Strategies to Overcome Pulse Production Constraints in West Bengal, India

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Abstract

Pulses are *basic ingredient* in the diet of a vast majority of Bengali population as they are perfect mix of high bio-logical value when supplemented with cereals. At present West Bengal is producing 1.58 lakh tons of pulses from 2.01 lakh ha area and the average productivity is 786 kg ha^{-1}. But, the demand for pulses in the state is about 15.82 lakh tons. It means, the state has to produce 10 times its present production to meet the demand. In the last 15 years, area of pulses declined due to cropping system shift to vegetables and boro rice with introduction of irrigation facilities. Cultivation of pulses in marginal and sub-marginal and less fertile lands, non-availability of good quality seed, adoption of local low yielding varieties and problems in safe storage are the major constraints in pulse production. The mismatch between production and demand for pulses in the state can be narrowed down by following suitable agro-techniques, replacing non-descriptive local varieties with high yielding pest and disease resistant varieties, expanding it's cultivation to non-conventional area with adequate transfer of technical knowledge, introducing it in the existing cropping systems, developing region specific high yielding cultivars, creating adequate and safe storage facilities

1. Introduction

Pulses are the ideal supplements for cereals due to their high protein (21-40%) and essential amino acid (lycine) content and are recognized as an integral part of Indian diet in general and Bengali diet in particular. These are one of the cheapest sources of dietary protein. 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 state of West Bengal suffers from acute shortage of pulses. During the last 12 years (1996-97 to 2010-11), the production of pulses varied from 1.82 to 2.14 lakh tons. To alleviate protein malnutrition, a minimum of 50 g pulses per capita per day should be available in addition to other sources of protein such as cereals, milk, meat or eggs (Ali and Kumar, 2005). With the present level of production, per capita availability of pulses in West Bengal is 4.46 to 6.75 g $head^{-1}$ day^{-1}. Nearly 10 times increase in present production is to be achieved to meet the current demand of pulses in the state. As of now, most of the demand of pulses is being met from imports which is a huge loss to the exchequer.

At present more than ten pulse crops are grown in an area of 1.97 lakh ha with a production of 1.76 lakh tonne and productivity 896 kg^{-1} ha in West Bengal. Lentil (57450 ha), black gram (56890 ha), grass pea/lathyrus (25780 ha) and green gram/ *mung* (17650 ha) are the major pulse crops grown in the state. Among the different districts of West Bengal, two districts *viz.,* Murshidabad (50782 ha) and Nadia (45784 ha) have major pulse producing area. Other districts are Malda, Birbhum, Midnapore (E), South 24-parganas and North 24-parganas.

2. Trends of Pulse Production

In contrast to the remarkable increase in area of *boro* rice (summer rice), oilseeds, potato and vegetables, the area as well as yield of pulse crops in West Bengal declined during last 15 years (1996-97 to 2010-11) (Figure.1 and Figure 2). Not only the area of pulse crops has been decreased, they have been pushed to marginal and sub-marginal land which is reflected in the productivity (Table 1 and Figure 2). Except greengram, the area and production of other pulse crops decreased during this period (Table 1 and Figure 3).

The main reasons behind the decrease in area, production and yield are:

2.1. Increase in irrigated area during rabi season

Table 1: Year wise Area, Production and Yield rate of major Crops in West Bengal

Crop		1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Total cereals	A	6212	6336	6335	6574	5918	6558	6297	6360	6268	6241	6144	6169	6353	6060	5365
	Y	2187	2241	2248	2237	2297	2490	2438	2484	2543	2486	2575	2578	2545	2573	2728
	P	13585	14202	14241	14704	13595	16326	15355	15798	15940	15513	15820	15903	16167	15591	14634
Boro rice	A	1056	1207	1450	1474	1402	1455	1406	1390	1376	1382	1401	1512	1556	1429	1369
	Y	3119	2958	3393	3031	3240	3034	2986	3086	3093	2928	3226	3259	2800	2991	3290
	P	3295	3570	4922	4468	4541	4415	4198	4289	4257	4047	4521	4926	4358	4276	4507
Total pulses	A	235	222	204	214	274	249	242	252	226	223	219	201	184	182	197
	Y	737	688	621	661	800	703	694	840	739	784	703	786	705	825	896
	P	173	153	126	141	219	175	168	211	167	174	154	158	129	150	176
Total oilseeds	A	509	508	493	502	598	604	568	685	673	643	703	707	704	682	671
	Y	841	761	769	808	953	816	837	951	827	969	917	998	828	1066	1048
	P	428	387	379	406	570	493	475	652	557	623	645	706	583	727	703
Jute	A	620	642	612	614	652	636	620	620	569	559	595	609	584	614	568
	Y*	12	12	12	12	14	13	13	13	14	14	14	13	13	15	14
	P*	7506	7549	7374	7428	8836	8505	8367	8367	7853	7989	8412	8216	7873	9325	8137
Potato	A	314.3	284	318	316	299	299	349	308	321	354	408	401	386	387	409
	Y	26956	20947	21023	23689	25606	26090	19761	24711	222	21053	12384	24704	10677	35768	32831
	P	8472	5949	6689	7482	7673	7822	6902	7622	7107	7462	5052	9901	4121	13838	13421
Vegetable	A	514	734	700	722	780	839	875	860	868	950	905	912	923	933	943
	Y	12986	10921	13383	11648	11957	12224	12157	12698	12663	12247	13361	13763	13874	13966	14135
	P	6671	8016	9367	8413	9333	10253	10636	10919	10997	11632	12088	12556	12803	13027	13334

