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Vertical coordination for optimization of the vegetable supply chain

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Abstract

This study is based on the concept of the vertically coordinated supply chain to produce value for the stake holders in the vegetables supply chain. The primary aim of this study is to measure the impact of vertical coordination concerning to vegetable supply chain industry. The research is descriptive in nature and Delphi technique has been applied to measure the impact of vertical coordinated supply chain on vegetable industry, demand-supply gap and price gap for vegetables, has been obtained through expert opinion. Neural Network Model is used for the prediction of the importance of different variables. The conclusion is based on the 16-6-14 structure study on independent variables-hidden factor of process-dependent variables or the predictors respectively. The outcome of this research is for the consumer in terms of price and beneficial for the farmers engaged in vegetable cultivation. Largely it can support all the intermediary participants of vegetable supply chain.

Introduction

The period of 11th five Years Plan (2007-2012) provided the support to agricultural sector and infrastructural facilities are in the process of expansion and expecting some positive support to work on the road map of the agricultural growth (Alam and Verma, 2007). Agriculture is the dominant sector of Indian economy and contributes to the sustainable growth. During the 11th Five Year Plan (2007-12) has done comparatively well in terms of output growth and achieved growth of 3.6 per cent in the gross domestic product (GDP). The 12th Five Year Plan has estimated the growth target to be 4 per cent for agriculture. Indian agriculture is getting positive support from rising external demand and the participation in the liberalized, privatized and globalised (LPG) economy. Government of India has allowed 100 per cent foreign direct investment (FDI) under automatic route in storage and warehousing including cold storages to boost investments for agriculture.

The responsibility for agricultural development is with the Ministry of Agriculture as the nodal agency and the Department of Agriculture and Cooperation organization is responsible for execution of all the development activity of the agriculture sector in India. The organization is responsible for formulation and implementation of national policies and programmes. Now horticulture has proved its position as one of the potential agricultural enterprise in accelerating the growth of economy. It is playing very important role in the securing nutritional needs, reducing poverty and employment generation programmes for the country (Chadha and Choudhary, 2007). It is offering a wide range of options to the farmers for produce cultivation and providing ample scope for sustaining large number of Agro industries which generate huge employment opportunities.

To improve small producer's livelihoods linking primary producers with global and national markets through fresh food retail chains is seen as one of the emerging agricultural marketing practices in India (Singhla *et al*., 2011). The attempt in exploring the determinants of participation in agricultural risk management by individual has been represented (Cole and Kirwan, 2009); temporal and regional components (Baba *et al.*, 2010) have suggested that the coverage of technology mission should be expanded to other niche areas of vegetable cultivation. Many papers view that with the demand in local labeling programs such as the National Buy Fresh Buy local promotion appearing in increasing number of consumers and will be seeing many messages about local and fresh produced vegetables (Onken and Bernard, 2010). The study has highlighted the needed effective measures to reduce the produce losses at various stages of distribution. The demand for a well developed vertical coordinated supply chain for food industry is discussed to satisfy increasingly diverse consumer preferences with the changing landscape faced by food supply chain participants. Many important discussions are on the economics of geographical indications is assessed within a vertical product differentiation framework that is consistent with the competitive structure of agriculture

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(Moschini *et al*., 2008). It is significance to revisit the definition of vertical coordination provided (Mighell and Jones, 1963) explaining that the term includes all the ways of harmonizing the vertical stages of production and marketing. The market-price system, contracting, cooperation and vertical coordination are some of the alternative means of coordination. Within this concise definition is the notion that vertical coordination encompasses a continuum of possibilities from open market to spot transactions at the one end through the full vertical coordination and at the other and including strategic alliances, joint ventures and contracting etc. This move is a private sector adaptation to a market environment that has changed due to a host of technological, regulatory and financial developments and in addition to changes in consumer preferences like quality, food safety etc. The idea generated for contracting and other forms of vertical coordination is important parts of the supply chains for many agricultural produces (Goodhue *et al*., 2010).

Research problem

The inefficiency of supply chain is attacking two ways on vegetable pricing, one is the wastage due to poor storage and another is demand supply gap due to improper flow of information.

Research questions

The research problem observed can get solved with solving the following research questions. Can vertical coordination in supply chain reduce the wastage due to perishibility of vegetables? Can vertical coordination in supply chain assure the non seasonal availability of vegetables? Can vertical coordination in supply chain reduce the transaction cost that will reduce the market price of vegetables for end consumer? Can vertical coordination in supply chain support the price benefit for vegetables and vegetable growers? Can vertical coordination in supply chain attract entrepreneurs to venture in vegetable production?

