TECHNOLOGY ADOPTION GAP IN SOYBEAN PRODUCTION OF MAHARASHTRA STATE

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ABSTRACT

Soybean [Glycine max] is the world's natural source of protein and is the most important oilseed crop of the world. It is grown successfully on various types of soil and agro-climatic conditions. A investigation was carried out, among the soybean cultivators for the year 2013-14, to study the technology adoption gap in soybean production of Maharashtra. Results revealed that, with respect to extent of adoption by the soybean cultivators on various components of soybean production technologies. Extent of adoption of use of seed rate (about 93-99 per cent) was near to the recommended level by all adopters from all regions of Maharashtra. The major contributors in yield gap of soybean were sowing time, seed rate and irrigation. The study has revealed that, the composite indices has categorized- 93 cultivators as low adopters group and 50 as medium adopters and single cultivator found as high adopters. Major technologies adopted by the soybean cultivator were seed rate (i.e. 93-99 per cent) and least technologies adopted were manure, seed treatment and irrigation. So, there existed a sizeable gap in the adoption of various recommended technologies in the cultivation of soybean in Maharashtra. The exception was in the technology i.e. seed treatment and use of manures. So it is suggested that, soybean cultivators from all regions of Maharashtra should adopt the almost all the recommended technologies to harvest the free benefit of these technologies for having maximum production and therefore, overall farm returns in general.

Keywords: Extent of Adoption, Soybean Production, Contribution Of Technologies, Composite Index

I. INTRODUCTION

A technology transfer programme would be considered effective if there is minimal or no gap between the potential and realized impacts of the technology. It means that, monitoring of adoption or adaptation of technologies is an integral part of the technology transfer system. Therefore, transfer of technology must be preceded and succeeded by technology assessment, reasserting that technology transfer and assessment are complementary processes. Adoption of improved production practices is the key to higher production of crops and higher incomes to farmers. The technical knowledge of farmers appears to be the key link to higher level of adoption. Once farmers acquire knowledge, they begin to use and apply improved practices in their fields. Even among farmers, there is a great variation in their levels of knowledge, as well as their readiness to accept, try

new methods and adopt improved production practices. Some need more time to grasp and get convinced and hence need longer sustained support from extension agencies.

Indian scientists have been successful since the beginning with progressively improved varietal and crop management technology which include, among the recent ones, multiple disease pest resistant varieties, hybrid variety technology, export quality, high yielding varieties for varied rain fed ecologies and integrated pest and nutrient management packages. In 2011-12, the area grown under soybean was 10.59 million hectare with production of 129.57 million tones and yield was 1192 kg per hectare in India. In Maharashtra, the area under soybean was 3010 thousand hectare with production of 3969 thousand hectare having yield 1319 kg per hectare. The present study aims at analyzing, technology adoption gap in soybean production of Maharashtra state.

II. METHODOLOGY

As there is no production of soybean due unsuitable weather conditions in Konkan region of Maharashtra state, hence, only three regions *viz.*, Western Maharashtra, Marathwada and Vidarbha were selected for the study of soybean where the area under these oilseed crops is concentrated.

Table 1. Technology wise extent of adoption

Sr. No.	Practices	Extent of adoption
1.	Seed rate	$EA = \frac{\text{Seed rate used by cultivators}}{\text{Recommended Seed rate}}$
2.	Time of sowing	$EA = \frac{\text{No of days delayed for sowing}}{\text{Recommended time of sowing}}$
3.	Gap filling	$EA = \frac{\text{No of days delayed for gap filling}}{\text{Recommended days for gap filling}}$
4.	Farm yard manures	$EA = \frac{\text{Manures quantity of FYM applied}}{\text{Recommended dose of FYM}}$
5.	Fertilizers (NPK)	$EA = \frac{\text{Nutrient applied by cultivators(N, P and K)}}{\text{Recommended dose of nutrients (N, P and K)}}$
6.	Plant protection	Farmers who used insecticides get score one and those who did not used they get the score zero.

For the study of soybean, Ahmednagar (Western Maharashtra), Latur (Marathwada) and Amravati (Vidarbha) were selected on the basis of maximum area. Two tahsils from each district and two villages from each tahsil were selected. In all, twelve villages for soybean were selected for the study. The list of cultivators growing these oilseeds from the selected villages was prepared from revenue records at village level. For the study, 12 farmers were randomly selected from each village. Thus, total 144 farmers were selected for the present study. The information on different aspects related to the study was obtained from the identified sample farmers by survey method. The survey method was used for the collection of primary data. The individual soybean growers were interviewed and detail information was collected for the year 2013-14 with the help of prepared schedules for the study.