A= Area (000' ha); Y= Yield (kg ha^{-1}); P= Production (000' tons); Y*= Yield (bales ha^{-1}); [1 bale=170 kg]; P*= Production in '000 bales ; Souce**:** Estimates of area, production and yield rate of major crops in West Bengal, Dept. of Agriculture, Govt. of West Bengal (2009, 2011 and 2012)

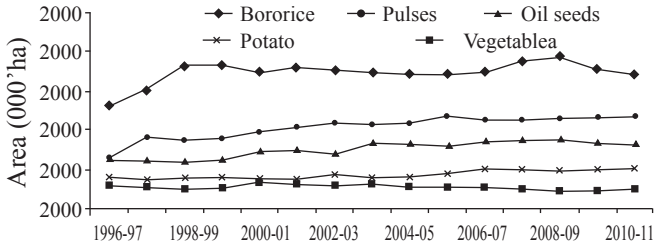

Figure 1: Trend of area of *boro* rice, pulses, oilseeds, potato and vegetables in West Bengal (1996-97 to 2010-11)

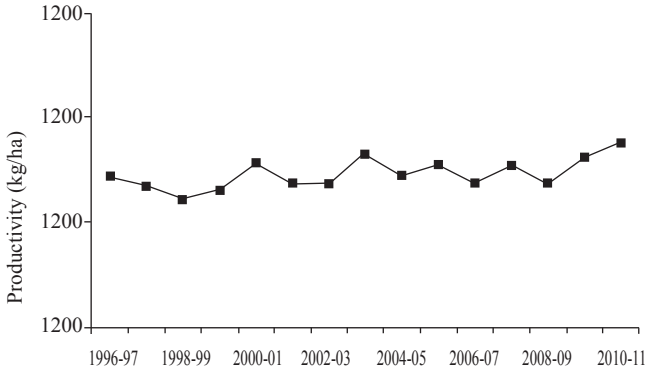

Figure 2: Trend of pulse productivity (1996-97 to 2010-11)

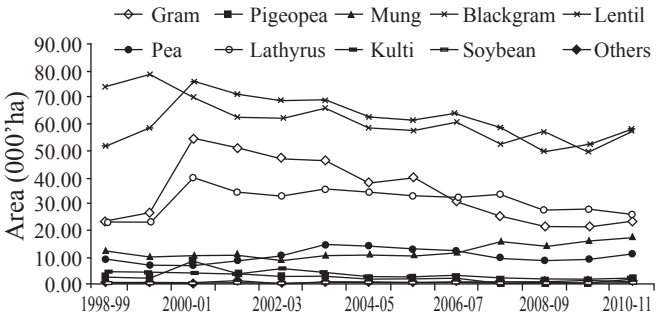

Figure 3: Trend of area under different pulse crops in West Bengal (1998-99 to 2010-11)

With the availability of irrigation water (53% area is irrigated) in fertile land, farmers started boro rice, oilseeds, potato and vegetables cultivation instead of pulses and they have been pushed to marginal and sub-marginal lands.

2.2. Abnormal weather condition

Delayed precipitation during *kharif* season, or excessive rainfall or prevalence of winter rains is

another reason for decrease in area, production and yield as a whole. Incidence of diseases (particularly viral disease) or

pests is to be considered as an important reason for decrease in area, production and yield of pulses in West Bengal.

3. Yield Gaps

Yield gaps of different pulse crops at different agro-climatic zones are calculated on the basis of research plot yield *vs.* average farmers' plot yield in that particular zone. There are huge gaps between research plot/field yield and farmers' plot in each and every agro-climatic zone (Table 2). The production as well as the yield of pulse crops could be boosted up substantially through technology transfer by front line demonstration. With the existing acreage the total pulse production can be more than doubled if this yield gap can be covered. This improvement in research plot was mainly due to the varietal manipulation coupled with improved agro-techniques.

