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An Examination of the Factors Discriminating Onion Growers in West Bengal

Jui Ray[1], Arabinda Mitra[2], Ranjan Chaudhuri[3] and Debashis Sarkar[4]

[1,2]Department of Agricultural Economics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia- 7410252, India.
[3]Department of Marketing, National Institute of Industrial Engineering, Mumbai, India.
[4]Department of EES, Palli Siksha Bhavana, Visva-Bharati, Sriniketan-731236, India.

Corresponding author: juirayndri@gmail.com

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ABSTRACT

The present study is based on empirical survey (2013-14) on hundred sample onion growers from Nadia and Hooghly districts of West Bengal in an attempt to characterise them into different classes in terms of several indicators covering both categorical and continuous variables and examining the factors discriminating them. The goal of this research article is to advocate intervention measures for augmenting onion production in a deficit state of West Bengal. K-means cluster analysis, Group characterization technique and Linear Discriminant Analysis tools have been used for the study. It has been found that the causes of poor performance among low-yield group emanate from cultural practices, technology adoption and managerial lapses. Institutional linkages, developing and restructuring farmers' oriented bodies, promoting SHGs and building up Onion Producers Company and providing marketing infrastructure and provision of cold storages may change the status of poor onion growers.

Keywords: Onion Grower, Group Characterisation, Linear Discriminant Analysis.

Onion represents one of the favourite vegetable irrespective of regions, classes and seasons. According to area-estimate (2010-11) onion is harvested in around 10 lakh hectares covering 10% of vegetable-area in India. In terms of production, India ranks second following China in the world. However, India lags far behind world-average yield. Variation in yield is also being seen across the states as well as within the states in India. Similarly, onion growers are not uniform within an echelon of agro-climatic environment.

This study attempts to focus on characterisation of onion growers and examining the factors discriminating them in homogeneous agro-climatic tracts of West Bengal. The goal of this research article is to advocate intervention measures for augmenting onion production in a deficit state of West Bengal.

Data Base and Methodology

This study is limited to four sample villages falling in Nadia and Hooghly districts of the state. Both the districts represent one third of entire onion-area of the state. Onion is harvested mainly in the low-lying areas in the catchment territory of the Ganges. Topography, soil and agro-climatic environment encourage farmers to follow jute-onion based farming system from time immemorial. Rabi-onion cultivation is the normal practice of farmers in those districts. Two onion-dominated villages from each sample district were selected purposively. Thereafter, fifty farmers from each village were selected following Simple Random Sampling without Replacement. The reference period of study is 2013-14.

Using k-means cluster analysis onion growers were classified into three homogenous groups, viz. high,

medium and low in terms of yield per unit of land. Thereafter, Group characterization tool was used in this study. Characterization of groups is based on the principle of comparing the values of a descriptive statistic indicator computed on the whole sample and computed on the sub sample related to the group. For a continuous variable, the mean is compared and the test value is defined as follows:

$$t_c = (\mu_g - \mu)/\sqrt{\{(n-n_g)/(n-1)\times(\sigma^2/n_g)\}},$$

where the mean on the whole sample is μ, the empirical variance is σ^2, the mean computed into the group is μ_g, size of the data set is n, and size of the sub-sample is n_g. The indicator follows asymptotically Gaussian distribution, then for a 5% significance level, we consider that the difference is significant if the absolute value is greater than 2. In case of discrete indicator, the proportion is evaluated with the test value statistic as:

$$T_d = \{n_{jg} - (n_g \times n_j)/n\}/\sqrt{\{(n-n_g)/(n-1) \times (1- n_j/n) \times (n_g \times n_j)/n\}}$$

Where nj is the number of instances corresponding to the category in the whole sample, n_{jg} is the number of instances corresponding to the sub-sample related to the group, the group size is n_g. Here, again the criterion is mainly used to highlight the category which characterizes the better the group of observations.