Objectives

The study has the two specific objectives to achieve. The first objective is to know the effect of vertical coordinated supply chain on demand-supply gap and price gap for vegetables by experts. The second objective is to measure the impact of vertical coordinated supply chain on vegetable industry.

Literature review

Agriculture was always an entrepreneurial activity and findings of the research by (Vesala *et al.*, 2007) talks about the farmer's entrepreneurial identity with many characteristics like growth-oriented, optimistic and having more personal control of their business activities. The transition has taken it from entrepreneurial activity to intrapreneurial activity (Karimi *et al*., 2011). 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 (Karimi *et al*., 2011) shows that it must expand to further steps of industrialization to support the human resource development activities for agricultural marketing. The research of (McElwee *et al*., 2006) 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 (McElwee *et al*., 2006). 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 (Sparling and Duren, 1998) through lower transaction costs and increased margins (Roekel *et al*., 2002) and improving performance in one or more quality dimensions such as quality, time, cost, flexibility and environment (Trienekens, 1999) all for consumer satisfaction.

The nature of product and demand characteristics influence the form the supply chain takes added (Sparling and Duren, 1998) such that if customers want products at the lowest possible costs, the chain will focus on producing high volume standardized products, minimizing production and distribution costs while if demand is for innovation or customized products, the chain will be built to facilitate maximum flexibility and adaptability. A parallel view expressed (Boselie, 2002) and further referred to the low cost

strategy as chain optimization while the innovation and optimization which are ways of satisfying and segmenting the market were referred to as integral chain care and chain differentiation. Information is one of the most important aspects for the growth of agricultural sector and very essential to develop an appropriate agricultural information system that can support both the agricultural information and the development and training of agricultural information specialists. Discussion of the paper (Thapisa, 1997) gives an insight of the need of programme that can provide the necessary professional training. The stability in agricultural development can get done systematically only on stressing the development of existing agricultural libraries and it is needed to be empowered. The importance and need of a regional network also cannot get ignored for the speedy delivery of information to all the needy users. The method of communication of agricultural information (Oduwole and Okorie, 2010) is also expected to go through the research and is crucial to enabling farmers make informed and decisive decision. In order to make agricultural extension much more effective the information providers such as librarians, agricultural extension workers and village heads/chiefs and the Commission should also emphasize the importance of functional agricultural extension services covering in-service training, continuing education, on-farm adaptive research, evaluation and monitoring of extension services and the establishment of media resource and communication centers (Oduwole and Okorie, 2010). The ability of the nation to get the higher yield of produce completely depends on the ability of the country to explore and sharing of the updated information with the community. Research (Kiplangat, 1999) says that the rural populations of developing economies suffer from poverty and the agricultural advancement can help them to eradicate poverty. At the same time information distribution system must work very aptly. By 2020 Kenya is being a highly industrialized country and this can get achieved only by the development of agriculture and rural sector. There is strong need to explore the different ways of communication development to support agriculture (Kiplangat, 1999).

The findings of the study (Lwoga *et al*., 2011) demonstrate the importance and degree of need for knowledge and information moreover reveals the farmer's tendency for the information seeking patterns though much of research done and paper published and availed as print materials has very negligible use due to their unavailability and illiteracy. As per the research study (Lwoga *et al.*, 2011) Radio and cell phones have been a good source of information sharing compared to advanced technologies (i.e. internet and e-mail) having less importance for farmers. Farmers also believe that they should come forward to access agricultural information and knowledge available at different sources. The paper (Ocran and Biekpe, 2008) has tackled the problem of developing an effective market information system. Policy makers should consider the provision of agricultural extension services. The susceptibility of food output to rainfall should get addressed by both government and producers. Research (Kalusopa, 2005) says that utilization of information is necessary for agricultural development activities. But effective information has to be systematically collected, organized and repackaged and must be available in easily accessible source as and when needed (Kalusopa, 2005). As the study shows that the information in the agricultural sector is scattered, poorly developed and unfocused. In order to improved agriculture, it is needed to have a well organized and functional integrated information delivery system to provide information that must be timely available with relevancy, accuracy, and reliability and in desired usable forms (Kalusopa, 2005). There is a need to redesign the information support system for agricultural development. There can be much of possibility for creating small-scale irrigation systems and development in losses due to heavy rainfall with support of government can get explored. Authors (Ocran and Biekpe, 2008) suggests tackling all the problems together will help in reducing the transaction cost of producers and can make the produce cheaper for the end market and consumers.

