# Agricultural Supply Chain Efficiency Measurement using Optimization Equation

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***Abstract-*** **The study is descriptive but quantitative data collected through the administered structured questionnaire interpreted and presented exploratory with explanations for the primary understanding. The need for finding the relationship and to get the understanding of effect of producer's variable with vertically coordinated agricultural supply chain variables that can measure the efficiency of agricultural supply chain and can develop the optimized equation is the main idea behind the study. Objectives formulated as to find the relationship of Producer's variables with agricultural supply chain variables, to understand the effect of Producer's variables with agricultural supply chain variables and to get the econometric model as the solution for the proposed conceptual model. Cluster sampling method of probability sampling was used to select the respondent from a cluster of green agricultural growers. The sample size for the farmer was 757. Study concludes that, Market and selling, Credit and stock strategy, and prices and transaction cost are having strong relationship and impact on vertically coordinated agricultural supply chain. Constraints in the specific case of producers is conceptually not accepted based on the responses of farmers. The current research has the novelty of applying econometric assessment model for the agricultural supply chain which can be a common technique for the applicability in agribusiness. Although many research have suggested conceptually uses of econometric model but variables and dimensions considered here are innovative at its level. Especially in this research the dimensions considered are Market & Selling, Constraints, Credit & Stock, and Prices & Transaction are not common in earlier studies but here the main concern is to assess these dimensions with the application of econometric model.**

***Keywords-*** Agriculture, supply chain, produce, vertical coordination, optimization

## 1. Introduction

The commercial functions involving in transferring agricultural produce of farm and horticultural from producer to consumer is the agricultural marketing. Another dimension of agricultural marketing reflects the supply of produce from rural to rural and rural to urban and from rural to industrial consumers. The more number of intermediaries incur more costs and each transaction leads to high expenses and invites cost. Ultimately at the time it reaches to the producer the high cost of the produce and low price gives a negative gap to the farmer. In the entire process of marketing the producer gets the lowest price though the ultimate consumer pays the highest price as the involvement of more middlemen in the entire distribution process. There are numerous complexities involved in agricultural marketing as agricultural produce involves element of risk due to perishibility, seasonality and the type of produce, pricing of the produce but more than this the demand and supply mismatch. The interwoven mesh ultimately makes a deep impact on agricultural marketing [1]. The major structural changes in the world are taking place due to the efforts of agricultural industry to develop the agricultural sector in developing countries. The concept of agricultural production is changing from an industry controlled by family-based firms to organized and structured larger firms that are more accurately considering across all the dimensions of production to distribution of value chain in many developed countries [2]. The trend of market-orientated reforms and multilateral trade liberalization with structural adjustment programs in developing countries has contributed for the increased integration of world market [3]. The observation of the research conducted as ref. [4] for agricultural development government rarely collaborates with its associative partners though the collaborations among companies are very common in the business world.

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 [9]. 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 [6]. 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 ref. [7] 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

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first recognized by ref. [12] 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. Agricultural SCs comprise organizations that are responsible for the production and distribution of agricultural produces [8]. In general SCs for fresh agricultural products (such as fresh agricultural, 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.

The different views are all represented in literature. Whereas some authors refer to SCM in the context of an individual organization or dyad others refer to the SC level or the network level of analysis. In this thesis the SC level of analysis is chosen taking account of the other participants in the SC network too. The aim of the supply chain is to produce value for the ultimate consumer whilst satisfying other stakeholders in the SC. A supply chain is a network of (physical and decision making) activities connected by material and information flows that cross organizational boundaries. 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 [10]. 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 [11]. Ref. [14] highlight 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 [21].

