Indian Journal of Extension Education
Vol. 54, No. 1, 2018 (143-148)

Clustering of Various Agricultural Processors for Identifying Training Need to Promote Value Chain Development

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ABSTRACT

Considering the importance of training for capacity building of small and medium processor the study was undertaken to identify the perceived training need of various processors in different agricultural commodities. From nine selected agricultural commodities, 15 processors were selected from each commodity, constituting 135 sample sizes. The hierarchical agglomerative clustering was used to cluster these processors based on similarity for training need. It was found that the guava, mango, tomato and potato processors form cluster 2 as they required similar type of training due to comparatively less favourable supporting entrepreneurial environment as well as they obtained highest scores for training need. The third cluster included the Mushroom, Maize, Wheat and Soybean processors, which were having similar training need due to favourable supporting entrepreneurial environment as well as they obtained lower training need scores. According to Kendalls' coefficient, all the processors were agreed that marketing (3.78) was most preferred area of training followed by technical (3.22), information (2) and social responsibility (1). The highest training need score was obtained for potato processor (2272) and lowest for soybean processor (1953).

Keywords: Entrepreneurial environment, hierarchical agglomerative clustering, marketing, processors, training need etc.

INTRODUCTION

The Indian food processing industry is one of the largest industries in our country and ranks fifth in terms of production, consumption and exports as well as contributes 14 per cent to India's GDP through manufacturing in 2015-16 (MoFPI, 2017). The food processing industries are labour intensive sector, provides employment to millions of people. In food processing mainly small and medium processors are engaged resulting into insignificant proportion of agricultural produce to be processed. Thus, in order to strengthen the food processing sectors there is need of capacity building of small and medium processors through proper training.

Some of the literature supported that entrepreneurial training impart generic management skills like marketing, finance, record-keeping, human relations as well as industrial relations mainly to small and medium processors, thus, gradually helps in realizing the performance of enterprise (Solomon, 2004) . Training helps the processors to develop skills and expose them to different information which could be utilize for the progress of enterprise. The several authors argued that access to new information was indispensable for the initiation, survival and growth of firms (Mead & Liedholm, 1998; Kristiansen, 2002; Duh, 2003; Swierczek & Ha, 2003). Although the availability of new information depends on personal characteristics of processor such as the level of education, infrastructure qualities such as media coverage and telecommunication systems, and on social capital such as networks (Kristiansen, 2003). The establishment of an active small and medium enterprise and the effective utilization of quality business information have been identified as crucial in attaining long-term and sustainable economic growth for developed and developing countries alike (Corps, 2005). In addition, training helps in developing network through which an entrepreneur can obtain resources and get critical support for the development and growth of a business (Dodd & Patra, 2002; Harris & Wheeler, 2005). Thus, considering the importance of training, the present study was undertaken to identify the areas of perceived training need of various agricultural processors belonging to three broad categories of agricultural commodities *i.e.* food grain, fruit and vegetable.

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METHODOLOGY

The agricultural commodities like food grains (Maize, Wheat and Soybean); vegetables (Potato, Tomato and Mushroom) and fruits (Mango, Guava and Aonla) were selected purposively based on their post-harvest losses and/or potential for undergoing value chain development. After the selection of agricultural commodities, the states and further districts were selected purposively for each identified agricultural commodities based on high production under crop and/or potential for value chain development. Selected districts for the present study were Bihar (Maize), Modipuram (Potato), Lucknow (Mango), Allahabad (Guava), Pratapgarh (Aonla), Sonepat (Mushroom) and Indore (Wheat, Soybean, Tomato). From each agricultural commodity 15 processors were selected, thus, the sample size was 135.

The scale was developed to identify the training need of processors in four dimensions namely market, technical, information and social responsibility with Cronbach's alpha coefficient as 0.855 and Spearman-Brown coefficient as 0.785. The content validity was checked through Lynn's method 1986 as 0.93. Hierarchical Agglomerative Clustering (HAC) technique was used to cluster the various processors for training need. It is a bottom-up approach, it starts by adding a cluster for each of the observations to be clustered, followed by iterative pair-wise merging of clusters until only one cluster is left at the top of the hierarchy. For clustering the different processors in each dimension (Market, Technical, Information and Social responsibility) of training need, ward method was used as it is based on minimum variance or error sum of square within cluster. Within the cluster there was similarity for that dimension of training need and between the clusters there was dissimilarity. The graphical representation of HAC is called dendrogram which is a tree like structure, starting with groups of leaves form branches, branches merge into limbs and eventually into tree. To identify the agreement among judges for determining which dimension of training need as most preferred area Kendall's coefficient of concordance was used. To determine in each dimension, which processors required most or least training need Kruskal–Wallis one-way analysis of variance was used. It is a non-parametric method for testing whether samples originate from the same distribution. The test statistic (for large sample) is

