Supply Chain Management through Vertical Coordination in Vegetable Industry

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Abstract*- The study provides empirical evidence of the importance of various vertical coordination variables needed for the effective implementation of vertically coordinated supply chain approach in vegetable industry for the measurement of efficient accessibility of vertical coordination effect benefits. Survey methodology has been used to collect data. Neural network model has been used to know the importance of vertical coordination variables as well the relation of vertical coordination variables with the vertical coordination effect variables. This study contributes to the literature by exploring the importance of various variables extracted from literatures which is applied specific five vegetables namely potato, brinjal, cabbage, cauliflower and okra. The participants involved in study are producers only and limited to the Odisha. Findings have very clearly mentioned the importance of variables. Further this can get used by the govt. organizations for policy formulation as well for the decision process in providing the input facility support. The outcome can be beneficial to other vegetable supply chain participants like intermediaries and entrepreneurs engaged in value addition and processing of vegetables. This study is one step further contribution to the body of knowledge on vegetable supply chain vertical coordination approach.

Keywords: *Vertical Coordination, Vegetable Supply Chain, Survey Methods, Regression Analysis,*

1. Introduction

Agriculture was always an entrepreneurial activity and findings of the research talks about the farmer's entrepreneurial identity with many characteristics like growth-oriented, optimistic and having more personal control of their business activities [27]. Since the 1980s literature on SCM stresses the need for collaboration among successive actors from primary producer to final consumers to better satisfy consumer demand at lower costs [1] [7] [22].

SCM deals with total business process excellence and represents a new way of managing the business within each link and the relationships with other members of the

SC. A driving force behind SCM is the recognition that sub-optimization occurs if each organization in a SC attempts to optimize its own results rather than to integrate its goals and activities with other organizations to optimize the results of the chain [4]. Ref. [21] refers to the interdependency of activities in the SC says If one activity fails the chain is disrupted creating poor performance and destabilizing the workload in other areas thereby jeopardizing the effectiveness of the SC. This was first recognized [8] when he modeled a factory – distributor – retailer system and showed that small disturbances in one part of the system can very quickly become magnified as the effect spreads through the SC. Vegetable SCs comprise organizations that are responsible for the production and distribution of vegetable produces. In general SCs for fresh agricultural products (such as fresh vegetables, flowers, fruits) may comprise growers, auctions, wholesalers, importers and exporters, retailers and specialty shops. Basically all of these SC stages leave the intrinsic characteristics of the product grown or produced in the countryside untouched. The main processes are the handling, storing, packing, transportation, and especially trading of these goods. Ref. [1] provides an extensive review of the literature and research on SCM. Whereas some authors refer to SCM in the context of an individual organization or dyad [6] others refer to the SC level [11] or the network level of analysis [2]. In this paper the supply chain level of analysis is chosen taking account of the other participants in the supply chain network too. The aim of the supply chain is to produce value for the ultimate consumer whilst satisfying other stakeholders in the supply chain. A supply chain is a network of (physical and decision making) activities connected by material and information flows that cross organizational boundaries. Agriculture too has been aligned with the production and service sector and needed to boost specifically in Iran. Lebanon has faced much of challenges and trying to come out from the challenges agro-industrial integration [12]. Problem lies with the establishment of an agricultural information programme in Southern Africa [22]. At the same time due to the growth in supermarket culture [14] many export companies, retail stores and catering outlets has moved up

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to control the bigger supply chain and the channel to get the longest reach to the consumer. So naturally it has generated much of competition [14] among the intermediaries operating in between the producer and consumer as well much of the challenge for producer and many of the options for consumers. This system the intermediaries are operating with much of uncertainty about the mode of transaction and increases the probability of perishibility and therefore the option left is vertical integration of the supply chain system. Ref. [14] refers, it is observed that integration will lead to reduce the wastage of produce and will continue to alleviate the demand supply gap through improvements in the timely flow of produce from producer to consumer.

2.   Review of Literature

Globally the new era of linking agriculture to food processing is being crucial for the food security. In this era of globalization Lebanese government needs to initiate the elimination of all subsidies and import control policies of food markets. As discussed the sustainable agriculture and developed the model shows that it must expand to further steps of industrialization to support the human resource development activities for agricultural marketing. The research of [15] concludes that marketing is critical for new entrepreneurial farm ventures. The factors it has taken in consideration are first focuses on situational factors, second entrepreneurial skills, and the third characteristics and attitudes of the farmer [15]. It supports the idea that in the context of farming, entrepreneurial skills and managerial skills are two different dimensions and gives strong reasons to argue that credible explanations concerning the performance of the farm enterprise cannot be straightforwardly reduced to the presence or absence of entrepreneurial skills. A supply chain is a network of organizations contributing to the design, production and distribution of a product from its inception to its consumption by the final consumer, while supply chain management is the coordination and control of all activities within a supply chain with the goal of maximizing values through lower transaction costs and increased margins and improving performance in one or more quality dimensions such as quality, time, cost, flexibility and environment [26] all for consumer satisfaction.

