Economic Affairs
DOI : 10.5958/0976-4666.2015.00109.6

Constraints in Adoption of Soybean Production Technologies in Northern Hill Region of Chhattisgarh Agro-Climatic Zone of Madhya Pradesh

Santosh Kumar[1], Deepak Rathi[2], S.B. Nahatkar[3] and Tadayoshi Masuda[4]

[1&2] *AER Centre, Jawahar Lal Nehru Krishi Vishwavidalaya India*
[3&4] *Directorate of Research Services and JICA Project, JNKVV, Jabalpur, India*

Corresponding author: santosh.ageco@gmail.com

Paper No.: 299 Received: 22 February 2015 Accepted: 25 December 2015

Abstract

A study was conducted to find out the yield gap, adoption pattern, determinants of adoption and constraints in adoption of soybean production technologies. The primary data was collected from 30 farmers selected on the basis of yield levels, as high, moderate and low in the Northern Hill Region agro-climatic zone of Madhya Pradesh. The study revealed that at overall yield level gap-I, II, and III were found to be 47.51%, 18.52 and 59.22%, respectively. More than 90% of respondents were not adopting land levelling, irrigation management, plant protection measures, seed treatment, and nutrient management due to various constraints such as lack of capital, high cost, lack of knowledge etc. Multiple regression analysis showed positive and significant impact of education on adoption of soybean production technologies. The model fitted was found to be bets fit with R^2 60%.

Keywords: Yield gap, adoption pattern, constraints

India is the fourth major soybean growing country in the world. Soybean is a major *kharif* (monsoon season) oilseed crop grown by the farmers of Madhya Pradesh, the 'Soy State'. This golden bean of 21st century is successfully being grown by the farmers of this "Soy State" since its resurrection in India during late sixties. This venture not only revolutionized the socio-economic status of soybean farmers but also provided them with an apt cropping system of soybean-wheat/chickpea as soybean occupied monsoon fallows in initial years of its establishment (Dupare *et al*. 2010). Soybean contributes significantly to the Indian edible oil pool. Presently soybean contributes 43 % to the total oilseeds and 25% to the total oil production in the country. Soybean has largely been responsible in uplifting farmer's economic status in many pockets of the country.

The production of Soybean in India has increased at a CAGR of 9.60% from 6.87 million tonnes in 2004-05 to 15.68 million tonnes in 2012-13. On the other hand, Soybean meal consumption has also increased at a CAGR of 10.82% over the last eleven years from 1365 thousand million tonnes in 2004-05 to 4225 thousand million tonnes in 2014-15. Therefore, to keep pace with the increasing demand it is imperative to increase the productivity level of Soybean in the country (http://www.ficci.com/spdocument/20539/Soybean-Report.pdf).

Madhya Pradesh produces 54% of the total production of soybean in the country. The other soya producing states are Maharashtra, Rajasthan and Uttar Pradesh. In the remaining states, soybean production is negligible. The western and north-western parts of Madhya Pradesh are major soybean producing areas. Comparatively, eastern and southern parts of Madhya Pradesh produce very little of it.

Madhya Pradesh is a leading state of India in terms of area and production of oilseeds and recognized as Soya State in the country. It becomes possible only due to the serious efforts made by the scientists and the government resulting into tremendous increase in oilseed production. Amongst different major oilseeds cultivated in Madhya Pradesh the total area covered in soybean was found maximum (79.10%). In Madhya Pradesh the Area under Soybean Cultivation during *Kharif* 2014 is 55.462 lac Hectares. The production during *Kharif* 2014 was 60.249 Lac MT. In northern hill region the area under soybean cultivation was 0.105 lacks ha, yield 850 per kg and production 0.089 lacks MT (SOPA, 2014). The adoption of an improved technology often results in increased technology depends various factors, which influence yield of the soybean. The soybean scientists claimed that they have developed a very good package of practices for soybean production technology to harvest good yield, but farmers were not able to harness its full potential. Hence, this study was undertaken to examine the yield gap, adoption pattern of soybean production technologies, determinants of adoption and constraints of technologies in northern hill region of Madhya Pradesh with some specific objectives. These are (1) to analyse the yield gap and adoption pattern of soybean production, (2) to find out the determinants of adoption of soybean production technologies and (3) to identify the constraints in adoption of soybean production technology.