The research carried (Zhang and Lane, 2001) has given a huge source for the agricultural research to get the secondary data available globally for a wider and deeper understanding of the subject. The websites are with the information of past and current scenario of horticulture, farming, agronomy, agricultural production, agricultural development, agricultural policy and sustainable agriculture. The very informative websites are available with full of information (Zhang and Lane, 2001) and the information is in English and really it is of high importance. In agriculture, it is very difficult to say (Laoubi and Yamao, 2009) a single correct answer for any of the problem, the reason is, it depends on many variables and most of them are uncontrollable. Agricultural produce supply chain facing many of the challenges in Sub-Saharan Africa and Ghana but the research of (Ocran and Biekpe, 2008) exclusively talks about the need of the improvement in the reduction of transportation cost and can get done by improving the quality of roads reaching to farms

and agricultural producing areas. The observation concludes that since agriculture is the science of locality so approach should be very justified. Long term strategies are needed to account the heterogeneity of agriculture.

Theoretical framework

Given the complex environment faced by small farmers in developing countries in the context of current changes in vegetable supply chain systems (VSCS). It is necessary to look for an analytical framework that helps us to understand these changes and search for mechanisms that allow small farmers to tackle challenges and take advantage of potential opportunities offered by VSCS. New Institutional Economics (NIE) is proposed here as a suitable approach. NIE is focused on analyzing market imperfections e.g. limitations of small farmers to participate in vertically-coordinated markets (Harris *et al.*, 1995). NIE has its origin in the works and focuses on the role of institutions in economic transactions (Menard, 2000). According to mainstream economic theory economic agents (farmers in this case) will coordinate their actions if the benefits of doing so outweigh the costs. However in the real world this does not always happen regardless of the potential gains (Harris *et al*., 1998). One reason for such behavior is that while economic agents are inherently rational limitations in information and frictions in trade hamper them in this pursuit such that they are rationally bounded (Harris *et al.*, 1998; Williamson, 2000). Highlights of the study (Reardon and Berdegue, 2002) shows, the importance of the growth of supermarkets in developing countries considering it as a huge market opportunity that can be used as an engine for poverty alleviation and development. The question that arises is what are the factors that hamper small farmers to participate in supermarket supply chains and take advantage of these potential opportunities? The traditional spot market is considered to be inefficient under the new VSCS thus supermarket chains look for coordinated relationships with their suppliers. Nevertheless small farmers continue using the traditional market because it is where they are used to selling their products and therefore cannot switch to new marketing systems immediately just because of potential gains. A reasonable hypothesis is that farmers face positive transaction costs that limit their participation in coordinated markets such as the supermarket supply chains.

The concept value-added activity originates (Porter, 1985) value chain framework and introduced

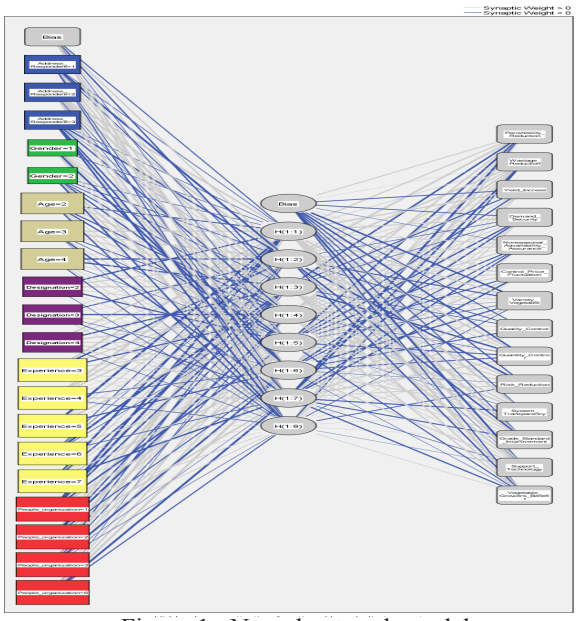

Figure 1. Neural network model

the value chain framework to describe the activities of an individual organization. The value created by these activities minus the costs of executing them represents the margin the organization makes. Value is the amount buyers are willing to pay for what a company provides and it is measured by total revenue. The total set of value-adding activities is divided into primary and support activities. Porter defines primary activities as the activities involved in the physical creation of the product and its sales and transfer to the buyer as well as after-sale assistance. Support activities are defined as those that support the primary activities and each other by providing purchased inputs, technology, human resources, and various firm-wide functions (Porter, 1985). The value chain of an organization is the system of dependent activities the execution of an activity impacts the costs or effectiveness of other activities. Porter's argument is that the value chain may be used to identify and understand the specific sources of competitive advantage and how they relate to creating added value for customers.

