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An study about factors responsible for the Post-harvest losses of soybean in Sehore district of M.P

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Abstract
India is blessed with diverse agro-ecological conditions ideally suited for growing nine annual oilseed crops. Soybean is the second largest oilseed crop in India next only to groundnut. In soybean production system, at all stages of operations the post-production losses occur. Keeping the importance of post harvest of losses of soybean, the present investigation was conducted with the specific objectives to examine the factors responsible for post harvest losses of soybean. The present study was confined to Sehore district of Madhya Pradesh. The Sehore district purposively selected for study because, this district is one of the important soybean growing tracts in the state. Multi stage stratified random sampling technique was used for drawing a sample for the present study. The fitted regression equation explained 98.9 per cent of variation in post harvest losses of soybean was due to inclusion of these 6 independent factors. The f-ratio was 401 there by indicating good fit of the function. The results of this regression analysis clearly indicated that the size of land holding, area of soybean, marketable surplus and process with manually, bullock or through machinery were found to positive influence of post harvest losses. On the other hand, number of family worker and level of education of respondents were found to negative influence of post harvest losses. Public awareness campaigns must be implemented in order to increase awareness of the costs and implication of losses after harvest/production.

Keywords: Coefficient of multiple determinations, factors influencing, Post Harvest losses, regression, Soyabean

Introduction
Soybean is the second largest oilseed crop in India next only to groundnut. It accounts for 31.1 per cent of total oilseeds. India is the fifth largest producer of soybean in the world. However, soybean sector in India has exhibited spectacular growth in terms of cultivation area, production and productivity. In India, Madhya Pradesh and its adjoining states *viz*. Maharashtra and Rajasthan constitute predominant soybean belt. These three states accounts maximum soybean area of the country and become "Tom-Thumbs" in case of soybean area. Soybean research had played an important role in the last 3 decades in enhancing its area and production. The area of soybean increased tremendously in these states along with increased productivity.

In respect of economy concern of oilseed in Madhya Pradesh it is found that Madhya Pradesh is an important contributor of oilseed to India as regard area, production and productivity. Madhya Pradesh covered 24.7 per cent of total oilseed area in India, contributed 22 per cent of production share and 89 per cent of productivity share of total oil seed of India. Soybean, rapeseed, mustard, sesamum and groundnut all together contributed 96.75 per cent of total oilseed area of the state. The remaining 3.25 per cent of oilseeds in the state was contributed by other oilseeds like linseed etc.

In soybean production system, at all stages of operations the post-production losses occur. The post harvest losses started from right in the field with standing crops at harvest time upto threshing, winnowing, handling, physical (drying), storage, market processing, transportation and mandi losses. There are so many factors which affect the post harvest losses from harvesting to marketing of produce. Because of these losses the quantity of marketable surplus reduced and quality deterioration causes low market price. These losses can be avoided by adopting improved post-harvest technology and post harvest management. In general, the soybean producer in study area operates limited size of farms, with limited access to resources and technology and reaping low productivity. On the other hand, poor quality produce and high levels of post harvest losses occur primarily due to non adoption of post harvest management practices at the production level.

The non adoption of post harvest management practices might be due to lack of knowledge and skill in post harvest handling, inadequacies in basic and post harvest specific infrastructure, transport, storage and marketing. Keeping the importance of post harvest of losses of soybean, the present investigation was conducted with the specific objectives to examine the factors responsible for post harvest losses of soybean.

Research Methodology

The present study was confined to Sehore district of Madhya Pradesh. The Sehore district purposively selected for study because, this district is one of the important soybean growing tracts in the state. Multi stage stratified random sampling technique was used for drawing a sample for the present study. At first stage of sampling, the block in the district was selected. At the second stage of sampling, the villages in the block were selected. At the third stage of sampling, the soybean growers were selected as respondents. The Sehore district is comprises of 5 blocks, namely Astha, Budni, Ichhawar, Nasurallaganj and Sehore. Sehore block in Sehore district have been selected purposively due to higher area under soybean and well known by researcher. At the second stage of selection, a list of major soybean growing villages has been prepared and among these 4 villages was selected purposively which are having highest area under soybean. At the third stage for the selection of respondents (soybean growers), a list of important soybean growing cultivators in each village have been prepared and divided into three groups i.e. small farmers (0.1 to 2 ha.), medium farmer (2.01 to 4 ha.) and large farmers (above 4 ha.). From this list 20 farmers from each size group have been selected randomly. Hence, total of 60 soybean growers have been considered for detail investigation.

In present study, both primary and secondary data were used to find out the findings of study. The data were collected using survey method.