Database and Methodology

For this study, Dindori district of Northern Hill Region of Chhatishgarh was selected as this district covers maximum acreage in soybean out of six districts of this region. A representative block of the selected district was selected on the basis of maximum acreage under soybean. From selected block a cluster of three villages were selected having the sizable area under soybean. From each selected cluster of these villages, the list of farmers was prepared on the basic of yield level as high (5), moderate (10) and low (15). From the selected farmers, information was collected with the help of pre-tested schedule. The yield gap I, yield gap II, and yield gap III were analysed as following formulae:

$$\text{Yield Gap-I: Yield gap –I (In per cent)} = \frac{Y_p - Y_d}{Y_p} \times 100$$

$$\text{Yield Gap-II: Yield gap (In per cent) – II} = \frac{Y_d - Y_a}{Y_d} \times 100$$

$$\text{Total Yield Gap (TYG): TYG (In per cent)} = \frac{Y_p - Y_a}{Y_p} \times 100$$

$$\text{Index of Realized Potential Yield (IRPY): IRPY} = \frac{Y_a}{Y_p} \times 100$$

Index of Realized Potential Farm Yield (IRPFY):

$$\text{IRPFY} = \frac{Y_a}{Y_d} \times 100$$

Where, Y_p = Potential Yield, Y_d = Potential Farm Yield and Y_a = Actual Yield

Factors, which affect adoption of technology in the production of soybean, were also identified and their effects were assessed by using multiple regression analysis of following form:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$$

Where, Y= Dependent variable, X_1 = Age (Years), X_2 = Education (Schooling in years), X_3 = Number of family members, X_4 = Total Area (ha.) and X_5 = Irrigated area (ha.)

Results and Discussion

The magnitude of YG I, II and III in soybean are presented in Table 1. It was observed from data that overall level the potential farm yield and actual yield was found to be 15.5 and 12.09 q/ha respectively; potential yield was 29.64 q/ha. The average yield gap-I

Table 1: Yield gap at various level of adoption

Particulars	High yield	Mid yield	Low yield	Overall
Potential yield (q/ha)	29.64	29.64	29.64	29.64
Potential farm yield (q/ha)	25	12.5	9	15.5
Actual farm yield (q/ha)	17.44	11.07	7.75	12.09
Yield gap-I (%)	15.65	57.83	69.64	47.71
Yield gap-II (%)	30.24	11.44	13.89	18.52
Yield gap-III (%)	41.16	62.65	73.85	59.22
Index of Realized Potential Yield (IRPY) (%)	58.84	37.35	26.15	40.78
Index of Realized Potential Farm Yield (IRPFY) (%)	69.76	88.56	86.11	81.48

Table 2: Adoption pattern and constraints related to deep ploughing

Particulars	High yield	Mid yield	Low yield	Total
Adopters (no.)	8(26.67)	11(36.67)	6(20)	25(83.33)
Non-adopters (no.)	1(3.33)	3(10)	1(3.33)	5(16.67)
Constraints				
High cost	0(0)	2(6.67)	0(0)	2(6.67)
Labour	0(0)	2(6.67)	0(0)	2(6.67)
Other	1(3.33)	0(0)	0(0)	1(3.33)

Table 3: Adoption pattern and constraints related to harrowing

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	8(26.67)	13(43.33)	7(23.33)	28(93.33)
Non-adopters (no.)	1(3.33)	1(3.33)	0(0)	2(6.67)
Constraints				
No effect on yield	1(3.33)	0(0)	0(0)	1(3.33)
High cost	1(3.33)	1(3.33)	0(0)	2(6.67)
Labour	0(0)	1(3.33)	0(0)	1(3.33)
Lack of time	1(3.33)	0(0)	0(0)	1(3.33)
Lack of knowledge	0(0)	1(3.33)	0(0)	1(3.33)

Table 4: Adoption pattern and constraints related to land levelling

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	2(6.67)	0(0)	0(0)	2(6.67)
Non-adopters (no.)	7(23.33)	14(46.67)	7(23.33)	28(93.33)
Constraints				
No effect on yield	1(3.33)	0(0)	0(0)	1(3.33)
High cost	8(26.67)	13(43.33)	5(16.67)	26(86.67)
Labour	4(13.33)	7(23.33)	2(6.67)	13(43.33)
Other	1(3.33)	0(0)	0(0)	1(3.33)

Table 5: Adoption pattern and constraints related to seed treatment before sowing