4. Constraints in Pulse cultivation

4.1. Extension of irrigated area in rabi season

During last 15 years huge development in irrigation, particularly ground water irrigation has increased in the state. With the availability of irrigation water, farmers took the opportunity to cultivate food crops, cash crops and vegetable crops, which are more remunerative.

4.2. Less remunerative than other crops

Though the market price of pulse has increased rapidly in comparison with other crops, still farmers are not finding pulse cultivation as remunerative.

4.3. Deficiency in seed supply

Interested farmer do not have enough seed of good genotypes. In case of food crops, due to their higher yield farmers can put aside enough seeds for the next season after meeting the own consumption. This possibility in pulse crop is nil.

4.4. Storage problem

It becomes a problem for the farmers to store the pulse seeds through rainy season for the next season sowing. Pulse seeds are more attractive for the stored grain pests than cereals.

4.5. Preference of consumers to such pulses which are low productive

Though Bengali people take all types of common pulses, however they prefer more mung, black gram and lentil which are less productive than pigeon pea, gram and lathyrus.

5. Strategies to increase area and productivity

5.1. Productivity enhancement through

5.1.1. Replacement of non-descriptive local material

At present very little area is covered with high yielding pulse varieties developed either in West Bengal or in other states but suitable for West Bengal condition. There are proven experimental results of the trials conducted in the experimental fields over years to show that the adoption of modern improved varieties can enhance the yield 20-25%. Table 2 depicts that there is good increase in productivity of some pulse crops like mung, black gram and to some extent in gram.

5.1.2. Introduction of improved technology

Information in respect of effect of improved agronomic practices in the pulse crops towards betterment of yield is available in the state. But unfortunately very little of it is trickled down to the farmers' level. The aspect can be justified based on the following facts:

5.1.2.1. Timely sowing Though farmers are well aware about when to sow, the experimental evidences showed how the betterment of yield can be brought about by resorting to timely sowing practice. Sowing of pulse crop during mid November recorded the maximum yield of chickpea (Ray et al., 2010). Roy et al. (2009) observed better yield of lentil, when it was sown November.

5.1.2.2. Optimum seed rate Poor plant population in the farmers' field is one of the major factors towards poor yield. Crops sown with optimum seed rate to ensure optimum number of plants per unit area would give much better yield than what is obtained at present. Ample experimental results are available to support this. Generally black gram and green gram seeds are broadcasted but line sowing at 20x10 cm^2 spacing resulted better yield (Sengupta et al., 2001). *Lathyrus* requires a seed rate of 60-75 kg ha^{-1} under *utera* or *paira* system (Anonymous, 2006). When pulses grow as *paira* crop, it requires higher seed rate (Anonymous, 2008).

5.1.2.3. Fertilizer management

Table 2: Yield gap (kg ha^{-1}) of different pulse crops at different agro-climatic zones

Zone	Gram	Pigeon pea	*Mung*	Black gram	Lentil	Pea	Lathyrus
Hill	1117.00	983.00	800.00	661.00	906.00	1317.00	357.00
Terai	932.00	915.00	630.00	786.50	1211.00	1362.00	599.50
Old Alluvial	1060.60	1209.75	569.00	793.80	799.40	1345.20	493.80
New Alluvial	1056.67	986.00	580.67	840.00	823.67	1313.67	305.00
Red-Laterite	1103.75	1563.25	561.00	881.75	499.00	1373.00	564.00
Coastal Saline	1029.00	986.00	523.67	584.00	856.00	1378.00	393.67

Farmers are very reluctant to apply any fertilizer to pulse crop. They treat it as neglected crop. However, recommended dose of fertilizer increases the yield enormously. Spraying of 2% urea at flowering and 10 days thereafter increased the grain yield of chickpea (Bhowmik, 2006). Bhowmik (2008) observed highest grain yield of lentil with two spray of 2% urea one at pre-flowering and another 10 days thereafter along with 20-40-20-20 (N-P_2O_5-K_20-S kg ha^{-1}). Gupta and Bhowmik (2005) recorded highest yield of *lathyrus* with basal application of 10-25-20 (N-P_2O_5-K_20 kg ha^{-1})+2% DAP spray at flowering. Shamsuddoha et al. (2011) reported highest uptake of N, P, K, S and B in green gram with the application of sulfur and boron @ 8 kg and 2 kg ha^{-1} respectively. Application of molybdenum @ 0.4 kg ha^{-1} increases the yield of garden pea (Rabbi et al., 2011).

