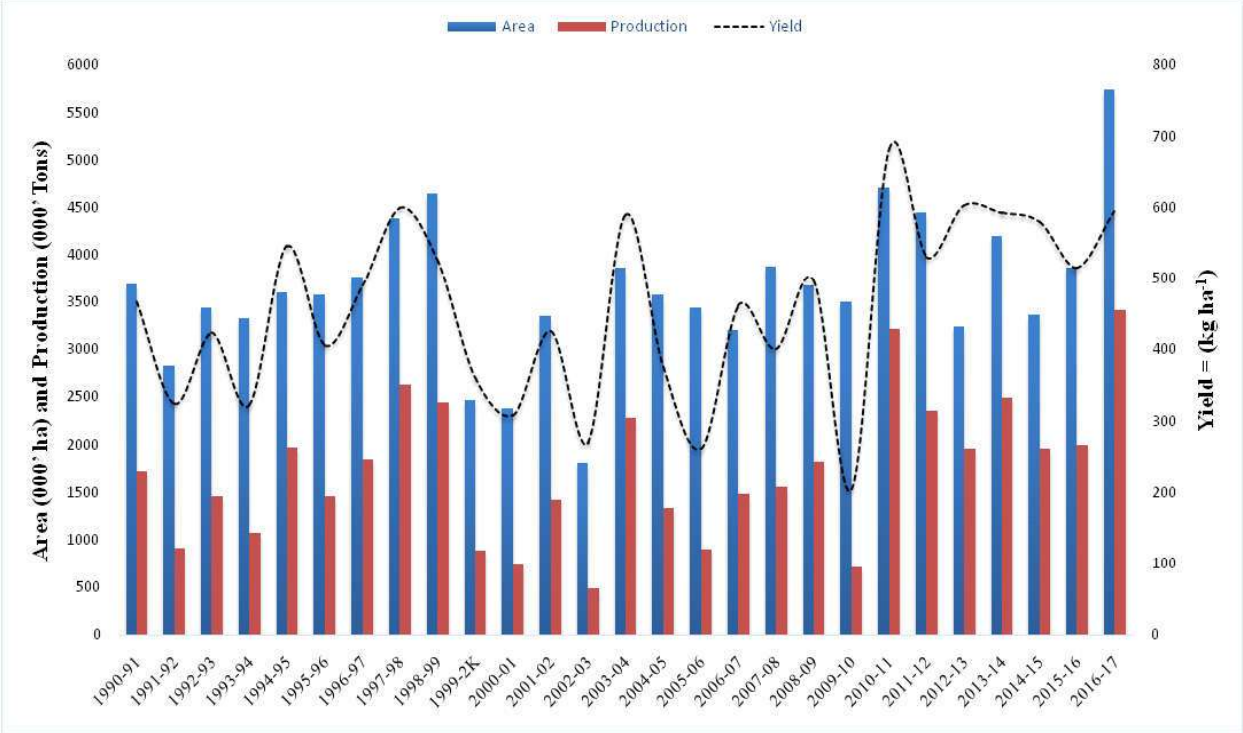

Fig. 1: Year wise Area, Production and Yield of Pulses in Rajasthan (1990-91 to 2016-17)