$$K = \frac{12}{N(N+1)} \sum_{i=1}^{g} n_i \left(\frac{\sum_{j=1}^{n_i} r_{ij}}{n_i} - \frac{N+1}{2} \right)^2$$

which follows a $\chi 2$ distribution with (g-1) degrees of freedom, where g is the number of groups n_i is the number of observations in i^{th} group, r_{ij} is the rank (among all observations) of jth observation from group i and N is the total number of observations across all groups.

RESULTS AND DISCUSSION

Clustering of various processors according to market dimension of training need

Figure 1 Dendrogram representing various processors into cluster based on market dimension of training need

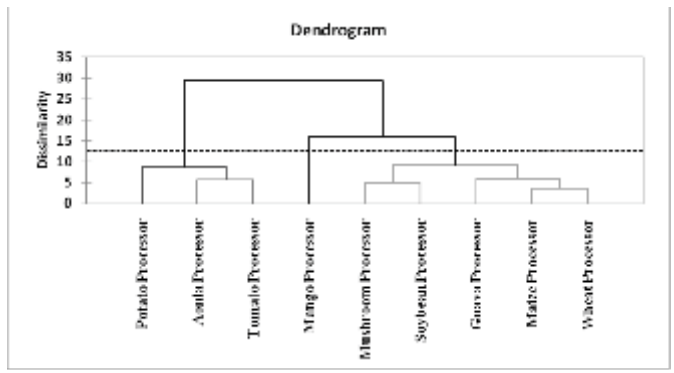

Table 1: Representation of the obtained clusters in marketing dimension of training need

Class	Cluster 1	Cluster 2	Cluster 3
Objects	3	5	1
Sum of weights	3	5	1
Within-class variance	1198.667	1042.800	0.000
Minimum distance to centroid	23.128	19.884	0.000
Average distance to centroid	27.901	28.451	0.000
Maximum distance to centroid	34.008	33.882	0.000
	Aonla Processor	Guava Processor	Mango
	Tomato	Mushroom Processor	Processor
	Processor	Maize Processor	
	Potato	Wheat Processor	
	Processor	Soybean Processor	

From Figure 1 and Table 1 it was evident that nine types of processors were clustered into three clusters based on minimum variance within cluster. It was found that aonla, tomato and potato processors of cluster 1 had similar training need within market dimension. The probable reasons might be due to similar training need for determining prices and discounts of processed products, competition in market and price differences among target customer. In cluster 2 five processors form the cluster, namely, Guava, Mushroom, Maize, Wheat and Soybean processors were included. This might be due to same training requirement for determining different types of products that can be developed, learning nutritional value

of products, new processing technology and online marketing. The third cluster included mango processor due to their higher training need for determining potential customers as well as point and volume of sale.

Clustering of various processors according to technical dimension of training need

Figure 2 Dendrogram representing various processors into cluster based on technical dimension of training need

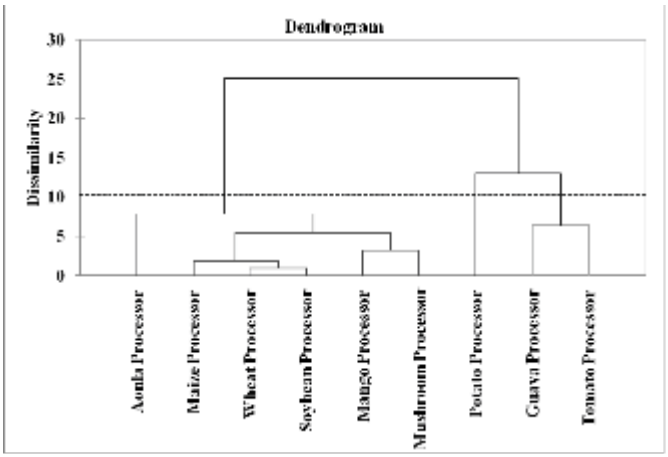

Table 2: Representation of the obtained clusters according to technical dimension of training need

Class	Cluster 1	Cluster 2	Cluster 3
Objects	6	2	1
Sum of weights	6	2	1
Within-class variance	1192.267	822.000	0.000
Minimum distance to centroid	17.013	20.273	0.000
Average distance to centroid	30.395	20.273	0.000
Maximum distance to centroid	41.139	20.273	0.000
	Aonla Processor Mango Processor Mushroom Processor Maize Processor Wheat Processor Soybean Processor	Guava Processor Tomato Processor	Potato Processor