## 2. Literature Review

Ref. [18] emphasizes the importance of institutions to facilitate coordination and lower the costs of economic transactions. For this reason NIE attempts to incorporate the role of institutions and institutional arrangements in the coordination of the activities of economic players [9]. NIE builds on neoclassical economics keeping underlying assumptions such as scarcity and competition but relaxing the assumptions of inherent rationality and perfect information. Additionally NIE incorporates institutions into the economic analysis which are not explicitly included by neoclassical economics [11]. Furthermore given the origins and scope of NIE it represents the culminating intersection of a number of different lines of investigation crossing discipline boundaries and engendering interdisciplinary studies allowing the cross-fertilization and mutual stimulation among historians, sociologist, political scientists, psychologists, lawyers, and of course, economists [10]. Many authors have used the NIE approach to analyze the economic rationale of farmer's decisions and the implications in their participation in farmer organizations and/or contractual relationships in the supply chain of contemporary agricultural supply chain systems [13]. Even though there is no consensus about what should be included under the umbrella of NIE, [8]consider that contractual uncertainty (transaction and information costs) and collective action are the salient points. Ref. [12] associate contractual uncertainty with information costs and asymmetry, transaction costs, and hold-up problems; and collective action with collective goods, common pool resources and free-ride problems. Many publications consider that the main areas of NIE cover transaction cost economics, contractual relations, and property rights [18].

However all these areas are inter-related? Transaction costs are associated with the process of exchange and their extent determines the organizational forms of economics activities [2]. Thus through the analysis of transaction costs the characteristics of different forms of organizational arrangements can be understood [8] argues that under the presence of positive transaction costs the governance structure of the firm should be analyzed with contract lens rather than with choice lens. Economic transactions usually face problems of asymmetric information, which may lead to bounded rationality and/or opportunism by one of the parties. Contractual relations can provide guidelines for relaxing these problems [12], however it is practically impossible to be able to write complete contracts [11]. The common principal-agent problem which may result in moral hazard and adverse selection is a typical problem caused by asymmetric information. Finally the presence of well-defined property rights in economic transactions and appropriate enforcing institutions is important for NIE since it can help to reduce conflicts, facilitate cooperation

and hence reduce transaction costs [15]. For the purpose of this research the ideas about the main areas of NIE are encompassed in the analysis of the role of transaction costs and collective action in small farmer's participation in new agricultural supply chain systems specifically the VCVSC. Uncertainty is usually derived by the incompleteness of contracts given imperfect information which can lead to opportunism of one of the parties to an agreement. In the case of contract farming small farmers commonly do not understand the content of the contracts. This facilitates agribusiness firms to act opportunistically. However firms also face uncertainty because when farmers do not honor the contracts firms usually do not sue farmers given the legal and social costs of suing small farmers [16]. Uncertainty can also be caused by environment factors such as weather variability or pest damages. For instance in the contract farming scheme farmers face a great risk of totally losing a cash crop production which is usually related with relatively high investments. Under this situation a small farmer can be discouraged to produce a cash crop. Contracting agribusiness firms also face the risks that if farmers lose their production they will not have the needed supply for processing plants or retail businesses. Frequency with which transactions occur can also affect the way that transactions are organized and hence their associated transaction costs. New VSCS demand products with particular characteristics in a consistent and frequent way which make spot markets inappropriate for some commodities [17] due to the need of constant monitoring [18]. Therefore governance structures and trust between parties is needed to reduce transaction costs associated with frequency. Ref. [15] considers that according to the degree of asset specificity, uncertainty and frequency, the governance of transactions can be managed in markets, hybrids and hierarchies. Thus, the way that minimizes transaction costs should be used. Generally, in the presence of high asset specificity, uncertainty and frequency the use of market governance increases transaction costs, consequently the need of coordination [19]. Transaction costs approach offers appropriate insights to address the relationship between small producers of agricultural and the VCVSCS. The VSC demands specific requirements in terms of quantity, quality and frequency. Therefore small farmers are uncertain if they will be able to supply the quantity and quality demanded. Information about grading and terms of contract also pose uncertainty on farmers. In the same way in order to participate in the VCVSC small farmers need specific investments that allow them to continuously produce and meet the frequency required by the market. Facing high transaction costs to enter the vertically coordinated agricultural supply chain (VCVSC) farmers may prefer to sell in the traditional market (TM) because it has lower requirements and furthermore they are better known by farmers. Nevertheless acting in these way farmers would forego the potential benefits of selling in the VCVSC.