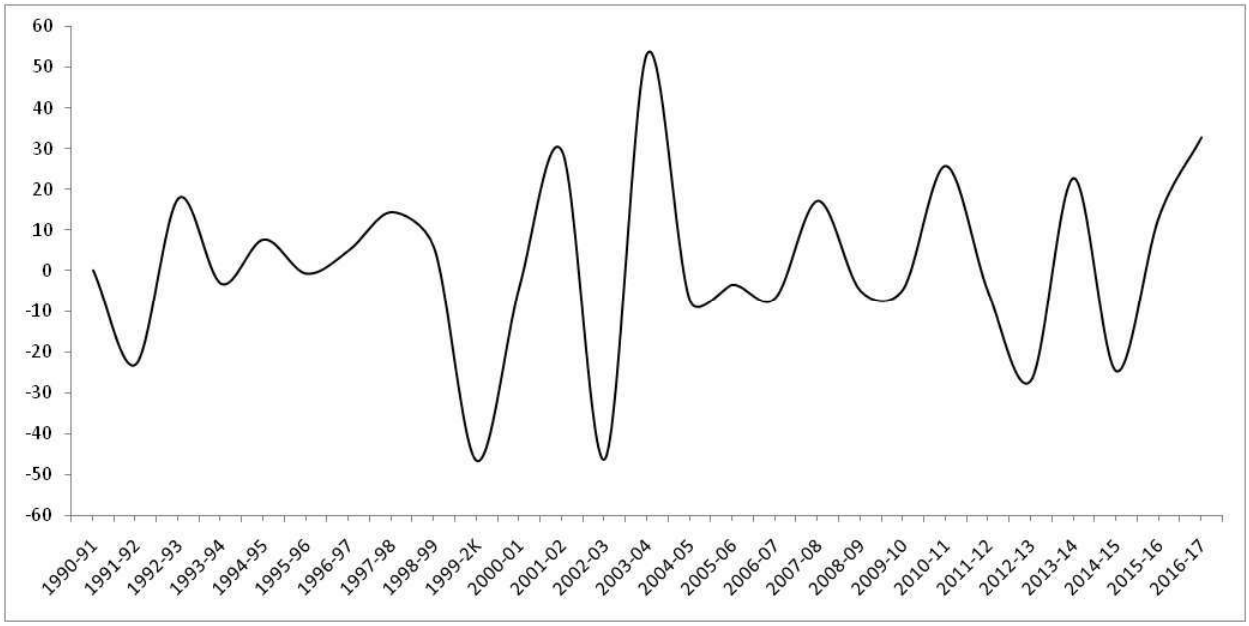

Fig. 2: Percent change in area under pulse crops in Rajasthan (1990-91 to 2016-17)

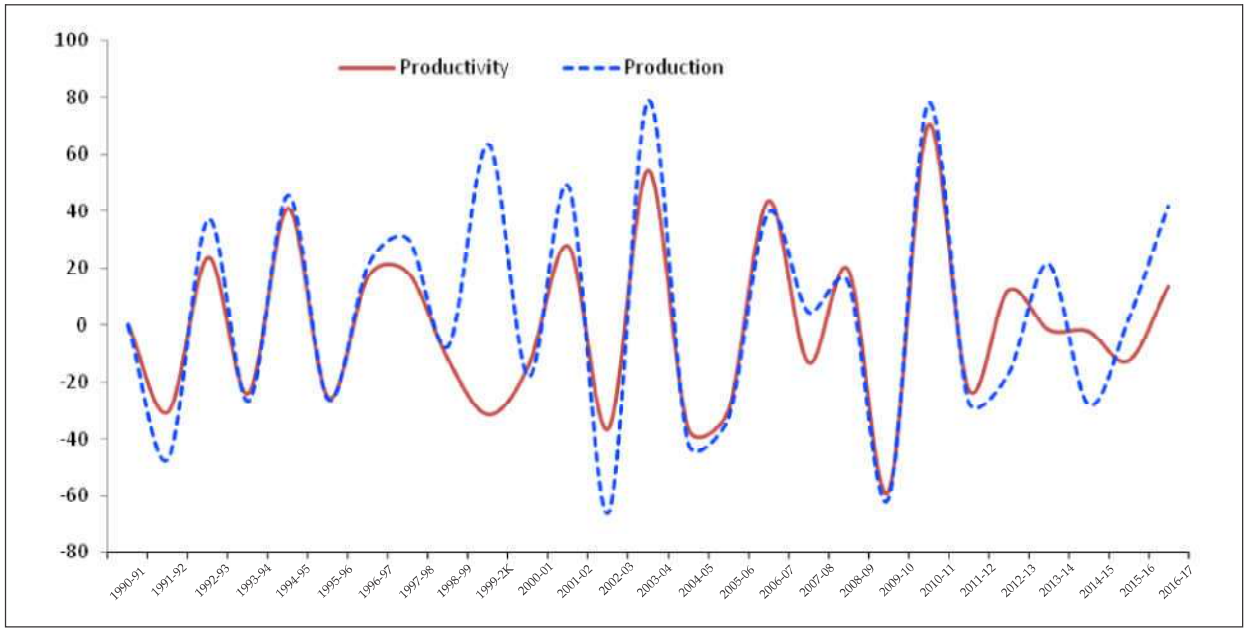

Fig. 3: Percent change in production and productivity of pulse crops in Rajasthan (1990-91 to 2016-17)