Analytical procedure

Factors responsible for post harvest losses of soybean

To find out the factors which are responsible for level of post harvest losses of soybean, the regression analysis was worked out as follows:

Regression analysis

In present study regression analysis was carried out using primary data collected from sampled soybean growers to identify the important factors affecting the level of post harvest losses. The functional form used was

$$Y = ax_1^{b1} . x_2^{b2} . x_3^{b3} \ldots\ldots\ldots X_k^{bk}$$

It is converted in to logarithmic form, so that it can be solved by the least square method. The logarithmic form of the function is express as under

$$\text{Log } y = \log a + b_1 \log x_1 + b_2 \log x_2 \ldots\ldots\ldots + b_k \log x_k.$$

Where

y = Dependent variable (extent of total post harvest losses, q/farm)

a = Constant or intercept value

b_1 to b_k = are regression coefficients of X_1 to X_k variables

X_1 to X_k = are variables.

X_1 = Size of land holding (ha/farm)

X_2 = Area under soybean (ha/farm)

X_3 = Extent of marketable surplus (q/farm)

X_4 = No. of family workers (per family)

X_5 = Education level of respondents (in study score was allotted for illiterate=1, Functional literate=2, Primary=3, Middle=4, HSSC=5 and College=6)

X_6 = Post harvest operations conducted by manually and bullock power or through machinery (for manual/bullock operation score allotted=1 and for machinery operation score allotted=2)

Results and Discussion

Socio-economic characteristics of soybean growers:

Socio-economic characteristics of respondents in study area considerably influences various economic activities like adoption of improved production practices, resource allocation, resource use efficiency, production pattern, distribution pattern and exchange of final product which is directly related with economy of farmers. The social factors such as the size of family, literacy, age, sex-ratio, social disparities and agrarian factors such as size of holding, land use pattern, irrigation pattern, cropping pattern as a socio-economic status, etc., either retard or promote the process of economic growth by influencing the efficiency in production process. It is therefore, necessary to conduct a micro level study related with socio-economic aspects of soybean producers. An attempt in this direction is made in present chapter as cross section data collected form selected respondents have been analyzed and presented in following characteristics.

A. Social structure

The important decisions in the farm business with reference to input use, cropping pattern and other managerial decisions are generally taken by the farmers and their family. In general the farmers are utilizing higher proportion of family labour in production process. Therefore, it is pertinent to have an idea regarding the age, education level of the soybean producers and family constituent existing at farm level.

Age and education Level

Age composition of soybean growers would also be determined their experiences in the practices of production. On the other hand, education status affects the managerial, marketing and financing efficiency. The level of education is generally considered as an index of social advancement of a community. Education enables man or women more capable of managing scarce resources and maximizing profit. Although, education is not in itself a sufficient condition for development of enterprise, it is certainly a necessary condition. Education is likely to influence management of soybean production. The data on distribution of soybean growers according to their age and education level has been presented in table 1.

Table 1: Distribution of soybean growers as per their age and education levels in different size of holding. (Number of soybean growers)

S. No.	Description	Size of holding			
		Small	Medium	Large	Average
A.	**Average age (year)**	44	46	40	43
1.	Minimum age	23	26	25	25
2.	Maximum age	70	71	60	67
B.	Education level				
1.	**Illiterate**	8	6	4	6 (30.00)
2.	Formal education	4	3	3	3 (15.00)
3.	Primary education	3	4	4	4 (20.00)
4.	Middle education	2	3	4	3 (15.00)
5.	Higher secondary school	2	2	3	2 (10.00)
6.	College	1	2	2	2 (10.00)

* Figure in parentheses shows percentage to total

Data depicted that the average age of soybean growers was found to be 43 years. The age of soybean growers found to variation in different size of holding i.e. in medium size of group the average age of soybean growers found to be 46 years followed by small farmers 44 years and large farmers 40 years respectively.

This assumed to be soybean growers under study found to be medium age group. The overall average distribution of soybean growers as per their age shows that the minimum age of soybean growers found to be 25 years and the maximum age of soybean growers found to be 67 years. This lead to the understanding that the phenomena with regards to the soybean production in study area would be related more by the middle aged group. This middle age group farmers are found to more energetic and progressive hard worker.

Table 1 also revealed that, at overall average level 30.00 per cent of soybean growers were found to illiterate and remaining 70.00 per cent of soybean growers was literate in different level of education. The distribution of soybean growers according to different level of education shows that among the total soybean growers, the maximum numbers of soybean growers were educated up to primary school (20.00%) to total farmers followed by middle education (15.00%), higher secondary level (10.00%) and (10.00%) were found to be graduates.