Apart from Group Characterization and K-means cluster analysis; we have used Linear Discriminant Analysis (LDA) as another statistical tool in this analysis. LDA was done to fit the discriminate prediction function. LDA concerns the development of linear composites of X_i variables with the property of maximally separating the groups. The functional form is: $Z= \sum(V_iX_i)$, Where X_i represents ith factor and V_i represents corresponding factor co-efficient.

Results and Discussion

Onion growers have been classified into three distinct groups according to mean-yield. Cluster cancroids are shown in Table-1. The table shows wide variation in mean-yield ranging from 67.29 quintals to 116 quintals per acre across sample growers. However, more than 85% growers belong to low and medium groups. Classification of groups has been tested. High R^2 (94%) value for classification signifies orderly grouping. Further, ANOVA results represent wide discrepancy in mean-yield between the groups and minimum variance within the groups. Thus, those three distinct homogenous clusters are concern for characterization. Characterization of the groups has been done on the basis of both continuous and discrete variables. The aim of this analysis has been to examine if there are differences between groups according to various statistical indicators such as quantum of labour use, organic mode of cultivation, critical input uses etc.

Table 1. Clustering of sample onion growers according to yield and cluster centroids

Cluster Centroids			
Attribute	**Cluster n_1 (Low)**	**Cluster n_2 (Medium)**	**Cluster n_3 (High)**
Size (nos.)	39	47	14
Yield (quintal/acre)	67.29	80.29	116.00

Table 2: Cluster size and WSS

Cluster	Description	Size	Proportion	WSS
Cluster n_1	Low	39	0.39	1.78
Cluster n_2	Medium	47	0.47	0.43
Cluster n_3	High	14	0.14	3.63

Table 3. One (1) way ANOVA - Clusters vs. Input Attributes

Attribute_Y	Attribute_X	Description				Statistical test		
Yield per bigha*		Value	Examples	Average	Std-dev	Variance decomposition		
		High	14	115.71	8.51	Source	Sum of square	d.f.
		Medium	47	80.53	1.55	BSS	24431.85	2
		Low	39	67.02	3.49	WSS	1517.53	97
		All	100	80.19	16.19	TSS	25949.39	99
						Significance level		
						Statistics	Value	Probability
						Fisher's F	780.83	0

*bigha: 33 decimal

Table 4: Characterization of low yield category cluster

Cluster (low yield group)-(39%) 39		
Attributes	**Test value**	
Continuous Attributes Group mean Std. Dev in parentheses		
Yield(quintal acre^{-1})	-6.47	67.03(3.49)
Total labour	-7.62	18.64(1.22)
Fertilizer (kg.)	-8.38	56.15(8.77)
Organic matter (quintal)	-8.63	0.00(0.00)
Discrete Attributes		
Micronutrient users (%)	-3.85	(0.0%)0.0%
Micronutrient non users (%)	3.85	(48.1%)100%
Pesticide users (%)	-5.58	(0.0%)0.0%
Pesticide non users (%)	5.58	(58.2%)100%
Organic manure users (%)	-9.95	(0.0%)0.0%
Organic manure non users (%)	9.95	(100%)100%
Cultural practices: Transplanting followers (%)	-4.72	(0.0%)0.0%
Cultural practices: Broadcasting followers (%)	4.72	(52.7%100%

Table-4 shows description of the low-category and test values of the table indicate that this group is highly differentiated from the overall sample population in terms of all the continuous attributes under study. None of the onion growers of this group uses organic manures. Similarly members of this particular group do not use micro nutrients and pesticides. This group is also distinct from the rest population in terms of cultural practices. Broadcasting method of cultivation is being carried out by all the group-members. This group also utilizes less number of man-power in production. Yield is far less than the mean yield of overall sample growers.

