

FACTOR ANALYSIS OF AN INSTRUMENT TO MEASURE THE VEGETABLE SUPPLY CHAIN EFFICIENCY

¹Debopam Chakrabarti, ²Dr. Kavitha Desai

¹PhD Research Scholar, University of Mysore.

²Associate Professor, Department of Professional Studies,
CHRIST (Deemed to be University), Bangalore.

ABSTRACT

Purpose- The purpose of this paper is to validate the different factors considered in a questionnaire through statistical analysis of pilot data. The questionnaire was designed to run a survey to find out the vegetable supply chain efficiency.

Design/Methodology/Approach- The Cronbach's Alpha statistical analysis was conducted on the pilot data collected from seventy respondents based on sample frame design. The different factors used to design the questionnaire to run the pilot study were validated. The questionnaire was revised for further use based on the statistical analysis.

Findings- It was observed that most of the factors are adequately designed for the questionnaire and are above the acceptable limit of 0.7 for Cronbach's alpha. The four channels which are selected for calculating the efficiency are adequate and we do not need to add additional option as 'others'. All other channels resemble the properties of the four basic channels and we should focus on those basic channels in our data collection. It was also observed that some of the factors for harvesting efficiency are overlapping and can be grouped as one. Few questions on marketing and demand management are found to be redundant and can be deleted from final questionnaire. Overall, it leads to a robust questionnaire for main data collection.

Research limitations/implications- The data analysis is based on the pilot data of selected districts which is assumed to be representative of the overall sample frame. There may be a need for minor adjustment during full-fledged data collection.

Practical implication- This study will help in designing a robust questionnaire which will be used as an effective tool for full survey.

Originality/value- So far there was no major study to design the questionnaire for measuring and comparing the efficiency of different supply chain channels. The Cronbach's Alpha analysis of factors will have added dimension in the originality and value of the study.

Keywords: supply chain management, vegetables, questionnaire, and Cronbach's alpha

1. INTRODUCTION

India has 12% of the World's arable land and we are the second largest fruits and vegetables producer in the world. But, the heterogeneous product supply base and presence of multiple non-value added intermediaries within the supply chain make the agricultural supply chain less competitive. Our farmers realize less than 1/3rd of the consumer price which may go as low as 1/6th or 1/7th compared to an equivalent figure of 2/3rd in developed countries. Hence, there is requirement to improve the supply chain efficiency to make the fruits and vegetables farming more profitable to the farmers.

Also, it is observed that there are limited research studies which have focused on challenges and issues of vegetable supply chain. Following are some of the channels for supply chain network of vegetables.

Channel 1:



Channel 2:



Channel 3:



Channel 4:

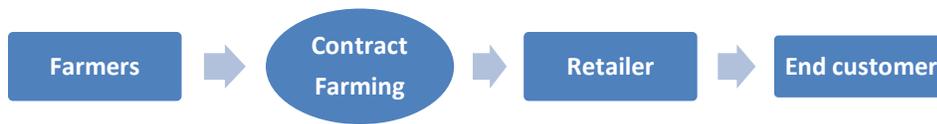


Fig 1.1: Different vegetable supply chain channels

There can be other variants of supply chain network. So, the problem is to understand the efficiency of different supply chain channels for vegetables and come out with a model which can provide appropriate price to the farmers by effectively managing the losses at different points of supply chain. The current paper is aimed to provide a statistical technique to validate the questionnaire design to help in a survey to identify various factors impacting the supply chain efficiency.

2. BACKGROUND OF THE STUDY

Considering the importance of finding out the supply chain efficiency of different distribution channels for vegetables the questionnaire should be designed keeping the following objectives into consideration:

1. To understand the supply chain efficiency for different channels (Direct to customer, whole sale market, Rythu Bazaar, Contract/contact with retail) for vegetables
2. To study the level of efficiency for different stages of supply chain and understand the gaps between perceived and expected efficiency
3. To identify the issues and challenges of supply chain efficiency for different channels
4. To study the impact of different factors such as harvesting, storage, transportation, market information flow etc. on the supply chain efficiency of different channels
5. To understand the various reasons for losses in the supply chain process and its impact on supply chain efficiency
6. To build a supply chain model towards improving supply chain efficiency for vegetables which might contribute towards betterment of the farmers

Different components which contributes to the vegetable supply chain efficiency are depicted below:



Figure 2.1: Various components of Supply chain efficiency

Every component plays an important role to improve the efficiency of the supply chain and different channels may have different challenges/advantages that attributes to the overall efficiency. The current study of efficiency is from harvesting to the marketing point and purchase efficiency of agricultural raw material will not be considered for the study. So, the questionnaire needs to be designed considering the above areas of efficiency.

3. QUESTIONNAIRE DESIGN

Considering the above areas which contributes to the supply chain efficiency, the different variables considered for the questionnaire are mentioned below with appropriate sub-group.