A neoclassical contract where price and safeguards play equally important roles is best suited for wholesaler-based governance structures. In neoclassical contracts, identities of transacting parties begin to matter. Based on transaction costs alone, the wholesaler governance structure is the one that minimizes transaction costs most, relative to the other two arrangements. However, a trade-off exists within this organizational mode: that of minimized transaction costs and the locked-in effect [20]. The framework shows that given the institutional environment, wholesaler governance is functioning optimally when using neoclassical contracts in a hybrid mechanism. It incurred the least total transaction costs among governance alternatives, due to the low negotiation and low monitoring costs. However, negotiation and monitoring costs could be low because of the locked-in effect: farmers have no alternative but to sell harvests to wholesalers in order to pay off their debts. The framework shows that a long-term contract where identities of transacting parties and safeguards matter is optimal for contractor-based governance structures. Using relation-based contracts in order to create binding trading relations works best for this governance structure. It incurred high negotiation costs because the farmers' whole harvest is at stake. Moreover, negotiation within a relational contract involves communication and adjustment to each other's personal and business interests. Note that the search process for trustworthy contractors increases relative search/information costs but reduces relative monitoring costs later on.

## 3. Research Problem

Organizations are in continuous interaction with institutions. In the case of competition or unfavorable environments, organizations look for skills and knowledge that allow them to survive as well as to shape institutional changes that favor them [5] .This reflects the concern of many authors [1] regarding the need for innovation in order to guarantee a 'fair game' that allows small farmers to compete in new agri food systems. The key role of organizations is that they could make numbers count as they could not when un-aggregated, that is, unorganized [17]. Many research discuss the cooperative movements launched in the nineteenth century in England and Germany (and later in Scandinavia) which allowed their members not only to exert economic and political pressure but also to achieve substantial self-help gains. A study considers that one of the best alternatives for farmers to deal with contemporary problems. It is collective bargaining as a way of achieving market power to negotiate with buyers of farm products, input and machinery suppliers and even with government. However he also warns that choosing

collective action will require a new way of thinking a great deal of organizational effort to gain economic power, and economic analysis to learn how to use that power effectively. Farmers can participate in different forms of collective action depending on their own situation and needs. The most common forms of collective action that farmers can participate in are networks, cooperatives and strategic alliances. Thus the general hypothesis in this research is that collective action can help farmers to reduce transaction costs associated with their participation in contemporary supply chains. Based on the broad literature review and observation practically the research problem observed as there is essentially a need for finding the relationship and to get the understanding of effect of producer's variable with vertically coordinated agricultural supply chain variables that can measure the efficiency of agricultural supply chain.

## 4. Research Objectives

For the reach of the solution to the problem following objectives formulated and planned accordingly for the data analysis to get findings and conclusion of research are:

- To find the relationship of Producer's variables with agricultural supply chain variables.
- To understand the effect of Producer's variables with agricultural supply chain variables.
- To get the econometric model as the solution for the proposed conceptual model.

## 5. Research Methodology

For this study quantitative research technique has been used and exploratory research design has been executed. Descriptive research involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data collection [12]. It often uses visual aids such as graphs and charts to aid the reader in understanding the data distribution. Cluster sampling method of probability sampling was used to select the respondent from the whole population, a cluster of green agricultural growers, out of which respondents were selected randomly. The process was done for the three districts leading in agricultural cultivation. The sample size for the farmer was 757. The sample size was neither based on the total population nor selected randomly, since there was not available a census about the number of farmers participating in agricultural supply chain. It was considered that the sample had been highly representative, according to the number of households producing or involved in the supply chain of vegetables in the three districts. The usage of power analysis was accepted in behavioral sciences for effective sample size selection for multiple regression analysis. Survey conducted for vegetable producers was based on cluster sampling taken in consideration the three districts of Odisha namely Khorda, Puri and Balasore. The producers study conducted on their farms mostly.

Quantitative data collected through the administered structured questionnaire interpreted and presented exploratory with explanations of happenings for the primary understanding. The major part of the analysis of data was done with SPSS using different quantitative techniques suitable for the study. The mostly used techniques are multivariate data analysis techniques correlation and regression.

