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Policy brief for enhancing pulse production in Bihar: A situation analysis

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Abstract
This paper discusses the importance of encouraging the production and level of adoption of technology, given their possible solution, to achieve the Sustainable Development Goal of reducing hunger and poverty as well as promoting health and nutrition in Bihar. This paper undertakes a situational analysis of area, production and yield analysis of three major pulses (Bengal gram, red gram, and lentils), along with that of total pulses, with reference to the time periods2003-2018along with reason for decline in area and production of major pulses in tal land. Trend analysis indicated that area and production over the reference period has been declined however the productivity shown an increasing trend. Despite of comparative advantage of pulse crop compared to competing crop farmers switch over to other competing crops due to volatility of price in markets. This paper also focused on development of policy in order to attain self-sufficiency by creation of procurement centre in each production zones that would be act as added incentives to the Pulse growers.

Keywords: Production, pulse, technology adoption, compound growth, cost and return etc.

Introduction
Pulses occupy a very important place in Indian agriculture. In India, pulses are grown over an area of 23.8 million hectares with a production of23.22 MT. The range of production is about 14-18 MT. However, from 2016-17, the production crossed 23 MT. In 2016-17, the production of pulses was 23.13 MT, in 2017-18, it was 25.42 MT and in 2018-19 is around 23.22 MT over an area of approximately 23.8 million hectares. (Govt. of India 2020) The average yield of pulses in the country is around 735 kilograms per hectare. In our country, pulses are a conventional and integral part of the human diet that is why trade prospects for pulses relied on sustained growth in demand of pulses. Bihar is one of the important pulses growing and consuming state in India. Among districts of the state, the total area and production of pulses in Patna district of Bihar is about 46.16 thousand hectares and 71.08 thousand tons respectively, which was observed as the highest area and production with respect to other districts of Bihar. In the case of chickpea, Patna district occupies 2nd rank in both area and production but 3rd in productivity. While in pigeon pea it ranks 10th position in terms of area in Zone III (B) of Bihar. In addition to this, huge variability in area and production of major pulses during 2000-2009 has been observed, however, the productivity during the same period is more stable which indicated that there is a scope to increase the production potential of major pulses in the state if adequate policy measures are taken up.
Pulse crop is mostly grown in rain fed condition and resulting in high yield fluctuation every year. Since from long time pulses have been considered as important nitrogen fixing crop in cropping systems, but with the introduction of irrigation and high profitability of alternative crop, the cultivation of pulse crop was marginalized (singh et,all . To find out the problem and opportunity, a comprehensive study has been carried out with main aimed at determination of factor causing declined in area and the various aspects of technological and economic perspectives of pulse production in target districts of Bihar. Pulse production in the district is low due to several constraints such as climatic conditions, inadequate supply of seed, diseases and insect-pest problems and poor crop management practices. This will help to formulate new policies for crop diversification with special emphasis on adoption of new cultivar in tal land of Bihar.

Methodology
The primary data of 120 farmers from two blocks i.e. Belchi and Mokama blocks of Patna district, consisting of three villages from each block were surveyed for 2017-18 following the

multistage sampling techniques. The data pertaining to different socio economic indicators of 20 pulse growers from each village were collected randomly. The secondary data on Area, Production and Productivity were obtained from the Block Offices, D.A.O Office Patna, and other Government publications to analyze the trends. The statistical measures like mean, percentage, ratio, frequency distribution, compound growth rate, and Garrett's ranking techniques were used to accomplish the objectives of study.

Findings and Discussion: Data collected from sample households indicated that the majority of households had agriculture as main occupation and higher percentage of respondents (43.33%) were of middle age group i.e. 36 to 50 years followed by older age group (35.83%). majority of the respondents were having Graduate to Higher Secondary degree and while only 3.33 per cent of the respondents possessed primary level of education. With increase in size of holding, farm mechanization has also increased on sample households. So far as cropping system is concerned, cereal crops dominate the scene by occupying more than fifty per cent of the gross cropped area in kharif season whereas in rabi season, the dominating crop was lentil followed by chickpea.(sinha *et al*. 2019) [9] However financial analysis indicated that return over cost / unit was comparatively more than its competing crops. Despite of these areas under pulses has been marginalized.