Constraints of pulse production in Rajasthan

The area under pulses of the region has undergone drastic reduction resulting in low production, although the productivity of major pulses has either increased or remained stagnant but still there is huge gap with potential yield. In general the pulse production constraints are depicted in Figure 5 Main constraints in Pulse production are enumerated as follows:

a. ***Climatic conditions:*** Delayed precipitation during kharif season, scarce or excessive rainfall or prevalence of rains at the time of maturity is one of the reason for decrease in pulse area, production and yield in the Rajasthan (Fig. 4). In most of the cases unseasonal rainfall received during maturity of kharif pulses in Rajasthan, which causes severe damage to the quality and yield of crop (Singh et al., 2015).

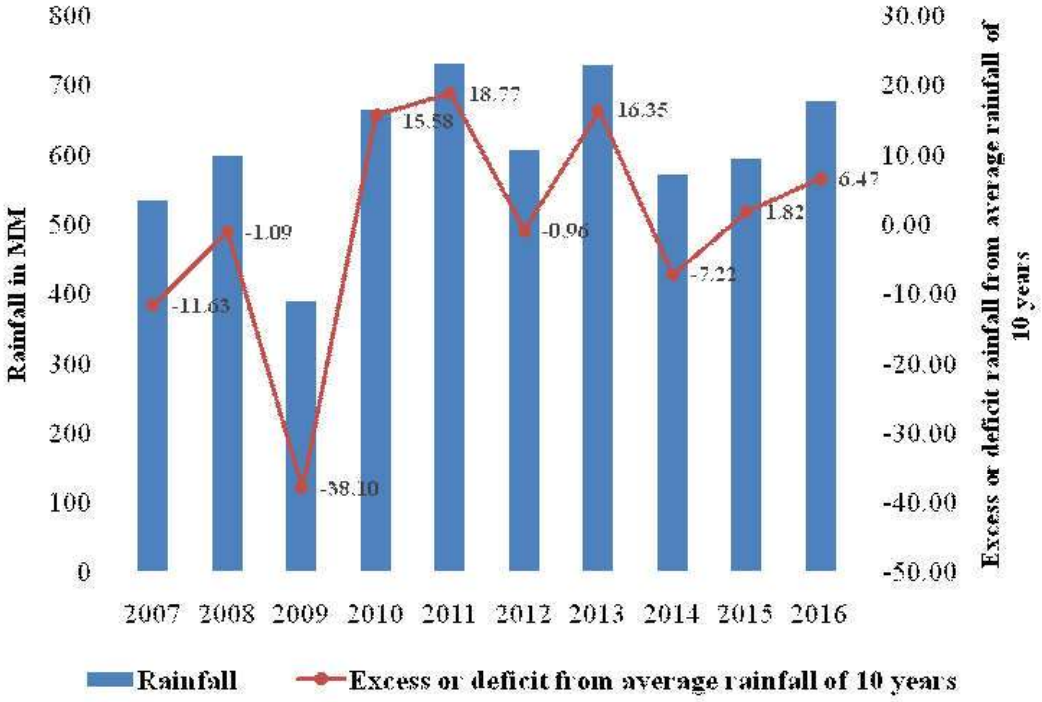

Fig. 4: Annual rainfall of Rajasthan and excess or deficit from average rainfall of 10 years
Source: Ground water year book 2016-17, central ground water board, Jaipur

Table 3:

Sl. No.	Crop	Insect pests	Disease
1.	Field pea (*Pisum sativum*)	Pod borer, stem borer , leaf minor	Powdery mildew, rust, downy mildew, wilt
2.	Urd (*Vigna mungo*)	White fly, Aphid, Spotted pod borer	Yellow mosaic virus, powdery mildew, leaf blight
3.	Mungbean (*Vigna radiata*)	Whitefly, Stem fly, Bihar hairy caterpillar	Yellow mosaic virus, leaf curl
4.	Pigeon pea (*Cajanus cajan*)	Pod borer and pod fly leaf tier	Fusarium wilt, Phytophthora stem blight, Alternaria leaf spot and powdery mildew
5.	Lentil (*Lens culinaris*)	Pod borer	Rust, wilt, Sclerotinia blight, collor rot
6.	Chickpea (*Cicer arietinum*)	Pod borer and cut worm	Fusarium wilt, Ascoochyta blight, and stunt virus
7.	Moth bean (*Vigna aconitifolia*)	Jassids, Aphids, Whitefly, White Grub	Fusarium wilt, Bacterial blight, Charcoal rot or ashy stem blight, Yellow Mosaic Virus, Cercospora leaf spot
8.	Cowpea (*Vigna unguiculata*)	Hairy caterpillar, Jassids, White fly, Aphids,	Anthracnose, Charcoal rot/seedling blight/root rot, Fusarium Wilt, Cercospora leaf spot, Powdery mildew, Bacterial blight, Cowpea Yellow Mosaic