Different variables considered for questionnaire design:

Table 3.1: Variables considered for Questionnaire Design

General demographic Information	Storage Efficiency
1 Name	25 Storage facility requirement
2 District	26 Storage facilities availability
3 Taluka	27 Approximate loss during storage
4 Village	28 Reasons for storage losses
5 Contact no.	29 General Remarks on Storing
6 Age	Transportation Efficiency
7 Annual Income	30 Distance of nearest market where produce is sold
8 What is the proportion of agricultural income out of total income	31 Mode of transport used
9 Source of investment	32 Road/infrastructure condition
10 Educational background	33 Transportation availability
11 No. of years in the profession	34 Approximate loss during Transportation
12 Number of family members	35 Approximate loss during loading/unloading
13 Total area of land used for farming	36 Reasons for transportation loss
14 Total area (%) used and quantity produced in Quintal for selected produce	37 General Remarks on transportation, loading/unloading
15 Infrastructure available	Marketing Efficiency
Channel Efficiency	38 Price information availability in advance
16 Channel selection	39 Approximate price received from different channels in last one year (High/Low/Average)
17 Reason for channel selection	40 Approximate loss during Market handling
18 Channel selection satisfaction	41 Reasons for marketing losses
19 General Remarks on Channel selection	42 General Remarks on Marketing
Harvesting Efficiency	Demand Efficiency
20 Harvesting plan and practice	43 Demand information availability in advance
21 Approximate loss during harvesting	44 General Remarks on Demand
22 Approximate loss during sorting/grading	Cost methods and components
23 Reason for harvesting and sorting loss	45 Method used for calculating the price?
24 General Remarks on Harvesting/Sorting/Grading	46 Cost components for different channels

Some of the variables mentioned in Table 3.2 needs factor analysis to ensure that we have considered all factors relevant to the variables and they are not overlapping.

The variables and the factors considered for factor analysis are mentioned below variables:

Table 3.2: Variables and factors considered for Factor analysis

Factors	Detail	Factors	Detail
17. Reason for channel selection		28. Reason for storage losses	
Reason_Price	Price	Reason_Store_condition	Improper storage condition
Reason_Trans	Transportation cost	Reason_Store_facility	Storage facility inadequate
Reason_Distance	Distance from market	Reason_Store_over	Over storage due to over harvesting
Reason_Payment	Payment promptness	Reason_Store_Shelf life	Shelf life expired
Reason_Credit	Credit taken from channel	Reason_Store_Others	Others (Please specify)
Reason_Other	Others (Please specify)		
23.Reasons for Harvesting losses		36. Reason for Transportation losses	
Reason_Unplan_Har	Unplanned harvesting	Reason_Trans_Avail	Non-availability of Proper transportation
Reason_Harv-method	Non availability of harvesting method	Reason_Trans_Distance	Distance from market
Reason_Impr_tools	Improper tools used		Bad
Reason_Maturity	Pre/over matured harvesting	Reason_Trans_Infra	Road/infrastructure
Reason_handling	Inappropriate handling	Reason_Trans_Theft	Theft
Reason_Weather	Weather condition	Reason_Trans_Store	Storage condition during transport
Reason_Harv_Others	Others (Please specify)	Reason_Trans_spil	Overload spillage
		Reason_Trans_labour	Carelessness of labor
		Reason_Trans_other	Others (Please specify)

41. Reason for Marketing losses

Reason_Market_buyer	Non availability of buyer
Reason_Market_handling	Improper handling at market
Reason_Market_packing	Improper packing
Reason_Market_theft	Theft
Reason_Market_other	Others (Please specify)
Market_other	Other reason for marketing loss

4. PILOT TESTING APPROACH

The scope of the study is in the state of Telangana which has 31 districts currently from earlier 10 districts. A multistage sampling method was used to narrow down the sample frame. Before identifying the sample frame it was important to select the few major crops to focus our study.

The top 3 vegetables (Tomato, Ladies finger, Brinjal) were selected based on the five years production data of major crops between 2012 and 2016 from Telangana Horticulture department in January 2017.

For the pilot study, 70 farmers from Medak, Ranga Reddy and Warangal were selected and their uses of channel is mentioned below (some of the farmers are using multiple channels):

Table 4.1: Uses of different channels by the farmers under pilot study

Channels	No. of uses
1 (Local market – direct to customer)	15
2 (Wholesale market)	30
3 (Rythu Bazaar)	16
4 (Contract/contact farming with retail)	14
5 (Others)	12

5. CRONBACH’S ALPHA ANALYSIS RESULTS

Based on the data collected through pilot testing the variables and factors mentioned in section 3 were statistically tested using Cronbach Alpha methods and the results are discussed below for each variable:

5.1 Variable- Reason for Channel Selection

The reasons for channel selection results with the existing factors are analyzed and the initial analysis has shown the result as below:

Table 5.1.1: Cronbach’s Alpha for channel selection before adjustment

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.577	0.643	30

Table 5.1.2: Cronbach’s Alpha values for channel selection if items are deleted

Cronbach's Alpha if Item is deleted

	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5
Price	0.560	0.506	0.564	0.532	0.668
Transportation cost	0.560	0.502	0.564	0.532	0.668
Distance from market	0.563	0.502	0.564	0.532	0.668
Payment promptness	0.560	0.502	0.564	0.532	0.668
Credit taken from channel	0.557	0.502	0.564	0.532	0.671
Others (Please specify)	0.553	0.510	0.545	0.533	0.892

Based on the result, we further analyzed the data and it was observed that the Channel 5 is actually a sub set of Channel 1 and 2 and we can delete the channel 5 (Others) related questionnaire and concentrate our study on four primary Channels only. The revised Cronbach’s Alpha value after deleting the Channel 5 factors are shown below:

Table 5.1.1: Cronbach’s Alpha for channel selection after adjustment

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.892	0.881	24

The above value of Cronbach’s Alpha is showing a steady trend and we can consider the factors for our questionnaire.

5.2 Variable- Reason for harvesting losses

The reasons for harvesting losses with the different factors were analyzed and the results are shown below:

Table 5.2.1: Cronbach’s Alpha for reason for harvesting losses before adjustment

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.475	0.465	7

Table 5.2.2: Cronbach’s Alpha values for harvesting losses if items are deleted

Factors	Cronbach's Alpha if the Item is deleted
Unplanned harvesting	0.072
Non availability of harvesting method	0.189
Improper tools used	0.424
Pre/over matured harvesting	0.621
Inappropriate handling	0.328
Weather condition	0.560

Others (Please specify)	0.506
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On further analysis, it was observed that the replies under “Others” are pointing actually towards market readiness. Because, the market is not ready to pay bare minimum price the harvesting is not done. This becomes the root cause for over matured harvesting. So, we can remove the factor “Pre/over matured harvesting” and replace this with “Market readiness”. The Cronbach’s Alpha analysis is showing a better result once we remove the same. The revised value is shown below:

Table 5.2.3: Cronbach’s Alpha for reason for harvesting losses after adjustment

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.670	0.672	6

The questionnaire will be adjusted based on the above finding.

5.3 Variable- Reason for storage losses

Table 5.3.1: Cronbach’s Alpha for reason for storage losses

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.928	0.923	5

The value is good and no adjustment is required for questionnaire.

5.4 Variable- Reason for transportation losses

Table 5.4.1: Cronbach’s Alpha for reason for transportation losses

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.931	0.925	8

The value is good and no adjustment is required for questionnaire

5.5 Variable- Reason for marketing losses

Table 5.5.1: Cronbach’s Alpha for reason for marketing losses

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.920	0.918	5

The value is good and no adjustment is required for questionnaire

6. ANALYSIS OF PILOT RESULTS

Overall analysis of Cronbach’s Alpha has shown that the factors considered for most of the variables are adequate and non-overlapping except the following variables:

- Reasons for channels Selection – The overall reasons selected for channel selection questionnaire are adequate. But, we do not need to consider any channels other than the four primary channels as shown in Fig.1.1
- Reasons for harvesting losses – The root cause of over matured harvesting was tracked as Market’s readiness to provide minimum price. The questionnaire will be corrected and final factors will be the following:
 - Unplanned harvesting
 - Non availability of harvesting method
 - Improper tools used

- Market readiness for minimum price
- Inappropriate handling
- Weather condition

There are other observations on questionnaire based on pilot data and the points mentioned below will be addressed in the revised questionnaire (Refer Table 3.1 for variable number).

- Variable 13 should have an additional factor on total land vs. total land used for vegetables and unit should be in acres.
- Variable 38 may not be useful as the reply is consistent. The pricing information is available only for channel 4 (Contract/Contact farming with retailers)
- Variable 41 should have another factor as most of the “Other” categories is leading to loss due to extended wait. The price come down towards the later part of the day
- Variable 43 may not be required separately as the reply is consistent and the advance demand information is not available other than channel 4
- Questions related to variable 46 needs to be administrate selectively where we can get relevant experience from the farmers. Most of the farmers are not having enough understanding of the cost components.

7. CONCLUSION

This study will help in designing a robust questionnaire which will be used as an effective tool for full survey. It was observed that most of the factors are adequately designed for the questionnaire and are above the acceptable limit of 0.7 for Cronbach’s alpha. The four channels which are selected for calculating the efficiency are adequate and we do not need to add additional option as ‘others’. So far there was no major study to design the questionnaire for measuring and comparing the efficiency of different supply chain channels. The Cronbach’s Alpha analysis of factors will have added dimension in the originality and value of the study.

Overall, it leads to a robust questionnaire for main data collection and also help the future research as a reference for usage of Cronbach’s alpha for questionnaire design.

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