The distribution of soybean growers in different size of holding it is found that the literacy position was found to increase with increasing size of holding. This lead to the understanding that the phenomena with regards to the soybean production in study area would be related more by the literate group.

A family in the present study was defined as a group of individuals living together, taking meals united and living under the control of one person as its head. It included husband, wife, son, daughter, brother, sister, parents and other close relative. The family structure and size are important indicators determining the social and economic well being of the families living in the area under consideration, because the higher number of members in a family constituting higher family labour force at the farm level.

The data on distribution of soybean growers according to their strength of the family and work force availability has been presented in table 2.

Table 2: Distribution of soybean growers as per their strength of family in different size of holding. (Number/family)

S. No.	Family structure	Size of holding			
		Small	Medium	Large	Average
1.	Small family (upto 5 members)	4	5	10	6 (30.00)
2.	Large family (above 5 members)	16	15	10	14 (70.00)
	Work force				
1.	Upto 2 workers in a family	4	8	11	8 (40.00)
2.	more than 2 workers in a family	16	12	9	12 (60.00)

* Figure in parentheses shows percentage to total

It is clear from the table that in respect of overall average figure of strength of the family showed that the maximum 70.00 per cent of soybean growers pertaining to have large size of family followed by 30.00 per cent of soybean growers pertaining to have small size of family. The distribution of soybean growers as they have total family members in a family showed that the strength of family found to decrease with increasing size of holding.

This lead to the understanding that the phenomena with regards to the soybean production in study area would be related more by the large size of family members.

The workforce in a family determines the economic condition of the family because maximum soybean growers are utilizing family labour in operational practices. Study depicted in respect of overall average figure of work force available in a family showed that maximum 60.00 per cent of soybean growers pertaining to have "more than 2 workers in a family". On the other hand, it is also found that 40.00 per cent of soybean growers pertaining to have "upto 2 workers in a family". The distribution of soybean growers as they have total workers in a family showed that the strength of family workers found to decrease with increasing size of holding.

This lead to the understanding that the phenomena with regards to the soybean production in study area would be related more by using with family work force which is higher in number with small size of holding.

For reduction of poverty and unemployment or generation of income and employment from agriculture sector, needs; better understanding the characteristics of respondents in relation to existing agrarian with the purview of them. In view of the above, the purpose of this objective is to show the socio-economic status of respondents and how the process of agricultural production operates resulted thereby a pool of labour force is employed and rest remains unemployed or

underemployed. This would also give the direction about income generation through adoption of improved production technology on their farm. The agrarian relation also responsible for resource use efficiency in production of crops. Hence, an analysis of the existing agrarian structure of the respondent's economy is pertinent. This portion of study deals with economic structure of the sample soybean growers. It includes the detailed analysis of land use pattern and cropping pattern at farm level.

Land use pattern

Land use is highly a dynamic process. Land resources constitute the fundamental base for all human activities. It is the most important natural resource of Madhya Pradesh where agricultural sector is relatively more prominent than the manufacturing sector.

Land use pattern is a process, which assigns each tract of land in an area to its proper class in a system of classes. The classes in the system are defined in terms of the qualities or characteristics with which the classification is concerned. The land use pattern of the state at any particular time is determined by the physical, economic and institutional framework taken together. In other words the existing land use pattern has been evolved as the result of the action and interaction of various factors such as the physical characteristics of land, the institutional framework, the structure of other resources such as capital, labour etc. The land use pattern of sample soybean growers has been presented in table 3.

Table 3: Land use pattern and level of irrigation on sample farm in different size of holding.(ha./farm)

S. No.	Particulars	Size of holding			
		Small	Medium	Large	Average
1	Size of holding	1.31	3.29	8.08	4.23 (100.00)
2	Uncultivated area	0.06	0.11	0.21	0.13 (3.07)
3	Cultivated area	1.25	3.18	7.87	4.10 (96.93)
4	Irrigated area	0.68	1.64	3.93	2.08 (49.17)
5	Kharif crops area	1.19	3.08	7.67	3.98 (94.09)
6	Rabi crops area	1.01	2.34	5.84	3.06 (72.34)
7	Gross cropped area	2.20	5.41	13.51	7.04 (166.43)
8	Cropping intensity (%)	176.00	170.13	171.66	172.60