Vertical coordination can be viewed as an alternative to SCM in that it attempts to manage and control channel efficiency through ownership. Research (Ellram, 1991) groups the advantages and respectively the disadvantages of vertical coordination into three broad categories. According to Ellram (1991) the literature does not agree on when vertical coordination will occur. A developed (Williamson, 1985) framework of three critical dimensions; these dimensions determine the way an organization should be structured in order to be most effective in bringing the firm's products to market. These are (1) the uncertainty associated with the transaction (cost,

Table 1. Reliability analysis (Cronbach's (α) alpha)

Pseudo R-Square	
Cox and Snell	.805
Nagelkerke	.939
McFadden	.840

Table 2. Parameter estimates

Predictor		Predicted: Hidden Layer1							
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	H(1:8)
Input Layer	(Bias)	-.270	.432	-.397	.167	-.068	.323	.549	.275
	[Address_Respondent=1]	-.140	-.933	-.206	.156	.419	.183	-.147	-.206
	[Address_Respondent=2]	.781	.942	.887	.735	-.077	-.063	.552	.364
	[Address_Respondent=3]	-.136	-.716	.000	-.429	.060	-.421	-.512	-.500
	[Gender=1]	-.165	.134	.246	.668	.455	-.777	.075	.351
	[Gender=2]	-.198	-.353	-.288	-.356	-.472	1.023	.495	-.449
	[Age=2]	-.673	.259	.444	-.498	-.492	.171	.166	-.417
	[Age=3]	1.337	1.012	.388	-.360	-.176	.180	-.567	-.022
	[Age=4]	.164	-1.502	-1.318	.262	-.121	.190	.201	-.301
	[Designation=2]	-1.049	.744	1.049	.329	-.770	.081	.007	-.115
	[Designation=3]	.123	-.489	.005	-1.319	.166	-.124	-.359	.153
	[Designation=4]	1.010	.347	-.975	1.168	.413	.844	.487	-.160
	[Experience=3]	2.087	-.990	.658	-.786	.493	.248	.263	.106
	[Experience=4]	2.027	1.138	.915	.022	.090	-.372	1.295	-.312
	[Experience=5]	-2.819	.349	.135	1.120	.006	-.753	.020	.068
	[Experience=6]	-.204	-.094	-1.241	-.135	.093	.408	-.321	.124
	[Experience=7]	-.918	.325	-.434	.218	.053	.540	-.902	.101
	[People_organization=1]	-2.011	-2.281	-.518	.030	-.659	.734	.050	.272
	[People_organization=2]	.139	1.489	-.397	-.769	.329	-.329	.968	.231
	[People_organization=3]	2.669	-.313	1.079	-.226	.379	-.783	-.031	-.070
	[People_organization=6]	.067	.095	-.029	.385	.436	1.095	-.946	-.354

timing and so on) (2) the degree to which specialized assets or investments is involved in the transaction, and (3) the frequency of the transactions. Arguments (Williamson, 2000) shows that assets become more specific to a single user, there is no advantage to purchasing outside. Vertical coordination is most likely for recurrent transactions, which require very specialized assets.

Data analysis and interpretation

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 80 respondents. The reliability (α) of the questionnaire is .765, 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. This has been done on the basis of the