5.1.2.4. Adoption of plant protection measures

Pulse crops, particularly chickpea and pigeon pea are much affected by insect pests like pod borer. Little or no measure till to date is taken to prevent this. Black gram and green gram are affected by mosaic disease; very little care is taken to prevent transmission of this by controlling the vector. Hand weeding at 45 and 65 DAS in lentil increases the yield significantly. In chickpea the maximum seed yield was recorded with weed free check (12.85 kg ha^{-1}) followed by fluchloralin @ 0.5 kg a.i. ha^{-1}+one hand weeding at 50 DAS (12.45 kg ha^{-1}) and two hand weeding at 30 and 60 DAS (12.18 kg ha^{-1}) (Jain et al., 2002). Black gram recorded the highest yield with the application of Pendimethalin 30 EC @ 1.0 kg a.i. ha^{-1}+one hand weeding (Anonymous, 2006).

5.1.2.5. Irrigation

Kharif pulses like black gram, pigeon pea do not require any irrigation. However, in *rabi* pulse crops like gram and lentil, yield increases with application of one irrigation. In case summer mung under deficient pre-monsoon shower application of two irrigations certainly increases yield. Chickpea recorded maximum grain yield when two irrigations were given at branching and pre-flowering (Ray et al., 2009).

5.2. Increasing area under pulses through

5.2.1. Cultivation in non-conventional area

In North Bengal a vast area is acidic in nature and remains fallow during post rainy season, with soil amelioration this area can be brought under pulse cultivation. In some pockets in North Bengal crops, like lentil and black gram are grown during post-*kharif* season after harvest of jute and upland rice. But there is still ample scope of increasing the acreage under pulses comprising the districts of Uttar Dinajpur, Dakshin Dinajpur, Jalpaiguri and Cooch Behar, provided the supply of soil ameliorant like dolomite and lime are assured. Even in areas where lentil and black gram are cultivated, replacement of traditional varieties with suitable high yielding type will increase the total production.

During the last few years it is becoming progressively difficult to grow gram particularly in the Gangetic-Alluvial zone where more than 60% pulse area is located. Gram is such a pulse crop through which total production of pulse can be increased. But, because of too much winter rain, its cultivation is becoming limited bringing down the total area as well as production. The four districts where more than 60% pulse area is located are Murshidabad, Nadia, North 24 parganas and Malda, Unlike these gangetic-alluvium districts, the experience is different in red-laterite districts like, Birbhum, where there is good scope of gram cultivation utilizing the residual moisture left after harvesting of kharif rice. Thus, there is possibility of increasing area of gram cultivation from gangetic-alluvium to red-laterite districts of Burdwan and Birbhum.

5.2.2. Cropping system

The sole cropping of pulse in pre- and post-rainy seasons by fitting them into double and multiple cropping systems has opened out bright prospects in irrigated as well as rainfed area (Gangwar and Ram, 2005). Inter-cropping of pigeonpea with maize has been identified as profitable. Inter-cropping of soyabean with direct seeded rice or pigeonpea with rice or black gram/green gram with rice under different management and spatial arrangement have shown better results. Inter-cropping of November planted crop like wheat and mustard opened the new vistas in increasing the production of pulse. Similarly, alternate row sowing (30 cm apart rows) of turmeric and greengram has been found to provide 7-10 q ha^{-1} of greengram without affecting the yield of turmeric and at the same time minimized the cost of weeding in turmeric (Kundu and Chatterjee, 1981 and 1982). Intercropping of greengram in between the rows of jute reduces the weed infestation as well as increases the system yield (Anonymous, 2003). Cowpea can be cultivated in rice-cowpea, rice-rice-cowpea and rice-mustsard-cowpea crop rotations for vegetable as well as seed purpose. It can be intercropped with maize, lady's finger etc., (Kumar, 2005).

5.2.3. Pigeonpea on bunds

Large field boundaries can be utilized for growing pigeonpea, particularly in watershed areas of Purulia, Birbhum, Bankura, Bankura and Burdwan, even the field boundaries of rice may be used. In the canal command area or even in the tube well command area a large areas along the irrigation channel remain fallow. Pigeonpea may be raised along these irrigation channels, which will boost the pigeonpea production.

6. Conclusion

Appropriate market intervention and promotion of post harvest

technology are equally necessary to encourage farmers to invest more in pulse production. A mass awareness programme to educate farmers on scientific storage along with distribution of seed storage bins can check the post-harvest losses and increase the shelf-life of pulses. Subsidy in the form of critical inputs as easy and cheap credits besides crop insurance policies can help the farmers to grow pulses with minimum risk.