In case of technical dimension of training need, six processors formed the cluster 1, due to similar training requirement for determining innovative products or services in value chain development, developing networking skill and effective financial planning as indicated in table 2 and fig 2. In cluster 2, guava and tomato processors required same types of training for knowing various quality and safety standards, registration of enterprise and sources, rule, procedures of credit availability. The final cluster included potato processor due to desire for determining sources, price trends, demand and supply of potato as raw material because of lack of availability and irregularity of suitable potato variety in study area.

Clustering various processors according to information dimension of training need

Figure 3 Dendrogram representing various processors into cluster based on information dimension of training need.

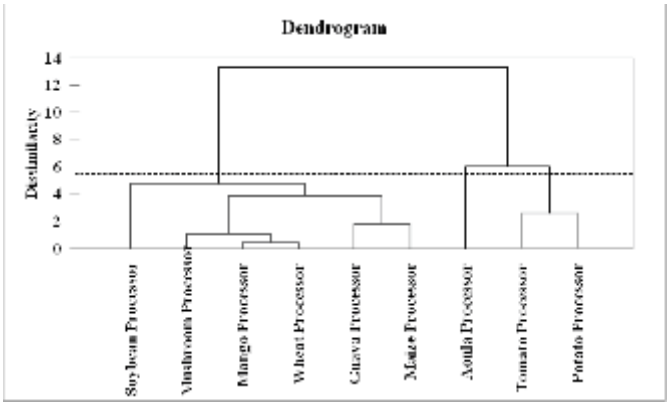

Table 3: Representation of the obtained clusters within information dimension of training need

Class	Cluster 1	Cluster 2	Cluster 3
Objects	1	6	2
Sum of weights	1	6	2
Within-class variance	0.000	653.400	179.500
Minimum distance to centroid	0.000	13.717	9.474
Average distance to centroid	0.000	22.479	9.474
Maximum distance to centroid	0.000	31.297	9.474
	Aonla Processor	Guava Processor Mango Processor Mushroom Processor Maize Processor Wheat Processor Soybean Processor	Tomato Processor Potato Processor

In case of information as dimension of training need, Aonla processors form cluster 1 due to their special information requirement on post-harvest management as indicated in table 3 and figure 3. However, in cluster 2 six processors were included namely; Guava, Mango, Mushroom, Maize, Wheat and Soybean processors, so this group of processor required similar training like information and support for enterprise expansion and diversification as well as information on how to search and utilize data from patents or other authorised sources. Third cluster (tomato and potato processor) required market information related to prices and flow of products.

Clustering of various processors according to social responsibility dimension of training need

Figure 4 Dendrogram representing various processors into cluster based on social responsibility dimension of training need

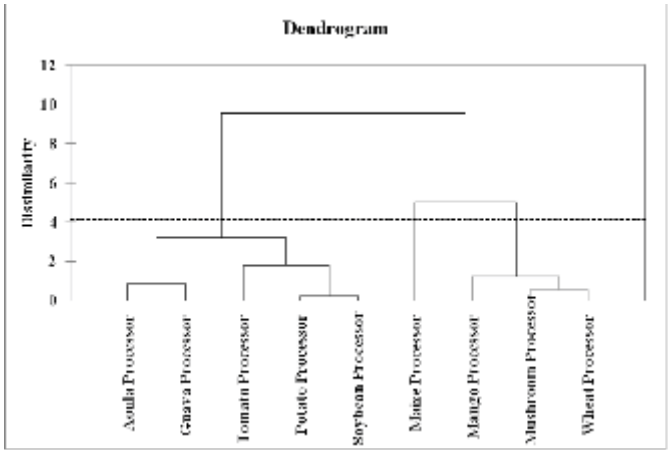

Table 4: Representation of the obtained clusters in social responsibility dimension of training need

Class	Cluster 1	Cluster 2	Cluster 3
Objects	5	3	1
Sum of weights	5	3	1
Within-class variance	380.800	269.000	0.000
Minimum distance to centroid	9.938	11.874	0.000
Average distance to centroid	16.681	13.297	0.000
Maximum distance to centroid	23.246	15.513	0.000
	Aonla Processor Guava Processor Tomato Processor Potato Processor Soybean Processor	Mango Processor Mushroom Processor Wheat Processor	Maize Processor

The aonla, guava, tomato, potato and soybean processor form cluster 1 in social responsibility dimension of training, hence they require similar training for effective utilization of funds and resources as showed in table 4 and fig. 4. Moreover, Mango, Mushroom and Wheat processors form cluster 2 due to their training need for reducing deleterious effect of processed products on human health and finally maize processor form the final cluster due to their training need for providing conducive working environment for work culture.