The planning and control of total materials flow from suppliers through manufacturing and distribution chain to the end-users [11]. The connected series of activities which is concerned with planning, co-coordinating and controlling material, parts and finished goods from suppliers to the end customer [21] The chain linking each element of the production and supply process from raw materials through to the end consumer, typically such a chain will cross several organizational boundaries[20]. A network of firms interacting to deliver a product or service to the end customer linking flows from raw material supply to final delivery [7]. A system whose constituent parts include suppliers of materials, production facilities distribution services and customers, all linked together via the feed forward flow of materials and the feedback flow of information [24]. The network of organizations that are involved through upstream and downstream linkages in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer [3], A network of processing cells with the following characteristics: supply, transformation and demand [5]. Networks of facilities that procure raw materials transform them into intermediate goods and then final products and deliver the products to customers through a distribution system. It spans procurement, manufacturing and distribution [13]. Material and information flows both in and between facilities such as vendors, manufacturing and assembly plants and distribution centers there are three traditional stages in the SC: procurement, production and distribution [23]. The integration of business processes from end-user through original suppliers that provides products, services and information that add value for customers [4]. The network of connected and interdependent organizations mutually and cooperatively working together to control, manage and improve the flow of materials and information from suppliers to end users [3]. A network of connected organizations aimed at the fulfillment of consumer needs in conjunction with the fulfillment of needs of other stakeholders of such an entity [2]. A network of processes with precedence relationships those are linked by the flow of products, information and/or money [26]. From the raw materials stage through to the end user as well as the associated information flow and materials flow up and down the SC [9]. Supply chain is all that converts concepts into cash and customer satisfaction [10], Supply Chain encompasses all the activities associated with moving goods from the raw material stage through to the end-user [18]. A supply chain consists of all stages involved, directly or indirectly, in filling a customer request [17]. Supply chain is life cycle processes supporting physical information, financial and knowledge flows for moving products and services from suppliers to end users. A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products to customers [16].

3.   Research Methodology

The study is descriptive in nature and for this purpose both the sources of data has been used i.e. primary source of data and secondary source of data. Firstly the secondary data is collected from literature

review to understand the existing theories in India and abroad. For this purpose the different sources used are online libraries, published articles by agricultural universities and govt. departments, different online databases and the printed published journals and books. Secondly the primary data is collected using a structured survey questionnaire with the agricultural experts of vegetable industry involved in the research and development of vegetables and farmers engaged in vegetable cultivation. The main conclusion of the research is drawn on the basis of data collected from primary sources by survey of respondents to visit the real field. This study is done in the state of Odisha in India taking the sample size of 107 respondents. For the analysis SPPS 20 software has been used. All the outputs are SPSS 20

generated and have got interpreted and analysed using the theoretical concepts given by different literatures. The reliability (α) of the Importance of vertical coordination questionnaire is .968 and reliability (α) of the Effects of vertical coordination questionnaire is .978, so the questionnaire used for the study is acceptable. Basically analysis is done for the prediction of the needed variables, those are most important for the vertically coordinated supply chain of vegetable industry. Effects of vertical coordination is taken as dependent variable where the relationship in between independent variable and dependent variable respectively importance of vertical coordination questionnaire and effects of vertical.

4. Results

Expert study carried with 107 respondents on the basis of data collected through structured questionnaire on 14 variables almost all the variables showing the same mean value nearing to 4 and in between 4 and 4.5, the Quality Control showing the mean value less than 4 as 3.94 which is again reaching to 4. The numeric values of std. deviation is comparatively higher showing the dispersion of responses among the respondents is good showing the varying opinions. The numeric value for std. error mean is comparative lesser which is other way better and shows the high quality of responses as shown in Table 1. The t- test applied among 14 variables namely Perishibility Reduction, Wastage Reduction, Yield Increase, Demand Security, Nonseasonal Availability Assurance, Control Price Fluctuation, Variety Vegetable, Quality Control, Quantity Control, Risk Reduction, System Transparency, Grade Standard Improvement, Support Technology and Vegetable Growers Benefit. Out of which 9 variables are namely Wastage Reduction, Demand Security, Nonseasonal Aavailability Assurance,

Control Price Fluctuation, Variety Vegetable, Risk Reduction, System Transparency, Support Technology and Vegetable Growers Benefit showing the p value less than or equal to 0.05 shows that there is no significant difference between the opinions of respondents with leading to values 4 and 5 of the response and enforcing all these 9 variables to get accepted for further study to know the actual importance in vertical coordination of vegetable supply chain. In the other hand 5 variables namely Perishibility Reduction, Yield Increase, Quality Control, Quantity Control and Grade Standard Improvement are getting the p value more than 0.05 shows that there is statistically significant difference between the opinions of respondents and suggesting to revalidate it with the further study and know really these 5 variables having the importance for vertical coordination of vegetable industry. Moreover the differences between condition Means are likely due to chance and not likely due to the variables manipulation as shown in Table 2.