Table 5: Description of Medium Yield Category Cluster

Cluster (medium yield group)- (47%) 47		
Attributes	**Test value**	
Group mean Std. Dev in parentheses		
Continuous Attributes		
Yield(quintal acre $^{-1}$)	0.2	80.53(1.56)
Total labour	2.05	23.15(1.08)
Fertilizer (kg.)	2.99	127.87(6.32)
Organic matter (quintal)	3.32	110.44(4.64)
Discrete Attributes		
Micronutrient users (%)	-2	(26.3%)10.6%
Micronutrient non users (%)	2	(51.9%)89.4%
Pesticide users (%)	1.48	(57.6%)40.4%
Pesticide non users (%)	-1.48	(41.8%)59.6%
Organic manure users (%)	7.49	(77%)100%
Organic manure non users (%)	-7.49	(0.0%)0.0%
Cultural practices: Transplanting followers (%)	-0.1	(46.2%)25.5%
Cultural practices: Broadcasting followers (%)	0.1	(47.3%)74.5%

Table 6: Description of high category cluster

Cluster (High yield group)- (14%) 14		
Attributes	**Test value**	
Continuous Attributes Group mean Std. Dev in parentheses		
Yield(quintal acre -1)	8.81	115.71(8.52)
Total labour	7.76	29.71(1.07)
Fertilizer (kg.)	7.48	208.57(10.27)
Organic matter(quintal)	7.36	223.93(4.01)
Discrete Attributes		
Micronutrient users (%)	8.29	(73.7%)100%
Micronutrient non users (%)	-8.29	(0.0%)0.0%
Pesticide users (%)	5.72	(42.4%)100%
Pesticide non users (%)	-5.72	(0.0%)0.0%
Organic manure users (%)	3.21	(23%)100%
Organic manure non users (%)	-3.21	(0.0%)0.0%
Cultural practices: Transplanting followers (%)	6.77	(53.8%)100%
Cultural practices: Broadcasting followers (%)	-6.77	(0.0%)0.0%

Now, coming to the medium category of cluster shown in table-5, we find that this group represents the largest class in terms of membership (47%). Barring yield measures this group is separated from the overall population in respect of uses of organic manure, fertilizer and man-power attributes. All the onion growers of this cluster have been using organic manure in production process. Quantum of organic uses (110.44 qtl acre^{-1}) is statistically significant in this category comparing to the overall population. This group has not been found statistically significant from the overall in terms of micro-nutrient use, pesticide application, and cultural practices.

The last category of onion growers, viz. high cluster

constituting a small sub-group (14% of the sample) excels in terms of yield, cultural practices and critical input uses. This particular group stands out as a distinct group as described in Table-6.

Table 7. Overall description of sample growers

Overall description of Sample Growers	
Attributes	**Group mean**
Continuous Attributes	
Yield bigha-1	80.19(16.19)
Total labour	22.31(3.83)
Fertilizer (kg.)	111.20(52.23)
Organic matter (quintal)	83.25(76.76)
Discrete Attributes	
Micronutrient users	19.00%
Micronutrient non users	81.00%
Pesticide users	33.00%
Pesticide non users	67.00%
Organic matter used	61.00%
Organic matter not used	39.00%
Transplanting	26.00%
Broadcasting	74.00%

Table 8. Roots and Wilks Lambda

Root	Eigen value	Proportion	Canonical R	Wilks Lambda	CHI-SQ	d.f.	p-value
1	654.37	0.99	0.99	0.000562	696.0163	18	0
2	1.71	1	0.79	0.368308	92.8917	8	0

Test values of all the selected attributes have separated it as a dissimilar entity. Average yield of this cluster is as high as 115.71 quintal acre^{-1} in contrast to the population mean of 80.19 quintal acre^{-1}. Similarly, fertilizer consumption (208.57 kg. acre^{-1}) in onion production is at high level comparing to counter groups. The modus operandi of cultivation is based on transplanting instead of broadcasting under this category. All the group members take care of plants using chemicals and micro nutrients for good harvest.