2.1 Extent of Adoption of Technology

Actual level of adoption of each item of technology on farmers' field was identified using recommended technologies developed by SAU's, Maharashtra. Efficiency of each technology was calculated. All efficiencies score was scaled from zero to one.

Extent of adoption of each component of recommended technology was considered as one (01). Extent of adoption (EA) was worked out by using following formula.

$$\mathbf{EA} = \frac{\text{Actual adop}}{\text{Recommanded te}}$$

2.2 Development of Composite Index

The components of technology recommended by the Universities for different crops in terms of adoption scores (X_1 ..... X_n) were utilized for developing composite index of technology adopted. A composite index is a single numerical value representing the net adoption of all components of technologies whose values lies in between 0 and 1(Nimbalkar *et.al.*).

The Principle Component Analysis (PCA) approach was used for developing composite index. A set of Kth components explaining 100 per cent of total variation of all components of recommended technologies were considered Correlation matrix where row represents variables and columns represents eigen vectors from which weight (wi) coefficients of components of technology say Σ is determined as,

$$\mathbf{W_i} = \frac{\mathbf{M_i}}{\sum \mathbf{M_i}}$$

Where,

W_i = Weight or coefficient of component of technology

M_i = Maximum element in i^{th} row

ΣM_i = Sum of maximum element in i^{th} row

The required linear function for deriving composite index were,

$$\mathbf{S_i = W_1X_1 + W_2X_2 + ... + W_nX_n}$$

Where,

S_i = Composite index score

X_i's = Adoption scores for individual component of technology

This provides adoption index (of all components of technologies) for each cultivator. The composite index obtained in the process lie in between 0 and 1. The composite score of farmers was classified as low level adoption (below 60 per cent) medium level (61-80 per cent) and high level of adoption (above 81 per cent).

2.3 To Measure the Contribution of Each Components of Technology

To measure the contribution of each component of technologies in the yield gap the data collected from various crops under study was used along with the adoption level of technologies and the yield gap was estimated in relation to the recommended yield. The number of cultivators for each crop over the districts and some farmers have not adopted all the technologies therefore, the farmers were deleted from contribution analysis considering the size of farmers.

The yield gap was considered as a function of level of adoption and the contribution of each technology in yield gap were worked out by fitting linear regression between the level of adoption of each technologies and yield gap.

$$Z_{ij} = \frac{[X_{ij} - X_j]}{S_j}$$

Where,

$$S_j^2 = \frac{\sum_1^n [X_{ij} - \bar{X}_j]^2}{n}$$

$$\bar{X}_j = \frac{\sum_1^n X_{ij}}{n}$$

i = 1, 2, 3,….., n and j = 1, 2, 3,…., k and Z_{ij} denotes the matrix of standardized indicators.

Yield gap between standard yield and actual by the farmer was regressed on standardized value of indicators and best fit were obtained. Contribution of each indicator in yield gap was studied to arrive at the concludings of yield gap and technological adoption gap.

IV. RESULTS

4.1 Distribution of selected cultivators on the basis of Composite Index (CI)

Even though the technology package was developed by the Agricultural universities for respective region, it is important to examine the extent of adoption and its cost effectiveness. Hence, the method of Principal Component Analysis (PCA) was used to estimate the composite indices for individual farmer. Thereafter, all the farmers under study were grouped according to composite index ranging from 0.01 to 0.60, 0.61 to 0.80 and above 0.81 as low, medium and high technology adoption groups. Distribution of selected cultivators showed the adoption of recommended technologies in the soybean cultivation.

Table 2. Distribution of Selected Soybean Cultivators According to Composite Index in Western Maharashtra

Sr.No.	Levels of adoption	No. of farmer	Area adopted (ha)
1	Low adopters (< 0.60)	24.00 (50.00)	18.25 (44.43)
2	Medium adopters (0.61 to 0.80)	23.00 (47.92)	22.43 (54.60)
3	High adopters (> 0.81)	1.00 (2.08)	0.40 (0.97)
	Total	**48.00 (100.00)**	**41.08 (100.00)**

It can be clear from Table 5 that, out of 144 sample cultivators, 93 farmers were categorized under low adopters. Accordingly, 50 cultivators categorized in medium technology adoption group, whereas there was only one cultivator coming under high technology adoption group. The composite index of individual farmer showed the adoption of recommended technologies in the soybean cultivation[1].