Clustering of different types of processors according to overall training need

Figure 5 Dendrogram representing different type of processors into cluster based on overall training need

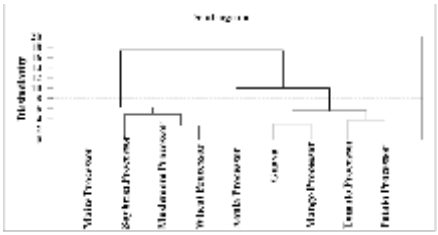

Table 5: Representation of the obtained clusters for overall training need

Class	Cluster 1	Cluster 2	Cluster 3
Objects	1	4	4
Sum of weights	1	4	4
Within-class variance	0.000	1780.417	2192.333
Minimum distance to centroid	0.000	30.878	24.387
Average distance to centroid	0.000	36.334	39.527
Maximum distance to centroid	0.000	40.626	46.933
	Aonla Processor	Guava Processor Mango Processor Tomato Processor Potato Processor	Mushroom Processor Maize Processor Wheat Processor Soybean Processor

According to overall training need, the guava, mango, tomato and potato processors form cluster 2 as represented in table 5 and fig. 5. This group of processors required similar types of training as these processors were having comparatively less favourable supporting entrepreneurial environment and they obtained highest scores for training need. The third cluster included the following processors *i.e.* Mushroom processor, Maize processor, Wheat processor and Soybean processor, which were having similar training need due to favourable supporting entrepreneurial environment and they obtained lower training need scores compared to cluster 2. Only aonla processor falls in cluster I, which might be due to much favourable and promoting entrepreneurial environment for aonla processor at Pratapgarh.

Overall training need scores among processors

Table 6: Representation of overall training need scores among processors

Processors	Obtained Training Score	Rank
Aonla	2035	VII
Guava	2217	III
Mango	2108	IV
Tomato	2264	II
Potato	2272	I
Mushroom	2106	V
Maize	2105	VI
Wheat	2001	VIII
Soybean	1953	IX

The maximum score for training need was obtained by potato processors (2272) followed by tomato processors (2264) due to less favourable entrepreneurial environment for potato processing at Modipuram and tomato processing at Indore. The minimum score for training need was obtained by soybean processors (1953), followed by wheat processors (2001) and aonla processors (2035). The probable reason behind this due to

favourable entrepreneurial environment for soybean and wheat processing at Indore and for aonla processing at Pratapgarh.

Agreement among various processors for training need

Table 7: Agreement among various processors for training need as per Kendall concordance test

Dimensions of training need	Mean Rank X^2 25.13 (3), p<0.01
Marketing	3.78
Technical	3.22
Information	2.00
Social responsibility	1.00

(Kendall's concordance coefficient W: 0.931 and N=9)

There was significant agreement as per Kendall's concordance coefficient (W= 0.931 at X^2 25.13 (3); p <0.01) among nine types of processors that marketing dimension (3.78) was the major dimension of training need as represented from table 7. After marketing, processors agreed for technical dimension (3.22) followed by information dimension (2) and social responsibility dimension (1) for training need. The market dimension included 4Ps *i.e.* product, price, place and promotion. Thus, most of the processors required training to determine types of products that can be developed from produce, its nutritional quality, size, pricing and discounting of products, identifying prices in different target groups, point and volume of sale, distribution of products, online marketing etc. Hence, market dimension was most preferred area of training need for various processors.

Table 8: Severity of training need among various processors for major dimensions of training need as per Kruskal walis test