b. Incidence of pests and diseases: Disease or pests is to be considered as an important reason for decrease in area, production and yield of pulses. During storage heavy damage is caused by pests in pulse crops. Minja (2000) indicated that most of the insect pests attack on the pigeon pea crop during reproductive stage and storage in tropical and subtropical regions. In the humid regions many insect and pests caused seed damage from 14-69% (Minja et al., 1999). The annual yield loss is estimated to be 20% in pigeon pea, 15% in chickpea and 30% in black gram and green gram. On an average 2.5-3.0 Mt of pulses are lost annually due to pests (Ali, 1998).

c. Abnormal soil conditions: Generally, pulse crop grow well under normal soil conditions and these are very sensitive to saline and alkaline soil conditions. The soil of the state has high pH and acute shortage or deficiency of some macro and micronutrient. Acute deficiency with respect to nitrogen, zinc and boron in traditional pulse growing affect the production of the pulse (Singh et al., 2013).

d. ***Quality seed production of pulses:*** Availability of quality seed of improved varieties in time is another constraint in production and productivity of pulses in Rajasthan. There is a wide gap in demand and supply of quality seed of pulse and seed replacement ratio is very low (2-5%), while the required seed replacement ratio is 10% as both public and private agencies have not been able to meet the requirement of quality seed.

e. ***Varietal constraints:*** Lack of high yielding and short duration varieties suitable for low fertile soil, low harvest index, high susceptibility to diseases and insect pests, flower drops, intermediate growth habits, poor response to inputs and instabilities in performances are the few of the varietal constraints, which affect the pulse production as whole.

f. ***Blue bull and stray cattle trouble:*** Pulses are vulnerable to attack by blue bulls and many stray cattle in this region. Because of the widespread menace of blue bulls and stray cattle in Rajasthan, the potential area suitable for taking pulse crops is left uncultivated by the farmers. There is no viable strategy available to minimize the trouble of blue bulls and stray cattle (Singh et al., 2018).

g. ***Agronomic constraints:*** Poor plant population in the farmers' field is one of the major factors towards poor yield. Non availability of improved varieties in time, improper sowing time, adverse climatic conditions, defective sowing method, inadequate irrigation and intercultural operation facilities etc. are major agronomic constraints for pulse production (Ramakrishna et al., 2000; Reddy, 2009).

h. ***Infrastructural Constraints:*** The marginal or small farmers of the state have lack of awareness of safe storage of grain/seed of pulses. Many pulse production areas are approachable only during fair weather. Warehousing facilities are either inadequate or inaccessible for poor and marginal farmers (Kumar, et al., 2010; Anonymous, 2013; Singh et al., 2013).

i. ***Input quality and availability related constraints:*** Appropriate quantities and timely availability of inorganic fertilizers continues to be a problem in many pulse growing area of the state. Inadequate availability of gypsum or pyrites remains a serious impediment in many states/regions (Singh et al., 2013a).

j. ***Credit, Marketing and Policy constraints:*** Cash and Credit are the key element for enabling small holder farmers to shift from low input-low-output to high- input-high-output agriculture. Mostly small and marginal farmers are engaged in cultivation of pulses. They have poor resource base and lack of risk-bearing capacity. A majority of the farming communities are in areas with poor banking infrastructure. Markets for pulses are meager and fragmented due to scattered production in the states. It is evidence that the pulse production area and productivity decreased due to non-availability of credit in time (Kumar et al., 2010).