Next, attempt has been made to characterize the groups in terms of several indicators using cannonical discriminant analysis. Two root-functions have been extracted. However, the first discriminant function figuring a relatively large eigen-value explains 99% of the group classification. The following table

Table 9: Coefficients of cannonical discriminat function

Coefficients	Unstandardized		Standardized	
Attribute	**Root n_1**	**Root n_2**	**Root n_1**	**Root n_2**
Total land(acre)	0.075	0.164	0.128	0.280
Onion land(acre)	-0.492	-0.209	-0.366	-0.156
Organic matter (quintal/acre)	0.305	0.051	1.071	0.179
Fertilizer (kg. acre-1)	0.009	-0.002	0.074	-0.015
No. of irrigation	0.992	-2.612	0.230	-0.607
Total labour (mandays acre^{-1})	0.266	-0.218	0.303	-0.248
pesticide use (discrete)	0.660	0.717	0.225	0.245
micronutrient use (discrete)	-2.444	-4.020	-0.525	-0.863
Transplanting (discrete)	0.686	0.272	0.226	0.090
Constant	-34.141	8.623	-	

shows brief estimates of Roots and Wilk's Lambda and validates significance of the function. Standardized eigen-vectors, i.e. coefficients of the discriminant functions are shown in Table 8. Discriminant score for the three group-means are shown in Table 9.

Table 10. Group centroids on the cannonical variables

Cluster	Root n1	Root n2
Low	-27.51	-0.78
Med	9.01	1.28
High	46.39	-2.13
Sq Canonical corr.	0.99	0.63

The significant factors discriminating the three types of growers include size of operated lands, proportion of onion lands, quantum use of organic manures, fertilizer use, intercultural operations and output raising. Test of equality of group-means of the factors are displayed in Table 11.

Conclusion

Onion (*Allium cepa*) family Alliaceae is one of the most important commercial vegetables. It is grown in western, northern as well as in southern India. Maharashtra, Gujarat, Uttar Pradesh, Orissa, Karnataka, Tamil Nadu, Madhya Pradesh, Andhra Pradesh and Bihar are major onion growing states in

Table 11: Tests of equality of group means

Tests of Equality of Group Means					
	Wilks' Lambda	F	df1	df2	Sig.
Total land (acre)	0.79	12.34	2	97	0
Onion land (acre)	0.77	14.04	2	97	0
Organic matter (quintal acre^{-1})	0.02	2.17E+03	2	97	0
Fertilizer (kg. acre^{-1})	0.04	1.05E+03	2	97	0
No. of irrigation	0.09	446.542	2	97	0
Total labour (mandays acre^{-1})	0.12	342.606	2	97	0
Pesticide use (discrete)	0.54	40.229	2	97	0
Micronutrient use (discrete)	0.35	89.985	2	97	0
Transplanting (discrete)	0.48	52.255	2	97	0

India. India stands 2nd position in Onion production after China in the World. Gujarat stands 2nd position in Onion cultivation after Maharashtra state in India. The productivity of onion is 22120 kg/ha in Gujarat against the all India average of 12580 kg/ha. In view of the importance of the crop, the goal of this research article is to advocate intervention measures for augmenting onion production in a deficit state of West Bengal. K-means cluster analysis, Group characterization technique and Linear Discriminant Analysis tools have been employed to find out the causes of poor performance of this crop. It has been found that the causes of poor performance among low-yield group emanate from cultural practices, technology adoption and managerial lapses. Institutional linkages, developing and restructuring farmers' oriented bodies, promoting SHGs and building up Onion Producers Company and providing marketing infrastructure and provision of cold storages may change the status of poor onion growers.

References

Shah *et al*. 2011. Onion production potential, limitations and its prospects for improvement in the farming system of Punjab, Pakistan. *Agricultural Science Research Journal*. **1**(9): 202- 212.

Sharma *et al*. 2011.Prices of Onions: An analysis. Economic and Political Weekly. **46**(2):22-25.

Johnson, R. and Wichren, D.W. 2002. 5th Edition. Pearson Education (Singapore) Pte. Ltd. Publishers. Delhi, India. pp. 581- 600.