7. Future Thrust

To increase area and production of pulse crops in West Bengal we need crop specific approaches, which should be adopted in the overall framework of systems approach. The major thrust areas to be addressed are as follows:

a. Replacement of cereal or other crops in the prevailing rice-wheat or rice-oilseeds cropping systems with high yielding varieties of pulses;
b. Inclusion of short duration varieties of pulses as catch crop;
c. Development of multiple disease and pest resistant varieties;
d. Reducing storage loses and improving market information and infrastructure;
e. Linking MSP to market prices can bridge the gap between demand and supply;
f. Developing high nitrogen fixing varieties or efficient *Rhizobium* strain, which will play a crucial role in sustainable agriculture; and
g. Coordination of research, extension and farmers to encourage farmer's participatory research.

8. References

Ali, M., Kumar, S., 2005. Pulses-yet to a breakthrough. The Hindu Survey of Indian Agriculture, 54-56.

Anonymous, 2012.Estimates of area, production and yield rate of major crops in West Bengal 2007-08 Dept. of Agriculture, Govt. of West Bengal, 157.

Anonymous, 2011.Estimates of area, production and yield rate of major crops in West Bengal 2007-08 Dept. of Agriculture, Govt. of West Bengal, 162.

Anonymous, 2009.Estimates of area, production and yield rate of major crops in West Bengal 2007-08 Dept. of Agriculture, Govt. of West Bengal, 227.

Anonymous, 2008. Annual report pulses and oilseed research station, Berhampore, West Bengal, 85.

Anonymous, 2006. Annual report pulses and oilseed research station, Berhampore, West Bengal, 80.

Anonymus, 2003. Annual report Zonal Adaptive Research Station, Mohitnagar, Jalpaiguri, West Bengal, 80.

Bhowmik, M.K., 2008. Effect of foliar nutrition and basal fertilization in lentil under rainfed condition. Journal of Food Legume 21(2), 115-116.

Bhowmik, M.K., 2006. Foliar nutrition and basal fertilization in chickpea under rainfed condition. Environment and Ecology 24S(4), 1028-1030.

Gangwar, B., Ram, B., 2005. Effect of crop diversification on productivity and profitability of rice (*Oryza sativa*) and wheat (*Triticum aestivum)* system. Indian Journal Agricultural Science 75(7), 435-438.

Gupta, S., Bhowmik, M.K., 2005. Scope of growing *lathyrus* and lentil in relay cropping systems after rice in relay cropping systems after rice in West Bengal, India. Lathyrus Lathyrism Newsletter 4, 28-33.

Jain, K.C., Singh, S., Nag, A.K., Sekhawat, V.S., 2002. Efficacy of different weed control methods in chickpea. Indian Journal Pulses Research 15(2), 172-173.

Kumar, D., 2005. Status and direction of arid legumes research in India. Indian Journal Agricultural Science 75(7), 375-391.

Kundu, A.L., Chatterjee, B.N., 1982. Growth analysis of turmeric as a sole crop and in mixture with other crops. Indian Journal Agricultural Science 52(9), 584-589

Kundu, A.L., Chatterjee, B.N., 1981. Effect of major nutrients on turmeric production as a sole crop or in mixture with other crops. Indian Journal Agricultural Science 51(7), 504-508.

Rabbi, A.K.M., Paul, A.K., Sarker, J.R., 2011. Effect of nitrogen and molybdenum on growth and yield of garden pea (*Pisum sativum* L.). International Journal of Bio-resource and Stress Management 2(2), 230-235.

Ray, M., Chowdhury, S., Nanda, M.K., Khan, D.K., 2010. Water use in chickpea (*Cicer arietinum* L.) in the gangetic alluvial zone of West Bengal. Journal of Agrometeorology 12(1), 81-84.

Roy, A., Aich, S.S., Bhowmik, M.K., Biswas, P.K., 2009. Response of lentil varieties to sowing time in the plains of West Bengal. Journal of Crop and Weed 5(2), 92-94.

Shamsuddoha, A.T.M., Anisuzzaman, M., Sutradhar, G.N.C., Hakim, M.A., Bhuiyan, M.S.I., 2011. Effect of sulfur and boron on nutrients in mungbean (*Vigana radiate* L.) and soil health. International Journal of Bio-resource and Stress Management 2(2), 224-229.

Sengupta, K., Nandi, S., Baral, M., 2001. Effect of sowing attributes on grain yield of rainfed blackgram [*Vigna mungo* (L)] crop. Proceedings of National Seminar of Crop Management, Feb.1-3, 15-18.