Table 3. Distribution of selected soybean cultivators according to composite index in Marathwada

Sr. No.	Levels of adoption	No. of farmer	Area adopted (ha)
1	Low adopters (< 0.60)	27.00 (56.25)	26.23 (74.71)
2	Medium adopters (0.61 to 0.80)	21.00 (43.75)	8.88 (25.29)
3	High adopters (> 0.81)	0.00 (0.00)	0.00 (0.00)
	Total	**48.00 (100.00)**	**35.11 (100.00)**

Table 4. Distribution of selected soybean cultivators according to composite index in Vidarbha

Sr. No.	Levels of adoption	No. of farmer	Area adopted (ha)
1	Low adopters (< 0.60)	42.00 (87.50)	57.46 (90.52)
2	Medium adopters (0.61 to 0.80)	6.00 (12.50)	6.02 (9.48)
3	High adopters (> 0.81)	0.00 (0.00)	0.00 (0.00)
	Total	**48.00 (100.00)**	**63.48 (100.00)**

Table 5. Distribution of selected soybean cultivators according to composite index in Maharashtra

Sr. No.	Levels of adoption	No. of farmer	Area adopted (ha)
1	Low adopters (< 0.60)	93.00 (64.58)	33.98 (72.58)
2	Medium adopters (0.61 to 0.80)	50.00 (34.73)	12.44 (26.57)
3	High adopters (> 0.81)	1.00 (0.69)	0.40 (0.85)
	Total	**144.00 (100.00)**	**46.82 (100.00)**

3.2 Extent of Adoption of Different Technologies at Different Levels of Adoption

Adoption of technology refers to actual practices adopted by the farmers for cultivation of particular crops. The State Agricultural Universities has undertaken various research programs for different crops. They have made various recommendations about technologies. For the present study, preparatory tillage, time of sowing, spacing, use of seed rate, fertilizer doses (N, P and K), inter culturing and irrigations, etc. were studied.

3.2.1 Extent of adoption of technologies in soybean cultivators in Western Maharashtra region

It is concluded from the Table (6) that, most of the farmers in Western Maharashtra under study, were adopting the technologies i.e. use of seed rate, preparatory tillage, use of variety, sowing time and application of nitrogen except technology of seed treatment. It was due to the time consuming and complicated seed treatment procedure[1].

Table 6. Extent of adoption of technologies in soybean cultivators in Western Maharashtra

Sr.No.	Technology	Level of adoption (%)			
		Low	Medium	High	Overall
1	Preparatory tillage	72.22	75.36	87.76	78.45
2	Variety	66.67	78.26	90.00	78.31
3	Sowing time	75.28	81.01	80.00	78.76
4	Spacing	50.00	65.22	80.00	65.07
5	Seed rate	95.72	99.64	90.00	95.12
6	Seed treatment	33.33	39.13	50.00	40.82
7	Manure	33.37	46.03	72.92	50.77
8	Nitrogen	79.67	76.35	77.98	78.00
9	Phosphorus	59.21	67.52	60.00	62.24
10	Irrigation	50.00	55.07	66.67	57.25
11	Plant protection	43.75	56.52	50.00	50.09

3.2.2 Extent of adoption of technologies in soybean cultivators in Marathwada region

It is observed from the Table (7) that, the extent of level of technology adoption *viz.;* sowing time, use of variety, application of nitrogen in Marathwada region was quite satisfactory. In medium and low adoption groups the extent of level of adoption of use of seed rate was at higher level. However, technology regarding seed treatment was found at lower extent in all adoption groups. It was due to unawareness about seed treatment among the farmers[2].

3.2.3 Extent of adoption of technologies in soybean cultivators in Vidarbha region

It is indicated from the Table (8) that, in Vidarbha region, the technologies viz., use of seed rate and sowing time were adopted at greater extent by low and medium adopters group. Moreover, technology of seed treatment is low in all adoption groups. This is because of the fact, in study area that, cultivators are unaware about the importance and proper knowledge about seed treatment[3].

It is concluded from above discussion that, extent of adopting use of seed rate were near to the recommended level by all adopters group from all regions of Maharashtra. The exception was the technology of seed treatment and use of manures. It is suggested that, low and medium adopters from all regions of Maharashtra should adopt the recommended technologies for the production of soybean[4].

Table 7. Extent of adoption of technologies in soybean cultivators in Marathwada region

Sr.No.	Technology	Level of adoption (%)			
		Low	Medium	High	Overall
1	Preparatory tillage	66.25	77.5	-	71.88
2	Variety	75.78	80.00	-	77.50
3	Sowing time	89.29	83.33	-	86.31
4	Spacing	67.86	70.00	-	68.93
5	Seed rate	89.39	97.34	-	93.37
6	Seed treatment	57.14	52.50	-	54.82
7	Manure	58.35	43.31	-	50.83
8	Nitrogen	82.06	73.26	-	77.66
9	Phosphorus	68.19	40.84	-	54.52
10	Potassium	37.37	31.65	-	34.51
11	Irrigation	50.00	50.00	-	50.00
12	Plant protection	60.71	62.50	-	61.61

Table 8. Extent of adoption of technologies in soybean cultivators in Vidarbha region