Table 1 T-Test to Vertical Coordination Variables

One-Sample Statistics				
Parameters	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Perishibility Reduction	107	4.20	.818	.079
Wastage Reduction	107	4.22	.756	.073
Yield Increase	107	4.02	.801	.077
Demand Security	107	4.38	.609	.059
Nonseasonal Aavailability Assurance	107	4.30	.647	.063
Control Price Fluctuation	107	4.29	.659	.064
Variety Vegetable	107	4.36	.704	.068
Quality Control	107	3.94	.725	.070
Quantity Control	107	4.08	.826	.080
Risk Reduction	107	4.17	.637	.062
System Transparency	107	4.30	.717	.069
Grade Standard Improvement	107	4.09	.622	.060
Support Technology	107	4.44	.586	.057

Vegetable Growers Benefit	107	4.44	.689	.067

Table 2 T-Test to Vertical Coordination Variables

One-Sample Test					
	Test Value = 4				
Parameters	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**
					Lower | **Upper**
Perishibility Reduction	2.483	106	.015	.196	.04 | .35
Wastage Reduction	3.068	106	.003	.224	.08 | .37
Yield Increse	.241	106	.810	.019	-.13 | .17
Demand Security	6.510	106	.000	.383	.27 | .50
Nonseasonal Aavailability Assurance	4.778	106	.000	.299	.17 | .42
Control Price Fluctuation	4.548	106	.000	.290	.16 | .42
Variety Vegetable	5.220	106	.000	.355	.22 | .49
Quality Control	-.800	106	.425	-.056	-.19 | .08
Quantity Control	1.054	106	.294	.084	-.07 | .24
Risk Reduction	2.733	106	.005	.168	.05 | .29
System Transparency	4.317	106	.000	.299	.16 | .44
Grade Standard Improvement	1.553	106	.123	.093	-.03 | .21
Support Technology	7.758	106	.000	.439	.33 | .55
Vegetable Growers Benefit	6.592	106	.000	.439	.31 | .57

Table 3 T-Test to Vertical Coordination Effect Variables (Individual)

One-Sample Test					
	Test Value = 4				
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference
					Lower | Upper
Individual growth with mutual interest	-4.303	106	.000	-.669	-.98 | -.36
VSCP growth with mutual interest	.526	106	.600	.040	-.11 | .19
AS growth with mutual interest	2.128	106	.036	.175	.01 | .34
Long term relationship for Individual growth	-2.397	106	.018	-.329	-.60 | -.06
Long term relationship for vscp growth	5.873	106	.000	.318	.21 | .43
Long term relationship for as growth	1.134	106	.259	.106	-.08 | .29
Individual growth with sharing benefits	7.457	106	.000	.421	.31 | .53
VSCP growth with sharing benefits	5.958	106	.000	.346	.23 | .46
AS growth with sharing benefits	4.736	106	.000	.271	.16 | .38
Individual growth with mutual interest	5.958	106	.000	.346	.23 | .46

VSCP growth mutual interest	2.216	106	.029	.159	.02	.30
AS growth mutual interest	4.736	106	.000	.271	.16	.38
Individual growth with open information	5.958	106	.000	.346	.23	.46
VSCP growth with open information	2.216	106	.029	.159	.02	.30
AS growth with the open information	4.736	106	.000	.271	.16	.38
Individual growth with interdependence	2.216	106	.029	.159	.02	.30
VSCP growth with interdependence	4.577	106	.000	.299	.17	.43
AS growth with interdependence	4.736	106	.000	.271	.16	.38

Table 4 T-Test to Vertical Coordination Effect Variables

One-Sample Statistics				
Parameters	N	Mean	Std. Deviation	Std. Error Mean
Mutual Interest	107	3.8488	.78103	.07550
Long term Relationship	107	4.0316	.66637	.06442
Shared Benefit	107	4.3458	.44137	.04267
Open Information	107	4.2586	.46763	.04521
Stability	107	4.2586	.46763	.04521
Interdependence	107	4.2430	.47928	.04633