*Figure in parentheses show to size of holding

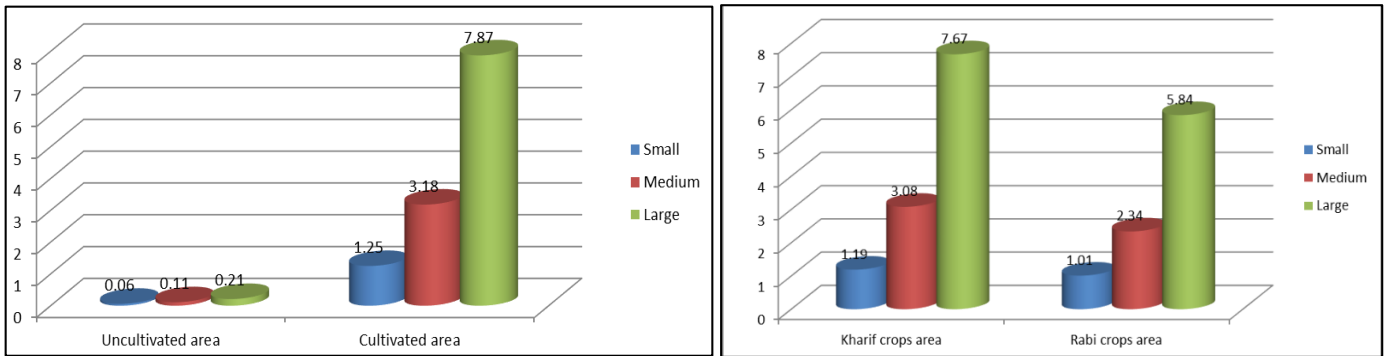

Fig 1: Size of Land Holding According to Cultivated area and Kharif and rabi crops area

It is evident from the data in respect of overall average of size of holding available with soybean growers was to be 4.23 hectare per farm. The size of holding was found to increase with increasing farm size. The average size of holding was found to 1.31 hectare with small farmers followed by average size of holding was found to 3.29 hectare with medium farmers and average size of holding was found to 8.08 hectare with large farmers respectively.

The data also clearly shows that in respect of overall average of cultivated area available with soybean growers was to be 4.10 hectare per farm i.e. 96.93 per cent to total size of holding. The cultivated area was found to increase with increasing farm size. The average cultivated area was found to 1.25 hectare with small farmers followed by average cultivated area was found to 3.18 hectare with medium farmers and average cultivated area was found to 7.87 hectare with large farmers respectively.

The data also clearly shows that in respect of overall average of irrigated area available with soybean growers was to be 2.08 hectare per farm i.e. 49.17 per cent to total size of holding. The irrigated area was found to increase with increasing farm size. The average irrigated area was found to 0.68 hectare with small farmers followed by average irrigated area was found to 1.64 hectare with medium farmers and average irrigated area was found to 3.93 hectare with large farmers respectively. The data in respect to availability of irrigation facilities shows very poor. Soybean is generally growing in kharif season when irrigation is not required. Hence, the low irrigation facility does not affect the crop yield of soybean.

Due to low irrigation facilities in the area only (166.43% to size of holding) area was covered under crops in a year when both the kharif and rabi crops were taken into consideration that area is called gross cropped area. The data regarding gross cropped area with different size of holding depicted that gross cropped area was increasing with increasing size of holding.

The overall average cropping intensity in the farm of soybean growers was found to be (172.60%). The highest cropping intensity 176.00 per cent was found with small size farmers followed by 171.66 per cent with large size of farmers and the lowest cropping intensity 170.13 per cent was found with medium size of holding.

In study area kharif crops were dominated over rabi crops due to low irrigation facilities. The overall average kharif crops area was found to 3.98 hectare per farm (94.09% to size of

holding). The kharif area was found to increase with increasing farm size. The average kharif area was found to 1.19 hectare with small farmers followed by average kharif area was found to 3.08 hectare with medium farmers and average kharif area was found to 7.67 hectare with large farmers respectively.

The overall average rabi crops area was found to 3.06 hectare per farm (72.34% to size of holding). The rabi area was found to increase with increasing farm size. The average rabi area was found to 1.01 hectare with small farmers followed by average rabi area was found to 2.34 hectare with medium farmers and average rabi area was found to 5.84 hectare with large farmers respectively.

Cropping pattern

The cropping pattern of sample holdings of soybean growers reflects towards the cropping sequences grown in their farm during the investigation. The cropping pattern on sample farms has been presented in table 4.

Table 4: Cropping pattern on sample farm in different size of holding. (ha./farm)

S. No.	Cropping pattern	Size of holding			
		Small	Medium	Large	Average
A.	Kharif crops area	1.19	3.08	7.67	3.98 (100.00)
1.	Soybean	1.08	2.68	5.20	2.99 (75.13)
2.	Other kharif crops	0.11	0.40	2.47	0.99 (24.87)
B.	Rabi crops area	1.01	2.34	5.84	3.06 (100.00)
1.	Wheat	0.85	1.70	3.35	1.97 (64.38)
2.	Gram and Other rabi crops	0.16	0.64	2.49	1.10 (35.95)

* Figure in parentheses show percent to their respective total

The cropping pattern on the farm of selected soybean growers showed that kharif crops were found to be dominated over rabi crops.