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	2(6.67)	0(0)	0(0)	2(6.67)
Non-adopters (no.)	7(23.33)	14(46.67)	7(23.33)	28(93.33)
Constraints				
No effect on yield, germination ratio, pest and disease	1(3.33)	0(0)	0(0)	1(3.33)
High cost	7(23.33)	12(40)	8(26.67)	27(90)
Lack of time	1(3.33)	1(3.33)	0(0)	2(6.67)
Lack of knowledge	6(20)	9(30)	5(16.67)	20(66.67)
Non available of chemicals	6(20)	4(13.33)	4(13.33)	14(46.67)
Other	1(3.33)	2(6.67)	0(0)	3(10)

Table 6: Adoption pattern and constraints related to intercropping

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	0(0)	0(0)	0(0)	0(0)
Non-adopters (no.)	9(30)	14(46.67)	7(23.33)	30(100)
Constraints				
Lower Yield	0(0)	2(6.67)	0(0)	2(6.67)
Higher cost	6(20)	10(33.33)	12(40)	28(93.33)
Pest & disease	12(40)	2(6.67)	9(30)	23(76.67)
Weed	5(16.67)	16(53.33)	6(20)	27(90)
Only Soybean Yield need	0(0)	2(6.67)	0(0)	2(6.67)
Lack of suitable implement	2(6.67)	2(6.67)	0(0)	4(13.33)
Other	1(3.33)	0(0)	0(0)	1(3.33)

was found to be 47.71% due to non-adoption of soybean technologies in the area. It implied that the farmers did not adopt the soybean production technology due to non-transferable of all the components of technology like inputs used, cultural practices, etc.

Yield gap-II was found to be 18.52%, which was due to various constraints presents in the area. It showed that the farmers did not adopt the recommended package of practices due to several socio-economical, biological and cultural constraints. Magnitude of total yield gap (gap-III) was worked out to be 59.22%. Sharma et al. (2006) estimated the existing adoption pattern, yield gap and constraints in adoption of recommended package of practices of soybean and found 35.89 % adoption gap in the area, which influenced yield up to 48.20% with the potential yield of soybean). The yield gap-I (47.71%) was higher as compared to yield gap-II (18.52%). The overall Index of realized potential yield estimated was 40.78% and realized potential farm yield was 81.94%.

Adoption pattern and constraints related to deep ploughing are presented in Table 2. The data shows that 83.33% of soybean growers adopted the deep ploughing in the study area. Other soybean growers were not adopted the deep ploughing due to high cost (6.67%), labour (6.67%) and others factors (3.33%).

Adoption and constraints related to field preparation of harrowing technology are presented in Table 3. The data indicate that the 93.33 percentage soybean growers adopted recommended number of harrowing. Others soybean growers were not adopted recommended number of harrowing due to high cost (6.67%), no effect on yield (3.33%), labour (3.33%), lack of time (3.33%), and lack of knowledge (3.33%).

It is clear from the Table 4 that the only 6.67 percentage soybean growers were adopted the land levelling, while on the others hand 93.33 percentage soybean growers not adopted the land levelling due to high cost, labour, no effects on yield and others as reported by 86.67, 43.33, 3.33 and 3.33%, soybean growers respectively.

The levelling plays as significant role as for as production of soybean is concerned because in a well levelled field the chance of stagnation of water becomes minimum and as a result of good aeration and soil temperature it leads to better productivity of soybean.

Adoption pattern and constraints related to seed treatment technology are presented in Table5. The data showed that the recommended seed treatment technology was adopted by only 6.67% of soybean growers in the study area.

The constraints for not adopting the seed treatment before sowing as reported by soybean growers were found to be high cost (90%), lack of knowledge (66.67%), non-availability of chemicals (46.67%), others (10%), lack of time (6.67%) and no effect of yield, germination ratio, pest and disease (3.33%).

Cent percent farmers were not adopting intercropping in soybean due to various constraints such as higher cost (93.33%), weed (90%), pest and disease (76.67%), lack of suitable implements (13.33%), lower yield (6.67%), and other (3.33%) (Table 6).

About 90% respondents were found to adopt manure and soil treatment in their fields while only 10% soybean growers not adopted due to no effect on yield (3.33%), lack of farm produce manure (3.33%) and lack of knowledge (3.33%) (Table 7).

As for as balanced nutrients application in soybean is concerned, more than 90% soybean growers were not adopting balance nutrition. Rest of the cultivators were not in position to use the recommended doses of nutrient in the fields due to high cost, lack of capital, no requirements and lack of knowledge as reported by 83.33%, 63.33%, 43.33% and 33.33% respectively (Table 8).

All most 100% soybean growers follow the drainage of excess water for cultivation of soybean in the study area (Table 9). Soybean growers were not in position to follow this system due to no sever moisture problem (3.33%), lack of time (3.33%) and others (3.33%).