Trend in Area, Production & Productivity of major crops

The growth rate of total pulse in Bihar was found to be declining at 2.05% in area and 0.30% in production whereas it shows a positive growth rate in yield with 1.79% during the year 2003-04 to 2017-18. In Patna district, the growth rate in area was only declining by (-) 0.96 % whereas production and yield shown positive growth rate of 1.74 % and 2.72 % respectively during the year 2003-04 to 2017-18. During the same year, lentil, chickpea and pigeon pea, showed a positive growth of 2.96%, 1.61% and 6.65% respectively in case of yield but in area and production both lentil and pigeon pea showed a positive growth rate by 0.82 and 3.81% and 0.26 and 6.92 % but only in chickpea it showed a negative growth rate by (-) 2.08 and (-) 0.51 respectively during the same year (Sinha et, all 2019) [9]. It could be seen from the Table 1 that area under pulses shown a negative growth rates of (-) 3.05, (-) 2.94 and (-) 0.72 per cent during the period I, II and III respectively whereas the production and yield shown a positive growth rate i.e., for the period I, II and III; the production was 0.19, 5.37 and 1.79 per cent however the growth in yield was 3.38, 8.57 and 2.52 percent respectively. The compound growth rate for the overall year (2003-04 to 2017-18) in area and production showed a negative growth rates of (-) 2.05, (-) 0.30 whereas yield showed a positive growth rate of 1.79 per cent.

Table 1: Compound growth rates (%) in area, production and yield of total pulses in Bihar (2003 - 2018)

S. No.	Year	Area	Production	Yield
1	Period I (2003-04 to 2007-08)	-3.05	0.19	3.38
2	Period II (2008-09 to 2012-13)	-2.94	5.37	8.57
3	Period III (2013-14to 2017-18)	-0.72	1.79	2.52
4	OVERALL (2003-2018)	-2.05	-0.30	1.79

Source: Compiled By The Authors

Importance of pulse crop in tal Land

From the observation of cropping pattern of sample farmers, Rabi pulses were occupied major area followed by the kharief pulse and summer pulse. It clearly indicated that pulse crop has been dominating in the cropping pattern of Tal land under study.

Table 2: Relative Importance of Pulse crop to total cropped area in study district 2017-18

Cropping pattern				
Crop	**Marginal**	**Small**	**Medium**	**Overall**
kharif				
Pigeonpea	0.06 (3.17)	0.14 (5.11)	0.46 (7.08)	0.18 (5.61)
Rabi				
Lentil	0.37 (19.58)	0.51 (18.61)	1.15 (17.69)	1.19 (18.38)
Chickpea	0.26 (13.76)	0.33 (12.04)	0.51 (7.85)	0.7 (10.90)
Summer				
Moong	0.09 (4.76)	0.14 (5.11)	0.25 (3.85)	0.3 (4.63)
Total	0.78 (41.27)	1.12 (40.88)	2.37 (36.46)	1.27 (39.56)
Gross Cropped Area	1.89 (100.00)	2.74 (100.00)	6.50 (100.00)	6.46 (100.00)

(**Source:** Compiled by the Authors)

Economics of major Pulse and competing crops

Table 3: Economic analysis of major pulse crops vs competing crops in study area (2017-18)

Items	Lentil	Chickpea	Pigeon pea	Paddy	Wheat
Cost of cultivation (Rs /ha)	28324.46	26275.00	28774.50	47540.00	48559.00
Gross income (Rs/ha)	60391.91	58938.57	57851.00	62767.22	79331.12
Net Income (Rs/ha)	32067.45	32663.60	29076.50	15227.22	30772.12
Return/Rs over cost ratio	2.13	2.24	2.01	1.32	1.63

Source: Compiled by authors

Study revealed that highest gross income Rs. 79331.12/ha was observed from wheat followed by rice (Rs. 627667.22/ha), lentil (Rs. 60391.91/ha), chickpea (Rs. 58938.60) and lowest from pigeon pea (Rs. 57851.02). However estimated cost of cultivation per hectare for chickpea was found lowest and highest for wheat crop as seen in table1. Thus, it may be said that per unit of investment in pulse given comparatively higher return than that of investment in its competing crops as return per Rs investment for chickpea (2.24) among all crops grown in different season was comparatively higher and was observed lowest for paddy crop (1.32)