Table 3. Parameter estimates

Predictor			Hidden Layer 1: (Bias)	H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	H(1:8)
Predicted	Output Layer	Perishibility_ Reduction	.458	.628	1.400	-.709	.605	-.717	.273	-1.020	.391
		Wastage_ Reduction	.032	.196	1.183	.483	.899	.365	.737	-.734	-.387
		Yield_ Increse	-.452	1.296	.186	-.488	.260	-.477	.118	.233	.122
		Demand_ Security	-.418	1.010	-.237	-.257	.416	-.640	-.603	.182	.325
		Nonseasonal_ Aavailability_ Assurance	-.082	.452	.624	.154	.640	-.522	-.410	-.492	.017
		Control_Price_ Fluctuation	.042	.742	.767	.511	.477	-.485	.960	-.687	.058
		Variety_ Vegetable	-.983	.905	-.654	.442	-.039	-.233	-.874	.637	-.196
		Quality_ Control	-.328	.068	-.386	-.289	.164	.082	-.538	.688	.113
		Quantity_ Control	-.694	.946	.349	-1.191	-.161	-.641	-.581	1.052	.130
		Risk_ Reduction	-.394	.016	-.958	.634	.520	.673	-.122	.521	-.441
		System_ Transparency	-.281	1.298	.027	.825	.839	-.085	.646	-.756	.118
		Grade _Standard _Improvement	-.265	.876	-.604	.890	.384	.244	.320	-.569	.029
		Support_ Technology	-.737	1.244	-.019	.943	.396	.141	.505	-.169	-.023
		Vegetable_ Growers_ Benefit	-.339	1.377	-.413	.465	.477	-.374	-.068	-.539	.197

Table 4. Parameter estimates (After removing the synaptic weight < .5)

Predictor			Hidden Layer 1: (Bias)	H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	H(1:8)
Predicted	Output Layer	Perishibility_ Reduction		.628	1.400		.605				
		Wastage_ Reduction			1.183		.899		.737		
		Yield_ Increse		1.296							
		Demand_ Security		1.010							
		Nonseasonal_ Aavailability_ Assurance			.624		.640				
		Control_Price_ Fluctuation		.742	.767	.511			.960		
		Variety_ Vegetable		.905						.637	
		Quality_ Control								.688	
		Quantity_ Control		.946						1.052	
		Risk_ Reduction				.634	.520	.673		.521	
		System_ Transparency		1.298		.825	.839		.646		
		Grade _Standard _Improvement		.876		.890					
		Support_ Technology		1.244		.943			.505		
		Vegetable_ Growers_ Benefit		1.377							

level of strength of effect of different independent variables on dependent variables including a hidden process of dimension reduction. Neural Network concept is the part of regression analysis, so it is mandatory to check the data set for fitness by finding the R- Square value. The value of R-Square and the different strengths are .805, .939, .840 (Table 1) the output of SPSS 20 shows that data set is fit for Neural Network analysis.

The Neural Network analysis works with factor analysis, a tool is provided for assessing the influence of a variable on a factor and therefore on the final predicted value. The tool takes the factor loadings which show the strength of the relationship between the observed variable and the underlying factor. The loadings have been used to rank each variable's importance, for this the synaptic weights (factor loading) more than .5 has been taken in consideration. The weights used to construct the Table-4 & Table-5

Table 5. Parameter estimates (After removing the synaptic weight < .5)

Predictor		Predicted							
		Hidden Layer 1							
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	H(1:8)
Input Layer	(Bias)							.549	
	[Address_Respondent=1]								
	[Address_Respondent=2]	.781	.942	.887	.735			.552	
	[Address_Respondent=3]								
	[Gender=1]				.668				
	[Gender=2]						1.023		
	[Age=2]								
	[Age=3]	1.337	1.012						
	[Age=4]								
	[Designation=2]		.744	1.049					
	[Designation=3]								
	[Designation=4]	1.010			1.168		.844		
	[Experience=3]	2.087		.658					
	[Experience=4]	2.027	1.138	.915				1.295	
	[Experience=5]				1.120				
	[Experience=6]								
	[Experience=7]						.540		
	[People_organization=1]						.734		
	[People_organization=2]		1.489					.968	
	[People_organization=3]	2.669		1.079					
	[People_organization=6]						1.095		

revealing the relationship between the independent variables and the dependent variable with predicted value. One approach (Potts, 2000) is to examine the weight connecting the input variables to the hidden layer as loadings closest to zero are least important. A variable is deemed unimportant only if all of these connections are near zero. Values (Table 2) display the weights connecting the input layer to the hidden layer. On the basis of this table it is observed that the two hidden factors of process H(1:5) and H(1:8) is getting discarded due to all the synaptic weight < than .5 (assumption taken for study). Bias value does not have much impact and showing only the relation in both the case of H(1:5) and H(1:8) has been kept out of the interpretation of the outcome. Among twenty independent variables of demography six has been discarded from the model. So the conclusion is based on the 16-6-14 structure study on independent variables-hidden factor of process-dependent variables or the predictors respectively. All the research questions have been in consideration to get the solution and the discussion below reaches both the objectives.