Only 10% soybean growers adopt the irrigation management in the study area (Table 10). While 90% soybean growers were not adopted this technology due to lack of irrigation (53.33%), lack of knowledge (13.33%) and no severe moisture problem (10%).

Majority of soybean growers not used chemical control of pest and disease in soybean (76.67%) due to no severe pest and disease problem (70%), high cost (26.367%), lack of time 10%) (Table 11), while 23.33%% soybean growers have used the chemicals in cultivation of soybean in the study area.

As regards to weed control by chemical in soybean, 73.33% respondents used chemical while 26.67% soybean growers were not in position to control weed in soybean due to no severe weed problem, high cost and other as reported by 23.33, 20, and 3.33%, respectively (Table 12).

An attempt was also made to find out the factors affecting adoption pattern by using multiple regression analysis considering five independent variables viz., Age

Table 7: Adoption pattern and constraints related to manure and soil treatment

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	8(26.67)	13(43.33)	6(20)	27(90)
Non-adopters (no.)	1(3.33)	1(3.33)	1(3.33)	3(10)
Constraints				
No effect on yield	0(0)	1(3.33)	0(0)	1(3.33)
Lack of farm prod	0(0)	0(0)	1(3.33)	1(3.33)
Lack of knowledge	1(3.33)	0(0)	0(0)	1(3.33)

Table 8: Adoption pattern and constraints related to intercropping

Nutrients and hormones	Particulars	High yield	Mid yield	Low yield	Overall
$ZnSO_4$	Adopters (no.)	2(6.67)	0(0)	0(0)	2(6.67)
	Non-adopters (no.)	7(23.33)	14(46.67)	7(23.33)	28(93.33)
Gypsum	Adopters (no.)	1(3.33)	0(0)	0(0)	1(3.33)
	Non-adopters (no.)	8(26.67)	14(46.67)	7(23.33)	29(96.67)
Soil application of bio-fertilizer	Adopters (no.)	1(3.33)	0(0)	0(0)	1(3.33)
	Non-adopters (no.)	8(26.67)	14(46.67)	7(23.33)	29(96.67)
Application of G. hormones	Adopters (no.)	0(0)	0(0)	0(0)	0(0)
	Non-adopters (no.)	9(30)	14(46.67)	7(23.33)	30(100)
Constraints					
Lack of Knowledge		5(16.67)	2(6.67)	3(10)	10(33.33)
Lack of Capital		3(10)	10(33.33)	6(20)	19(63.33)
No required		2(6.67)	9(30)	2(6.67)	13(43.33)
High cost		5(16.67)	12(40)	8(26.67)	25(83.33)

Table 9: Adoption pattern and constraints related to drainage of excess wate

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	8(26.67)	14(46.67)	7(23.33)	29(96.67)
Non-adopters (no.)	1(3.33)	0(0)	0(0)	1(3.33)
Constraints				
No severe moisture problem	1(3.33)	0(0)	0(0)	1(3.33)
Lack of time	1(3.33)	0(0)	0(0)	1(3.33)
Other	1(3.33)	0(0)	0(0)	1(3.33)

Table 10: Adoption pattern and constraints related to irrigation management

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	2(6.67)	0(0)	1(3.33)	3(10)
Non-adopters (no.)	7(23.33)	14(46.67)	6(20)	27(90)
Constraints				
No severe moist problem	2(6.67)	1(3.33)	0(0)	3(10)
Lack of Knowledge	1(3.33)	2(6.67)	1(3.33)	4(13.33)
Lack of irrigation	2(6.67)	8(26.67)	6(20)	16(53.33)

Table 11: Adoption pattern and constraints related to pest and disease control by chemical

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	2(6.67)	3(10)	2(6.67)	7(23.33)
Non-adopters (no.)	6(20)	11(36.67)	6(20)	23(76.67)
Constraints				
No severe pest and disease problem	5(16.67)	11(36.67)	5(16.67)	21(70)
High cost	4(13.33)	4(13.33)	0(0)	8(26.67)
Lack of time	0(0)	3(10)	0(0)	3(10)

Table 12: Adoption pattern and constraints related to chemical weed control

Particulars	High yield	Mid yield	Low yield	Overall
Adopters (no.)	9(30)	9(30)	4(13.33)	22(73.33)
Non-adopters (no.)	0(0)	5(16.67)	3(10)	8(26.67)
Constraints				
No severe weed problem	0(0)	4(13.33)	3(10)	7(23.33)
High cost	0(0)	4(13.33)	2(6.67)	6(20)
Other	0(0)	1(3.33)	0(0)	1(3.33)