Adoption level of farmers on pulse production technology

The adoption of pulse technology gave an idea that majority of sample farmers adopted rabi season for pulse production primarily under sole cropping system by using local variety mainly from owned source seed. The seed which was used by each farm size was initially originated mainly from other progressive farmers was treated mostly by soaking in water A substantial proportion of farmer adopted seed age of 3 to 6 years and broadcasting was the most commonly adopted method for sowing the pulse seed. (Dwivedi *et al* 2011) also found the same.The majority of farmers adopted local variety of pulses on each size group, but highest being found on small size (70.13 per cent) which may be implied that proportion of farmer adopted HYV of pulses was lowest on large size group (4.58%). So far as the source of seed is concerned, it was observed that majority of farmers procured it from other progressive farmers, however, highest being observed on marginal size group (78.26%) followed by small (70.13%) and medium size group (65.00%). It might be seen that majority of farmers use post- emergence spray of weedicide belong to medium farmers (67.00%) followed by small and marginal size group. Though, the majority of farmers adopted lowland for pulse production on each size group, however, highest proportion was observed on medium size group (60.00%) followed by marginal (56.52%) and small (54.55%). It clearly indicated positive relationship between the proportions of farmers adopted upland for pulse production and the size of holding. The proportion of farmers who adopted seed age of 3 to 6 years was found substantially high on each size group which being worked out 64.94 %, 55.00% and 52.17% for small, medium and marginal size group, respectively. Further the proportion of farmers adopted seed age less than 3 years was observed in the range of 34.78 to 28.57% among different size groups. Though, the majority of farmers adopted broadcasting method of sowing for pulse production on each size group, the highest being worked out was 95.65% on marginal size group followed by small (63.51%) and medium size group (90.00%). Thus, no definite relationship was observed between size of holding and the method of sowing of pulse crops.

Table 4: Adoption of pulse production technology by size group (% of farmer)

S. No.	Particulars	Marginal		Small		Medium		Overall	
		No.	%	No.	%	No.	%	No.	%
1	**Adoption by season**								
(i)	Rabi	16	69.57	59	76.62	18	90.00	93	77.50
(ii)	Kharif	7	30.43	18	23.38	2	10.00	27	22.50
	Total	23	100.00	77	100.00	20	100.00	120	100.00
2	**Adoption by type of cropping system**								
(i)	Sole crop	22	95.65	72	93.51	18	90.00	112	93.33
(ii)	Mixed/intercropped	1	4.35	5	6.49	2	10.00	8	6.67
	Total	23	100.00	77	100.00	20	100.00	120	100.00
3	**Adoption by variety**								
(i)	Improved	8	34.78	23	29.87	6	30.00	37	30.83
(ii)	Local/Unknown	15	65.22	54	70.13	14	70.00	83	69.17
	Total	23	100.00	77	100.00	20	100.00	120	100.00
4	**Adoption by source of seed**								
(i)	Purchased	5	21.74	23	29.87	7	35.00	35	29.17
(ii)	Owned	18	78.26	54	70.13	13	65.00	85	70.83
	Total	23	100.00	77	100.00	20	100.00	120	100.00
5	**Adoption by land type**								
(i)	Upland	4	17.39	7	9.09	2	10.00	25	20.83
(ii)	Medium land	6	26.09	28	36.36	6	30.00	55	45.83
(iii)	Low land	13	56.52	42	54.55	12	60.00	40	33.33
	Total	23	100.00	77	100.00	20	100.00	120	100.00
6	**Adoption by seed treatment**								
(i)	Treatment with trichoderma and vitavax	4	17.39	9	11.69	3	15.00	16	13.33
(ii)	Soaking of seed for 4-5 hrs in water	14	60.87	53	68.83	13	65.00	80	66.67
(iii)	Treatment with trichoderma	5	21.74	15	19.48	4	20.00	24	20.00
	Total	23	100.00	77	100.00	20	100.00	120	100.00

7	**Adoption by seed age**								
(i)	More than 6 years	3	13.04	5	6.49	3	15.00	11	9.17
(ii)	3 to 6 years	12	52.17	50	64.94	11	55.00	73	60.83
(iii)	Less than 3 years	8	34.78	22	28.57	6	30.00	36	30.00
	Total	23	100.00	77	100.00	20	100.00	120	100.00
8	**Adoption by method of sowing**								
(i)	Broadcasting	22	95.65	72	93.51	18	90.00	112	93.33
(ii)	Line sowing	1	4.35	5	6.49	2	10.00	8	6.67
	Total	23	100.00	77	100.00	20	100.00	120	100.00