Market		Technical		Information		Social responsibility	
Processor	Mean Rank X^2 65.64 (8)p<0.05	Processor	Mean Rank X^2 85.74 (8)p<0.05	Processor	Mean Rank X2 67.33 (8)p<0.05	Processor	Mean Rank X^2 51.23 (8)p<0.05
Tomato	109.26^{a}	Potato	115.50^{a}	Guava	112.06^{a}	Mushroom	97.66^{a}
Maize	97.20^{ab}	Guava	105.46^{ab}	Aonla	102.60^{a}	Tomato	93.76^{a}
Potato	95.33^{ab}	Mango	91.63^{abc}	Mango	83.16^{ab}	Aonla	90.90^{ab}
Mushroom	79.26^{ab}	Tomato	84.53^{abcd}	Tomato	82.03^{ab}	Potato	76.56^{abc}
Wheat	59.46^{bc}	Maize	65.20^{abcde}	Potato	69.50^{abc}	Mango	76.36^{abc}
Guava	57.36^{bc}	Mushroom	51.63bcde	Soybean	53.00^{bc}	Guava	64.00^{abc}
Soybean	53.46^{bc}	Wheat	44.06^{cde}	Maize	40.66^{bc}	Wheat	47.20^{bc}
Aonla	30.76^{c}	Aonla	27.36^{de}	Wheat	35.26^{c}	Maize	33.20^{c}
Mango	29.86^{c}	Soybean	26.60^{e}	Mushroom	33.70^{c}	Soybean	32.33^{c}

In case of market, tomato processor (109.26) had shown highest interest for training need due to their desire to develop more value added product from tomato; however Maize processors (97.20) were interested in promoting their products through online market and other schemes. In case of technical dimension, Potato (115.5) and Guava processors (105.46) had shown more interest because of their need for effective financial planning followed by use of modern technology and developing innovative value added products or services. In case of information, guava (112.06) and aonla processors (102.60) had shown more desire for training due to their requirement for information and support to agri-start up, its expansion and diversification. Other reasons were their need of information about new technology and how to search and utilize data from authorized sources. Mushroom (97.66) and tomato processors (93.76) had shown high interest in social responsibility dimension of training need due to need of effective utilization of funds and resources, reduce the deleterious effect of processed product on human health and to comply with government rules.

CONCLUSION

Presently, only insignificant proportion of agricultural produce is being processed due to involvement of small and medium processors as well as their lack of exposure to new technologies. Considering the importance of training for capacity building of processors; their preferred area of perceived training need was identified. According to four dimensions of training need *i.e.* market, technical, information and social responsibility, the processors were clustered based on similarity of training requirement within cluster for that particular dimensions. Further, obtained training need score was calculated and found least for soybean processor and highest for potato processor. The agreement among processors was judged and found that market was most preferred area followed by technical, information and social responsibility. Thus, we need to emphasize on marketing dimension of training more followed by other dimensions.

Paper received on : January 04, 2018
Accepted on : January 11, 2018

REFERENCES

Corps, M. 2005. Information and communications technologies in small and medium enterprise development. Available:www.globalenvision.org/library/7/698.

Cronbach, L. J. 1951. Coefficient alpha and the internal structure of tests. Psychometrika, 16,297-334.

Dodd, S. D., and Patra, E. 2002. National differences in entrepreneurial networking. Entrepreneurship Regional Development, 14 (2), 117-134.

Duh, M. 2003. Family Enterprises as an Important Factor of the Economic Development: The Case of Slovenia. Journal of Enterprising Culture, 11 (2), 111-130.

Harris, S., & Wheeler, C. 2005. Entrepreneurs' relationships for internationalization: Functions, origins and strategies. International Business Review, 14, 187-207.

Kendall, M. G.; Babington Smith, B. (Sep 1939). "The Problem of *m* Rankings". *The Annals of Mathematical Statistics.* 10 (3), 275–287.

Kristiansen, S. 2002. Competition and knowledge in Japanese rural business. *Journal of Tropical Geography,* 23 (1), 52-70.

Kruskal; Wallis 1952. "Use of ranks in one-criterion variance analysis". *Journal of the American Statistical Association,* 47 (260), 583–621.

Lynn, M. R. 1986. Determination and quanti?cation of content validity. Nursing Research, 35, 382– 385.

Mead, D. C., and Leidholm, C. 1998. The dynamics of micro and small enterprises in developing countries. World Development, 26 (1), 61-74.

Ministry of food processing industries. 2017.

Rokach, Lior, and Oded Maimon. 2005. "Clustering methods." Data mining and knowledge discovery handbook. Springer US, 321-352

Solomon, G. 2004. Entrepreneurship and the impact of entrepreneurial orientation training on SMMEs in the South African context: A longitudinal approach, Unpublished Mass Comm. Thesis, 2004, Cape Town: University of Western Cape.

Spearman, C. 1910. Correlation calculated from faulty data. *British J. Psychology,* 3, 271–295.

Swierczek, F. W., and Ha, T. T. 2003. Entrepreneurial orientation, uncertainty avoidance and firm performance: An analysis of Thai and Vietnamese SMEs. *International Journal of Entrepreneurship and Innovation,* 4 (1), 46-58.