In the farm of soybean growers it is found that among the total kharif crops 75.13 per cent area was covered under soybean crop followed by other kharif crops accounting 24.87 per cent to total kharif area. On the other hand, it is found that among the total rabi crops 64.38 per cent area was covered under wheat crop followed by gram and other rabi crops accounting 35.95 per cent to total rabi area.

The data regarding area under soybean depicted that the soybean area was found to increasing trends with the increasing of size of holding. It is depicted that on an average small size of soybean growers pertaining to 1.08 hectare under soybean followed by the medium size farmers pertaining to 2.68 hectare and large size of farmers pertaining to 5.20 hectare per farm.

The quantity of post harvest losses increase or decrease might be due to certain factors contributing in changes the extent of grain losses during different stages of post harvest operations. In this research paper an attempt has been made to analyse the contribution of various factors under study on change in extent of post harvest losses through regression analysis. In the order to examine the factors which affect the post harvest losses of soybean, a multi linear regression model was used and presented in table 5.

Table 5: Regression values of factors contributing the change in post harvest losses of soybean.

S. No.	Factors	Regression value
1.	X_1 = Size of land holding	0.308** (0.033)
2.	X_2 = Area under soybean	3.765** (1.048)
3.	X_3 = Extent of marketable surplus	3.065** (0.076)
4.	X_4 = No. of family workers	-0.05 N.S. (0.057)
5.	X_5 = Education level of respondents	-0.003 N.S. (0.029)
6.	X_6 = manually and bullock power or through machinery	0.018 N.S. (0.143)
7.	(R^2) Coefficient of multiple determinations (%)	98.9
	F – Ratio	401

Note: Figures in parentheses indicated standard errors of respective co-efficient.

* Significant at 0.05 per cent level of probability

** Significant at 0.01 per cent level of probability

R^2 Coefficient of multiple determinations

The fitted regression equation explained 98.9 per cent of variation in post harvest losses of soybean was due to inclusion of these 6 independent factors. The f-ratio was 401 there by indicating good fit of the function. The results of this regression analysis clearly indicated that the size of land holding, area of soybean, marketable surplus and process with manually, bullock or through machinery were found to positive influence of post harvest losses. On the other hand, number of family worker and level of education of respondents were found to negative influence of post harvest losses.

Among all these factors, the size of holding positively significantly influenced post harvest losses. 1 per cent increase in area of size of holding, 0.30 per cent increase in post harvest losses. The area under soybean positively significantly influenced post harvest losses. 1 per cent increase in area under soybean, 3.76 per cent increase in post harvest losses. The marketable surplus positively significantly influenced post harvest losses. 1 per cent increase in marketable surplus, 3.06 per cent increase in post harvest losses. Similarly the manual or machinery use determines positively non significantly influenced post harvest losses. It is found that with the adoption of machinery post harvest process will increase 0.018 per cent of post harvest losses.

Among all these factors, the number of family workers and level of education determine negatively non significantly influenced post harvest losses. 1 per cent increase in number of family workers, 0.05 per cent decrease in post harvest losses and 1 per cent increase in level of education, 0.003 per cent decrease in post harvest losses.

Conclusion

Among all these factors, the size of holding positively significantly influenced post harvest losses. 1 per cent increase in area of size of holding, 0.30 per cent increase in post harvest losses. The area under soybean positively significantly influenced post harvest losses. 1 per cent increase in area under soybean, 3.76 per cent increase in post harvest losses. The marketable surplus positively significantly influenced post harvest losses. 1 per cent increase in marketable surplus, 3.06 per cent increase in post harvest losses. Similarly the manual or machinery use determines positively non significantly influenced post harvest losses. It is found that with the adoption of machinery post harvest process will increase 0.018 per cent of post harvest losses. Among all these factors, the number of family workers and level of education determine negatively non significantly influenced post harvest losses. 1 per cent increase in number of family workers, 0.05 per cent decrease in post harvest losses and 1 per cent increase in level of education, 0.003 per cent decrease in post harvest losses. Public awareness campaigns must be implemented in order to increase awareness of the costs and implication of losses after harvest/production. Fixed targets must also be established to curb post harvest losses. To support the above activities the planners and extension personnel needs to be feed back information in respect of economic impact of post harvest management practices. In this context the present study would be an attempt to provide feed back information to the farmers, planners, extension personnel and agricultural scientist.

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