Source: Compiled by the Authors

Reason for decline in Area, Production and productivity of pulses in Bihar

The biotic/abiotic stresses cause extensive losses to pulse production in Bihar. Droughts, high and low temperature, water logging and salinity/alkalinity are major abiotic stresses affecting production and productivity of pulses. Among the insect pests and diseases, Helicoverpa armigera and wilt are the major biotic stress, damaging about 20-30% of the pulse production. Hence to minimize the losses, implementation of Integrated Pest Management (IPM) and Integrated Nutrient Management (INM) technologies is required. Several biotic and abiotic stresses are known to limit productivity of pigeonpea in our state (Singh et, all 2016 eastern parts of the country, where traditionally long duration (200-300 days) pigeon pea genotypes are cultivated in Kharif season also faced the same problem). However, it was observed that extreme abnormal temperature at the time of pod setting also reduce the productivity due to less fruit setting and forced maturity. Beside this, water-logging is one of major production constraint for pigeon pea, hence more area is shifting to maize in Kharif seasons. Apart from this, a viral disease, sterility mosaic is one of the major biotic stresses considered for heavy yield losses has been observed in almost all area under study. The extreme temperatures at reproductive stage of this area (often terminal high temperature stress) resulted in poor seed formation. Apart from this diversion of land to wheat in irrigated areas, and unsecured harvest of crop in isolated pockets due to social factors is another constraint. This is somewhat the major cause of declined in area under major pulses in Bihar.

Summing Up and Suggestions for Policy

Besides genetically improved varieties, the good agronomic practices efficient nutrient and weed management, and plant protection measures would have predominant role on the productivity of different pulses. Keeping in view the climate change, and management of biotic/abiotic stresses, the improvement in production pattern along with developing input responsive, short stature, short duration, and synchronous maturity variety suitable for mechanical harvesting need to be developed. Apart of this, adoption of modern technology as well as refinement of existing technologies used for different pulses crops to narrow down the yield gap is also need of hour. There are vast areas under water stagnation termed as Tal and Diara lands. Diara lands are lands situated in natural levees that get inundated for different periods of time and are periodically eroded and formed due to meandering, braiding and course changing of rivers (Perennial Rivers). Diara land is a local term used in Bihar needed to be target for adoption of improved variety of seed along with expansion of pulses (short duration) in cereal-dominated areas such as rice fallow land should also be use for pulse cultivation in Bihar. Major constraints for growing chickpea in Bihar are unavailability of suitable HYV of crop, erratic rainfall causes moisture stress in the post monsoon season, increasing incidence of disease and insect infestation, etc. Recently, consumption of chickpeas has gone up but this has not been reflected in the wholesale prices in the local communities. To increase area and production of chickpea in the study locations in Bihar, region specific approaches and prioritization should be given, and chickpea adoption needs to be considered within the farming systems of the crop choices of the farmers. Since, recently the rice and wheat crop acreage have been in increasing trend, and majority of farmers opt for cultivation of wheat in the post-monsoon season after rice; instead of chickpeas and other crops, especially when the irrigation is available at assured source. This is due to relatively low level of crop yield of chickpeas than wheat and other crops. In order to attain self-sufficiency, it is important to focus on research and development for pulses in terms of yield potential, fortification, and growing days. Despite of fetching more benefit than other competing crop, price of pulse is unstable. Therefore, assured procurement centre should be created in each production zones that would be act as added incentives to the farmers. The lack of an assured market price forced farmers to choose rice, wheat as main crop in their cropping pattern. In our state, there are no specific dal mills or efficient procurement of pulses which could ensure the timely payment therefore government procurement agencies is crucial to promote the agribusiness in these sectors. Most pulses are climate resilient and rain-fed. However, drought years do have an impact on their production (for instance, 2014-15). Hence development of organized markets for pulses is important. The decision on imports needs to be timely. Otherwise, by the time the imports arrive, the domestic supply is also in the market, leading to fall in prices and lower returns for the farmers.

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