

# Characterization of Potato Growers – A Case Study in West Bengal State of India

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## Abstract

This study oversees wide variation in productivity of Potato in West Bengal, India and identifies the distinct characteristics between high yielding and low yielding Potato growers. Set objectives were studied using Linear Discriminant Analysis (LDA). Our empirical study revealed that high yielding group is relatively aggressive in adopting improved technologies and practices compared to low yielding groups. They are ahead of low yielding farmers in terms of land preparation and irrigation. Observed significant correlation between adoption index and realization index in case of high yielding group also indicates that high yielding farmers are good adopters of technology. The significant factors discriminating the groups have been identified. This study concludes that though Potato is a capital intensive crop, the level of adoption depends not only on the quantum of inputs but also on the appropriate know-how practices at the farm level. At the end the authors made suggestions to improve the status of low yielding farmers.

**Keywords:** High yielding and low yielding growers, linear discriminant analysis, canonical coefficient, adoption Index, realization Index.

## Introduction

Income of the farmers can be augmented through adoption of modern technologies and practices recommended by the research stations. The apathy and sluggishness of Indian farmers in adopting modern technologies and practices are often criticized. In order to have stable production, there is a need for technological dissemination. Again, successful implementation of technology ultimately depends on fulfillment of farmers' expectation. Farmers are willing to adopt full course of input packages only when their expectation materializes in reality. The more the divergence, the lower will be the level of production. Selection of crop enterprises is based on expected yield in a given agro-climatic domain. A large number of seen and unseen factors, specially predetermined and uncertain factors govern farmer's decision sphere. The concern factors on which farmers possess control are most relevant as because

farmers have a-priori knowledge about their effect on production as well as yield. Farming practices involve different stages requiring varied level of decision factors. Desired level of output largely depends on timely application as well as quantum of decision factors.

This study focuses on the productivity of Potato crop in West Bengal as this state represents one of the leading states in India in terms of production and productivity. The major concern of Potato crop today is of declining productivity over the years. This study shall endeavor to the quantum of average expectation in terms of actual realization which helps to classify the farmers in high yielding and low yielding growers. A characteristic study of those classified groups would identify the significant factors causing variation of yield of Potato. Once these factors are identified, strategic planning could help formulating measures for minimizing gap between expected yield and observed yield on one hand and on the other, farmers would reap more nominal return than earlier.

### **Objective**

This study attempts to characterize and compare between high yielding and low yielding potato growers exploring the possibilities for overall development of this particular cash crop of the state.

### **Methodology**

This study is addressed to Hooghly district of West Bengal – a dominated Potato growing region contributing around 32% of total Potato production of the country. Four Blocks namely; Khanakul-1, Dhaniakhali, Haripal and Polba-Dadpur out of 18 blocks of the district were chosen by Simple Random Sampling Without Replacement (SRSWOR). Among the 240 Mouzas (Villages) contained in 4 Blocks 40 Mouzas were selected on the basis of same sampling adopted for the selection of Blocks. Finally, 200 sample Potato-farmers representing ultimate sampling units were chosen by SRSWOR from the total number of potato growers spread over the selected Mouzas. Primary data were collected from selected farmers through intensive visit and personal interview during the period November, 2011 to April, 2012.

Linear Discriminant Analysis (LDA) has been used to discriminate the Potato farmers belonging to two groups (high yielding and low yielding groups) based on multiple characters simultaneously with an objective that which factors are prospective with respect to yield attributing characters of Potato crop. These identified factors can be selected for exploitation in future improvement programme.

The basic assumption on which the entire LDA is based on is that each and every group or class belongs to multivariate normal population. This assumption warrants for precise estimation of probabilities and subsequent test of significance. But it is very difficult to get such data from the farmers' field. To tackle this problem the whole sets of data were transformed into standard normal variate:

$$Z'_i = [ X_i - \text{mean}(X) ] / \text{standard deviation}(X).$$

LDA has two steps – an F test (Wilk's lambda) is used to test if the discriminant model as a whole is significant, and if the F test shows significance then the individual independent variables is assessed to see which differs significantly in the mean by group and these are used to classify the dependent variable.