Table 13: Multiples Regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	7.464	3.089		2.417	.024
Age (yrs)	.032	.048	.104	.662	.514
Education (schooling yrs)	.396*	.176	.396	2.246	.034
No. of Family members	-.365	.486	-.099	-.752	.459
Total Area (ha.)	.257	.592	.183	.435	.668
Irrigated Area (ha.)	.471	.603	.324	.781	.443
R^2 (%)		60			

*Significant at P=0.05 level.

of the head of family ($X_{1)}$, Education of head of family ($X_{2)}$, Number of family members ($X_{3)}$, Total Area (ha.) ($X_{4)}$, and Irrigated area (ha.) (X_5) to find out the how these independent variables effect the adoption (Y) of improved technologies (Table 13).

The fitted function i.e. multiple regression analysis was found to be a good fit with R^2 60%, which shows 60% variation in yield was explained by the variables included in the model. The education (0.396*) was turned out to be positive and significant variable influencing the yield, this shows that as the level of education increases, the level of adoption is also likely to be increase. Others variables like age of farmer (0.032), total area (0.257) and irrigated area (0.471) also showed positive relationship but were non-significant, while number of family members (-0.365) was found to be negative and non-significant.

Conclusion

Soybean is an important cash crop for farmers in the Northern Hill Region of Chhattisgarh, agro-climatic zone of Madhya Pradesh. This study revealed that soybean growers faced various constraints in adoption of soybean technologies in this agro-climatic zone. The results observed the yield gap-I of 47.71% due to non-adoption of soybean technologies in the area. Yield gap-II was 18.52% and as a result on an average at overall level 60% yield gap-III observed in the study area. The index of realized potential yield and realized potential farm yield were found to be 40.79 and 81.49%, respectively. It shows that there is huge gap of 59% exist as for as harnessing the potential is concerned. The sincere efforts of a capacity building and transfer of technology through extension agencies are needed to fulfil this gap. This will insure efficient utilization of resources to meet out the goal of self-sufficiency.

Constraints to soybean production related to field preparation which includes the land levelling was not used because of high cost and labour used. Majority of soybean growers reported that use of seed treatment, intercropping, balance nutrients, irrigation management, and pest and disease were not adopted because of lack of knowledge, high cost, lack of time and non-availability of labour. Wuni (2011) also reported the similar result.

The education level (0.396*) of the soybean cultivator was found to be positive and significant at 5% probability level. Mustapha *et al.* (2012) found that educational level, farming experience and sources of information had significantly and positively influenced the adoption of improved soybean production technologies by respondents). It shows that adoption level of soybean production technology will increase by increasing their level of education. Age of cultivator (0.032), their area under irrigation (0.471) and total area (0.257) were found to be positive but non-significant, while number of family members (-0.365) was found negative and non-significant

References

Evaluation of the PPPIAD Project on SOYBEAN (2014-15) http://www.ficci.com/spdocument/20539/SOYBEAN-Report.pdf.

Mustapha, S.B., Makinta, A.A., Zongoma, B.A. and Iwan, A.S. 2012. "Socio-Economic Factors Affecting Adoption of Soya Bean Production Technologies in Takum Local Government Area of Taraba State, Nigeria", *Asian Journal Agriculture and Rural Development* **2**(2): 271-276.

Wuni Mbanya, 2011. Assessment of the Constraints in Soybean Production: A Case of Northern Region, Ghana *Journal of Developments in Sustainable Agriculture* **6**: 199-214.

Khare, Y.R., Mishra, P.K., Vinita Singh, Shrivastava, 2011. Adoption pattern of improved soybean production practices in Sagar district in Vindhyan pleatue agro-climatic zone of Madhya Pradesh, India*, Journal of Plant Archives* **11**(2): 1107-111.

Dupare, B.U., Billore, S.D. and Joshi, O.P. 2010. Farmers' Problems Associated with Cultivation of Soybean in Madhya Pradesh, India, *Journal of Agricultural Science and Technology* **4** (6) (Serial No.31)

Sharma, H.O., Patidar, M. and Nahatkar, S.B. 2006. Constraints of soybean technology in Vindhyan Plateau agro-climatic region of Madhya Pradesh, *Journal of Crop Research* **7**(1): 100-110.

SOPA, 2014. Estimates of Area, Productivity & Production of Soybean in India during Kharif (Monsoon) (*http://www.sopa.org/crop%20report%202014.pdf*).