Fig. 5: General constraints of pulse production

Strategies to improve pulse production in Rajasthan

a. Pulse crop is attacked by more than one disease and pest at a time. A variety of chemical, biological and cultural methods are utilized to reduce pest and disease damage. Adoptions of region specific Integrated pest management (IPM) modules which should cost-effective and minimize multiple pests and diseases and also ensure high productivity and profitability of the entire farming system of the region.

b. On-farm evaluation and demonstration of existing as well as recent technologies may be attempted to narrow the gap between yields realized on farmers' fields and research stations.

c. Special attention needs to be given to overcome seed production and distribution problems.

d. Timely availability of quality seed of different varieties of pulses should be arrange by involving seed societies, Rajasthan state seed corporation (RSSC), farmers, private sectors and Non-governmental organizations (NGO's) besides SAU's (State Agricultural Universities) and Indian Institute of Pulses Research. Participation of growers in pulse seed production should be encouraged by way of simplifying the registration and seed certification procedures.

e. Providing the basic advice to the farmers is very essential and extension system needs to be updated.

f. Production of quality seed of improved pulse varieties by farmers itself/ self-help groups/ private agencies needs to be encouraged to meet the demand of the farmers. Improved seed should be made available to the farmers at his doorstep at reasonable price and well in advance.

h. Intensification of production system through popularizing pulse cultivation during spring/ summer season under irrigated condition.

i. The farmers have to be educated about direct marketing, Government support price scheme, selling at nearly rural periodic markets, contract marketing arrangements with processors, wholesale traders or other bulk buyers.

j. Self-help groups (SHGs) promoted to market the produce, because individual marketable surplus being small in quantity and uneconomic to take to longer distance for better process. These self-help groups can be educated on product planning so that the similar variety or the similar quality can be produced by all members of group and would improve marketability of the product as well as bargaining power of the farmers.

k. Farmers should be trained and familiarized for advanced technologies, improved harvesting methods, standardization and grading, improved packaging and handling proper storage methods for profitable marketing of pulse produce.

l. Farmers need to be educated of various issues leading to value addition through primary processing.

m. Necessary efforts should be made to popularize the traditional storage of pulses by the rural or resource less farmers under optimum conditions so as to preserve the produce for longer period without damage.

n. Incorporation of short duration pulse crops like urdbean, mungbean to make the different production system profitable and improve soil health.

o. Research efforts to develop pest resistance and drought tolerant high yielding varieties of pulses.

p. Transfer of technology in relation to pulses should be strengthened in farmer participatory mode with active involvement of multidisciplinary team of scientists.

q. Minimum support price (MSP) of pulses needs to be made lucrative to the extent that pulses cultivation fetches equal returns to the farmers as in case of cereals.

r. All pulses need to bring under the umbrella of a wider crop insurance scheme which will develop confidence among the farmers taking pulses cultivation as they will consider these as assured crops.

s. Arrangement of life saving irrigation like farm pond construction, water harvesting structures, roof water harvesting, check dam construction etc. State Government has to take new initiatives in main pulse growing area of the state to provide lifesaving irrigation for pulse production under critical stages of the crops.

t. Pulse seed hub should be established in each agro-climate zone of the region.

u. Easy credit to be provided to all pulse growers.

v. The Government has to provide good subsidy to

the farmers on certified pulse seed production and sprinklers system.

w. To increase facilities of marketing of all pulses commodities through e-NAM (National Agriculture Market). This market is helps traders and exporters in procuring quality produce in bulk, at one place and ensure transparent financial transactions.

Conclusions

The production of pulses definitely needs to be increased manifold to meet the demand in coming years. Farmers grow pulses in the marginal lands with marginal input. Constraints of pulses production in Rajasthan can be solved with the increase the various sources of production. More effective and continuous efforts are needed to increase the area under cultivation of pulses. Pulse production can be increased by adoption of suitable region wise and crop specific biofertilizers application, easy credit facilities, more insurance price, good minimum support price (MSP) with procurement and appropriate incentives for pulse growers as well as creating necessary infrastructure for processing, marketing and value-addition facilities. Besides this, an additional area expansion through pulse crop introduction in non-traditional area would also enhance pulse production. In short, to increase area and production of pulse crops in state we need crop specific and region specific approaches, all components of advocated technology and strategies should be adopted in the overall framework of systems approach.

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