In order to identify the factors influencing the discrimination of two groups viz. high yielding and low yielding groups, the function used is given by

k

$$Z = \sum_{i=1}^k a_i Z'_i$$

i = 1

Where,

K is number of independent factors

Let  $d_i$  is the difference between the means of  $Z'_i$

$S_j$  is the variance covariance matrix

$a_i$  is the determinant function co-efficient

The  $a$ 's are obtained by solving the system of equations.

$$(a_i) (S_{ij}) = d_i$$

To test the discriminating power of the function, the test statistic (T.S):

$$\text{T.S.} = \frac{n_1 n_2 (n_1 + n_2 - k - 1)}{K (n_1 + n_2) (n_1 + n_2 - 2)} \times D^2$$

Where,

$D^2$  is the Mahalanobis function and obtained as

k

$$D^2 = \sum_{i=1}^k a_i d_i$$

i = 1

$n_1$  and  $n_2$  are sample sizes.

The test statistic follows F distribution with K and  $(n_1 + n_2 - k - 1)$  degrees of freedom.

Five sensitive factors namely, seed rate (kg./ha.), nitrogen (kg./ha.), phosphate (kg./ha.), potash (kg./ha.) and number of irrigation have been considered as key factors for a meaningful comparison between the groups in respect to adoption of technologies as these factors limit the yield of Potato. Adoption Index (A.I) has been expressed as:

r

$$\text{A.I} = [\sum_{i=1}^r P_i / R_i] / r$$

i = 1

Where,

$P_i$  and  $R_i$  are practiced level and recommended level of  $i^{th}$  factor respectively, and  $r$  is the number of key factors.

It is assumed that high yielding farmers are who realized expected yield at least 80% or more of the average yield of the last 5 years of the locality. They are relatively more aggressive in adopting improved technologies and practices compared to low yielding farmers. Realization Index (R.I) has been expressed in percentage as:

$$R.I = [\text{Observed yield} / \text{Expected yield (average of the last 5 years of the locality)}] \times 100$$

### Results and Discussion

In this study 106 sample growers belonged to high yielding group operating 57.15% of Potato area. Mean yield accrued to high yielding and low yielding categories were 19.60 tons and 14.80 tons per hectare respectively. Accordingly, farmers were classified into two broad groups, viz; high yielding growers and low yielding growers. Attempt has been made to characterize those groups and identifying the socio-economic cum managerial factors discriminating them.

**Table-1.** Test of Equality of Group-means between High Yielding and Low Yielding Potato growers in terms of Selected Socio-economic Characteristics.

Socio-Economic Characteristics	Wilks' Lambda	F(1,198)
Land size	0.912	4.135*
Area under crop	0.982	0.772
Land-man ratio	0.995	0.227
Total income	0.907	4.435*
% of farm income to total income	1.000	0.007
Education level	0.972	1.237

Figures in parenthesis indicate the degrees of freedom.

\* Significant at 5% probability level

Table-1 shows that among the selected discriminating socio-economic factors only two factors like land size and total income are found to be significant. In other words it can be said that high yielding farmers have a secured and strong mind-set to take challenges and risks involving costs. They are relatively aggressive in adopting improved technologies and practices compared to low yielding groups. This observation is well revealed in input -pattern use. Difference in the level of inputs use between groups could be seen from the Table-2.

**Table 2:** Test of Equality of Group-means between High Yielding and Low Yielding Potato growers in terms of Farm Inputs.

Farm inputs	Wilks' Lambda	F(1,198)
Seed rate	0.918	3.925*
FYM	0.884	5.640*
Nitrogen	0.984	0.684
Phosphorus	0.897	4.944*
Potash	0.928	3.353
Plant protection measures (value)	0.849	7.676**
Fertilizer (value)	0.940	2.728
Irrigation (value)	0.816	9.674**

Figures in parenthesis indicate the degrees of freedom.

\* Significant at 5% probability level

\*\* Significant at 1% probability level

It is recorded from the table that seed rate, use of manure (FYM), phosphorus, plant protection measures and expenses on irrigation are significant factors in explaining the variation in the level of realization over expectation of yield of Potato. In fact yield parameters of Potato crop depends mostly on appropriate amount of healthy and quality seeds. FYM and phosphorus have also significant role for Potato cultivation because FYM improves soil health and phosphorus directly improves the growth of tuber. As the crop is very susceptible to pest attack, proper application of plant protection chemicals plays a major role in determining the level of yield. Similarly it is also true in case of irrigation expenses.