Sr.No.	Technology	Level of adoption (%)			
		Low	Medium	High	Overall
1	Preparatory tillage	78.57	88.89	-	83.73
2	Variety	73.81	83.33	-	78.57
3	Sowing time	83.33	88.89	-	86.11
4	Spacing	64.29	83.33	-	73.81
5	Seed rate	99.81	99.87	-	99.84
6	Seed treatment	40.48	41.67	-	41.08
7	Manure	56.09	52.69	-	54.39
8	Nitrogen	78.13	68.22	-	73.18
9	Phosphorus	46.23	62.52	-	54.38
10	Irrigation	60.32	66.67	-	63.50
11	Plant protection	66.67	66.67	-	66.67

3.3 Contribution of Technologies in the Yield Gap

To measure the contribution of each component of technologies in the yield gap the data collected for soybean crop was used along with the adoption level of technologies and the yield gap is estimated in relation to the recommended yield. The yield gap has been considered as a function of level of adoption and the contribution of each technology in yield gap has been worked out by fitting linear regression between the level of adoption of each technologies and yield gap. The results so obtained for all regions, is presented in table below.

3.3.1 Contribution of technologies in the yield gap of soybean in Maharashtra

In Western Maharashtra, sowing time (14.31 per cent) and seed rate (14.31 per cent) were the major contributors in reducing yield gap of soybean production Maharashtra as shown in Table. 9,[1].

It can be concluded from Table 10 that, sowing time and use of seed rate have explained about 14.66 and 14.31 per cent contribution in yield gap of soybean production in Marathwada region,[1].

It can be seen from the Table 11 that, in Vidarbha region the major contributors in yield gap of soybean production technology were sowing time (16.96 per cent) and use of seed rate (11.18 per cent),[2].

It is concluded that, sowing time and use of seed rate were the major contributors of yield gap in all regions. The soybean cultivators need attention towards these important contributors for increasing the productivity.

Table 9. Contribution of technologies in the yield gap of soybean production in Western Maharashtra

Sr. No.	Technology	Standardized regression coefficient	Contribution of technologies (%)
1	Preparatory tillage	-0.1223	4.77
2	Variety	-0.0229	5.17
3	Sowing time	-0.2007	12.81
4	Spacing	-0.1004	3.21
5	Seed rate	-0.2356	17.43
6	Seed treatment	0.0568	2.03
7	Manure	-0.0982	7.07
8	N	0.1316	10.12
9	P	0.0193	14.12
10	Crop management	0.3365**	8.08
11	Irrigation	-0.2009	12.56
12	Plant protection	-0.0908	2.63

Table 10. Contribution of technologies in the yield gap of soybean production in Marathwada

Sr. No.	Technology	Standardized regression coefficient	Contribution of technologies (%)
1	Preparatory tillage	-0.0812	3.97
2	Variety	-0.5093*	8.17
3	Sowing time	-0.2127	14.66
4	Spacing	0.3759	5.79
5	Seed rate	0.0289	14.31
6	Seed treatment	0.1044	2.61
7	Manure	0.2004	5.91
8	N	-0.2095	11.46
9	P	0.2583	9.82
10	K	-0.1114	1.83
11	Crop management	-0.1900	4.83
12	Irrigation	-0.0549	13.12
13	Plant protection	-0.1141	3.92

Table 11. Contribution of technologies in the yield gap of soybean production in Vidarbha

Sr. No.	Technology	Standardized regression coefficient	Contribution of technologies (%)
1	Preparatory tillage	-0.0610	3.33
2	Variety	-0.7703**	7.17
3	Sowing time	0.1492	16.96
4	Spacing	0.5563*	9.41
5	Seed rate	-0.1207	11.18
6	Seed treatment	-0.0203	2.04
7	Manure	-0.2314	8.71
8	N	0.0451	11.08
9	P	-0.2753	8.66
10	Crop management	-0.0115	6.01
12	Irrigation	-0.1142	11.15
12	Plant protection	-0.2215	4.31

IV. CONCLUSIONS

The study has revealed that, the composite indices has categorized- 93 cultivators as low adopters group and 50 as medium adopters and single cultivator found as high adopters. Major technologies adopted by the soybean cultivator were seed rate (i.e. 93-99 per cent) and least technologies adopted were manure, seed treatment and irrigation. So, there existed a sizeable gap in the adoption of various recommended technologies in the cultivation of soybean in Maharashtra. The major contributors in yield gap of soybean were sowing time, seed rate and irrigation. The agricultural scientists, extension scientists and state agricultural technocrats should re-launch awareness generation campaign to educate the soybean cultivator about the benefits of the use of the recommended dosages of various inputs in soybean cultivation in Maharashtra state.

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