Table 5 T-Test to Vertical Coordination Effect Variables

One-Sample Test						
	Test Value = 4					
Parameters	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Mutual Interest	-2.002	106	.048	-.15117	-.3009	-.0015
Long term Relationship	.491	106	.625	.03161	-.0961	.1593
Shared Benefit	8.104	106	.000	.34579	.2612	.4304
Open Information	5.720	106	.000	.25857	.1689	.3482
Stability	5.720	106	.000	.25857	.1689	.3482
Interdependence	5.244	106	.000	.24299	.1511	.3349

The t-test applied on 18 variables of vertical coordination effect namely individual growth with mutual interest, vscp growth with mutual interest, as growth with mutual interest, long term relationship for individual growth, long term relationship for vscp growth, long term relationship for as growth, individual growth with sharing benefits, vscp growth with sharing benefits, as growth with sharing benefit, individual growth with mutual interest, vscp growth mutual interest, as growth mutual interest, individual growth with open information, vscp growth with open information, as growth with the open information, individual growth with interdependence, vscp growth with interdependence and as growth with interdependence taking the test value 4 showing 16 variables have the p value less than or equal to 0.05 shows that there is no statistically significant difference between the opinions of respondents though only 2 variables have the p value more than 0.05 shows that there is statistically significant difference between the opinions of respondents. Most of the respondents agree and strongly agree on these 16 variables. This has been taken for further study in group as shown in Table 3. On the basis of data collected 6 variables almost all the variables showing the same mean value nearing to 4.

The numeric values of std. deviation is comparatively higher for the first variable Mutual Interest and the second Long term Relationship showing the dispersion of responses among the respondents is good showing the varying opinions though other 4 Shared Benefit. Open Information, stability and Interdependence are showing comparative lesser value. The numeric value for std. error mean is showing the same pattern as the std. deviation value with much lesser values as shown in Table 4. The t- test applied among 6 variables namely Mutual Interest, Long term Relationship, Shared Benefit, Open Information, Stability and Interdependence. Out of which 4 variables are namely Shared Benefit, Open Information, Stability and Interdependence showing the p value less than or equal to 0.05 shows that there is no statistically significant difference between the opinions of respondents and enforcing all these 4variables to get accepted for further study to know the actual importance in vertical coordination of vegetable supply chain. In the other hand 2 variables namely are Mutual Interest and Long term Relationship getting the p value more than

0.05 shows that there is statistically significant difference between the opinions of respondents and suggesting revalidating it with the further study and knowing really these 2 variables having the importance for vertical coordination of vegetable industry. Moreover the differences between condition Means are likely due to chance and not likely due to the variables manipulation as shown in Table 5.

The Model Summary table is providing the R (0.594) and R^2 (0.353) values. The R (0.594) is representing the strength of the simple correlation, which is good. The R^2 (0.353) and Adjusted R^2 (0.347) indicates that dependent variable, "VC Effect", can be explained by the independent variable, "VC Importance" as 35%. The ANOVA table indicates that the regression model predicts the outcome variable is significantly well. Coefficients, provides us with information on predictor variable and showing that both the constant and VC Importance contributing significantly to the model.

5. Managerial Implications

Supply chain management through vertical coordination in vegetable industry will give necessary insights for better understanding of the ways for perishibility reduction, wastage reduction, yield increase, demand security, nonseasonal availability assurance, control price fluctuation, variety vegetable, quality control, quantity control, risk reduction, system transparency, grade standard improvement, support technology and vegetable growers benefit for the realization and will help in suggesting ways for storage facility. Methods suggested can contribute to develop

6. Conclusion

On the basis of study we can conclude that perishibility reduction, wastage reduction, yield increase, demand security, nonseasonal availability assurance, control price fluctuation, variety vegetable, quality control, quantity control, risk reduction, system transparency, grade standard improvement, support technology and vegetable growers benefit are the

organized more regulated vegetable markets to have more effect on these variables of vertical coordination like Mutual Interest, Long term Relationship, Shared Benefit, Open Information, Stability and Interdependence. Evidences from the research will add necessary insights to the literature of agricultural marketing. Public Private Partnership (PPP) models can be developed that can be a successful contribution of agriculture in GDP of economy. The gap found and solution suggested as vertical coordination in supply chain of green vegetables can lead to the self sufficient country for green vegetables.

variables needed to study for the development of vegetable supply chain in vertically coordinated approach. More over in the vertically coordinate supply chain approach the effects the mutual interest, long term relationship, shared benefit, open information, stability and interdependence that can support in development of a sound supply chain in vegetable industry and can have in multi way benefit to all the stakeholders.

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