**Table 3:** Test of Equality of Group-means between High Yielding and Low Yielding Potato growers in terms of Managerial Practices.

Practices	Wilks' Lambda	F(1,198)
Number of ploughing	0.873	6.280*
Top dressing of nitrogen (Days after sowing)	0.991	0.370
Number of irrigation	0.869	6.459*
Intercultural operation	0.954	2.062

Figures in parenthesis indicate the degrees of freedom.

\* Significant at 5% probability level.

Among the factors of managerial practices high yielding farmers are ahead of low yielding farmers in terms of land preparation and irrigation as can be seen in Table-3. Tillage operation is an important factor in case of root crops.

Table-4 depicts human resource uses for different operations between the groups. The most significant indicators discriminating the groups are of labor uses in fertilizer application, weeding, irrigation and harvesting. Potato is a labor intensive crop and needs constant watch and management. High yielding growers could hire labor as and when necessary in contrast to counter group. Low yielding growers could not provide inputs from own sources owing to their poor capacity.

**Table 4:** Test of Equality of Group-means between High Yielding and Low Yielding Potato growers in terms of Labor Characteristics.

Labor Characteristics	Wilks' lambda	F(1,198)
Total labor	0.933	3.087
Hired labor to total labor	0.971	1.305
Family labor land preparation	0.939	2.801
Hired labor land preparation	0.928	3.339
Family labor in fertilizer application	0.905	4.503*
Hired labor in fertilizer application	0.986	0.632
Family labor sowing	0.957	1.948
Hired labor sowing	0.977	1.018
Family labor in weeding& earthing up	0.989	0.486
Hired labor in weeding& earthing up	0.915	3.974*
Family labor in irrigation	0.911	4.201*
Hired labor in irrigation	1.000	0.000
Family labor in plant protection	0.937	2.801
Hired labor in plant protection	0.986	0.486
Family labor in harvesting	0.986	0.632
Hired labor in harvesting	0.913	4.088*

Figures in parenthesis indicate the degrees of freedom. \* Significant at 5% probability level.

Table-5 shows that the estimates of correlation between adoption index and realization index. We found that high yielding farmers are good adopters of technology.

**Table 5:** Correlation Matrix between Adoption Index and Realization Index of Potato

Groups	r	t value
High yielding farmers	0.518633	3.093019**
Low yielding farmers	0.364879	1.517815

\*\* Significant at 1% of probability level.

The factors which discriminate the farmers between high yielding and low yielding groups are presented in Table-6. Analyzing the means of significant factors between the groups it can be concluded that high yielding farmers pay more attention to the adoption of scarce farm inputs and practices at the farm level.

**Table 6:** Group Means of Significant Factors Discriminating the Potato Farmers between High Yielding Low Yielding Groups.

Factors	Canonical Co-efficient	Quantity Used	
		High Yielding Group	Low Yielding Group
Size of land holding (ha.)	3.426	0.932	0.265
Number of ploughing	-1.383	3.3529	2.0714
Seed rate (kg./ha.)	-0.361	16.362	13.746
FYM (qn./ha.)	-0.383	17.058	1.7857
Phosphate (kg./ha.)	-0.276	92.823	80.500
Plant protection measure (Rs./ha.)	2.038	648.52	393.28
Value of irrigation (Rs./ha.)	-0.073	392.35	230.00
Number of irrigation	0.229	7.9412	6.3214
Total income (Rs)	0.281	42944.35	35058.42
Family labor in fertilizer application (man-days)	0.2036	1.0240	2.7613
Hired labor in weeding and earthing-up (man-days)	0.3413	21.4329	12.3852
Family labor in irrigation (man-days)	0.2746	11.7241	14.3304
Hired labor in harvesting (man-days)	0.3321	24.1581	14.4820

## Conclusion

This study highlights that there is much scope for augmenting yield of potato through dissemination of technology and institutional reforms. Potato growers, particularly low yielding growers can minimize input and managerial costs through collective or co-operative farming. Further, institutional support, particularly financial support at village level would strengthen them to adopt modern practices. Crop-insurance at local level would also facilitate the risk-bearing capacity of farmers. Simultaneously, extension activities at village level through Government, NGOs, and Farmers' institutions need to be widened.

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