H(1:1) factor is formed using the six independent variables ([Address_Respondent=2], [Age=3], [Designation=4], [Experience=3], [Experience=4], [People_organization=3]) with a very high synaptic weight and having effect on ten dependent variables (Perishibility_Reduction, Yield_Increse, Demand_ Security Control_Price_Fluctuation, Variety_ Vegetable,Quantity_Control, System_Transparency, Grade_Standard_Improvement, Support_ Technology, Vegetable_Growers_Benefit).

H(1:2) factor is formed using the five independent variables ([Address_Respondent=2], [Age=3], [Designation=2], [Experience=4], [People_ organization=2]) with a very high synaptic weight and having effect on four dependent variables (Perishibility_Reduction, Wastage_Reduction, Nonseasonal_Aavailability_Assurance, Control_ Price_Fluctuation,).

H(1:3) factor is formed using the five independent variables ([Address_Respondent=2], [Designation=2], [Experience=3], [Experience=4], [People_organization=3]) with a very high synaptic weight and having effect on five dependent variables (Control_Price_Fluctuation,Risk_ Reduction,System_Transparency,Grade_Standard_ Improvement, Support_Technology).

H(1:4) factor is formed using the four independent variables ([Address_Respondent=2], [Gender=1], [Designation=4], [Experience=5]) with a very high synaptic weight and having effect on five dependent variables (Perishibility_Reduction, Wastage_ Reduction, Nonseasonal_Aavailability_Assurance, Risk_Reduction, System_Transparency).

H(1:6) factor is formed using the four independent variables ([Gender=2], [Designation=4], [Experience=7], [People_organization=1], [People_ organization=6]) witha very high synaptic weight and having effect on four dependent variables (Wastage_Reduction, Control_Price_Fluctuation, System_Transparency, support_Technology).

H(1:7) factor is formed using the three independent variables ([Address_Respondent=2], [Experience=4], [People_organization=2]) with a very high synaptic weight and having effect on four dependent variables (Variety_Vegetable, Quality_ Control, Quantity_Control, Risk_Reduction).

Findings and Cconclusion

During the analysis of data using the Neural Network Model for the prediction of the importance of different variables observed from the literature study based on the inputs of respondents (Expert Opinion) to know the effect of vertical coordinated supply chain on demand-supply gap and price gap for vegetables by experts as the first and the most important objective could get reached. The explanation of findings for first objective is discussed. Variables are arranged in the decreasing order of importance based on the total synaptic weight strength affected by all the factors of process. "System_ Transparency (3.608)>Control_Price_Fluctuation(2.98)>Wastage_ Reduction(2.819)>Support_ Technology(2.692)>Perishibility_ Reduction(2.633)>Risk_ Reduction(2.348)>Quantity_Control(1.998)>Grade_ Standard_Improvement(1.766)>Variety_ Vegetable(1.542)>Vegetable_Growers_ Benefit(1.377)>Yield_Increse(1.296)>Nonseasonal_ Aavailability_Assurance(1.264)>Demand_

Security(1.01)>Quality_Control(0.688)".

Here it is very clear that in experts opinion system transparency, price fluctuation control, wastage reduction, support to technology, perishibility reduction and risk reduction are the six variables having very high synaptic weight strength concludes that the vertical coordination in supply chain of vegetable industry is strongly needed and will have a high impact on these variables to optimize the vegetable supply chain for the development of vegetable sector. Other seven variables quantity control grade standard improvement, variety vegetable, vegetable growers benefit, yield increase, non seasonal availability assurance, demand security are also having much higher values but compared to earlier set is not so important but need to cared. The only variable quality control is having very less value showing will not having much impact on vegetable supply chain. This has justified the second objective very efficiently that to measure the impact of vertical coordinated supply chain on vegetable industry.

The most important outcome of this research is for the consumer in the sense of price, and beneficial for the farmers engaged in vegetable cultivation. Largely it can support all the intermediary participants of vegetable supply chain. This study can be a guiding map for the researchers working in the area of supply chain for agricultural produces and can get used as the valid source for assumption. Moreover the regulatory authorities of agricultural produce marketing can have the usage for decision making and optimize the vegetable supply chain.

Future research

The study is a part of doctoral research and another working papers also going on with strengthen the efficiency of vegetable supply chain with the approach of vertical coordination. The research carried here in the geographic setup of Odisha state of India and needed to get evaluated for the conceptual viability all around the globe. The study is based on the opinion of experts of the area but the acceptance of the concept for implementation, the view of all the stakeholders of the supply chain is too important. Further research must get carried with the vegetable producers and intermediaries of the vegetable supply chain.

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