## 6. Research Hypothesis

Hypothesis 1: Market and selling has a positive impact on vertically coordinated agricultural supply chain.
Hypothesis 2: Vertically coordinated agricultural supply chain is strongly associated and affected by constraints in the specific case of producers.
Hypothesis 3: Credit and stock strategy is an important and most considerable criteria that affects vertically coordinated agricultural supply chain.
Hypothesis 4: Farmers are strongly considering the prices and transaction cost as the criteria that effects vertically coordinated agricultural supply chain for the successful implementation.

## 7. Proposed Conceptual Model

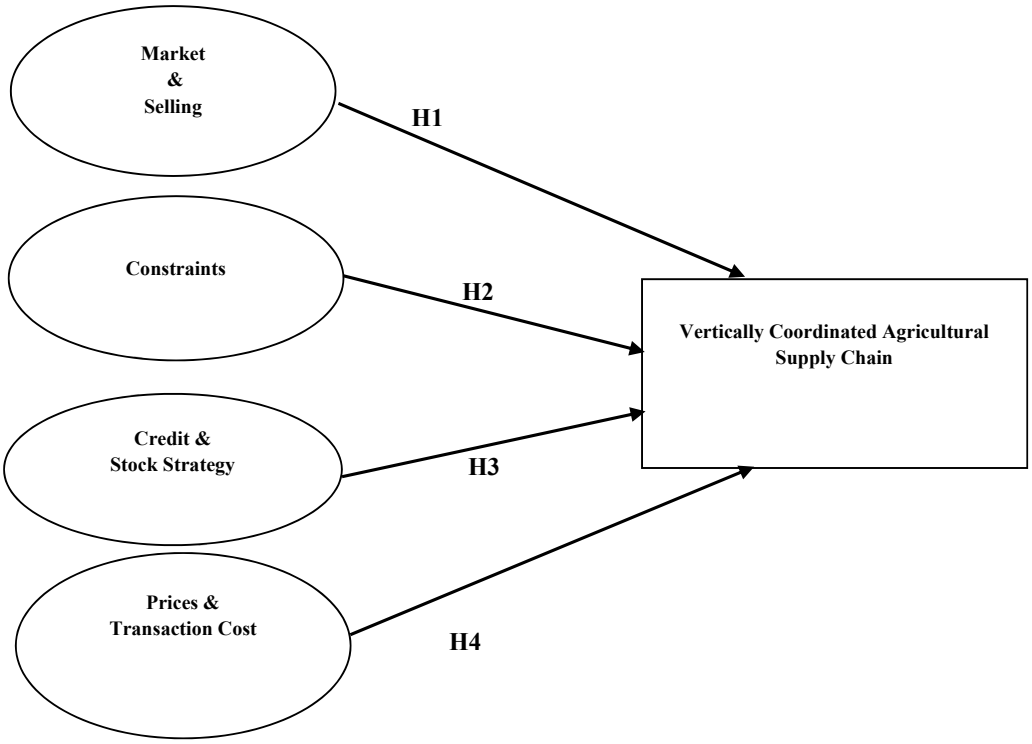


**Figure 1.** Proposed conceptual model

## 8. Data Analysis

**Table 1: Reliability Analysis of Producer's Questionnaire**

| Variable | Factor | Reliability (Cronbach's Alpha) |
|---|---|---|
| Variable 1 | Market and Selling | .890 |
| Variable 2 | Constraints | .914 |
| Variable 3 | Credit and stocks strategy | .749 |
| Variable 4 | Prices and transaction cost | .878 |
| Variable 5 | Importance of vertical coordination | .968 |
| **Overall** | | **.922** |

As shown above Table1, It is explaining the reliability which is high for each individual variable as well altogether with variables as overall is 0.922 [17].

**Table 2: Respondent's Profile**

| Parameters | | Frequency | Percentage |
|---|---|---|---|
| Respondent Address | Bhubaneswar/ Khorda | 250 | 33.0 |
| | Puri | 279 | 36.9 |
| | Balasore | 228 | 30.1 |
| Gender | Male | 605 | 79.9 |
| | Female | 152 | 20.1 |
| People Engaged Full Time in Vegetable Farming | 1-3 | 474 | 62.6 |
| | 4-6 | 283 | 37.4 |
| People Engaged Part Time Vegetable Farming | 1-3 | 384 | 50.7 |
| | 4-6 | 62 | 8.2 |
| | 7-9 | 311 | 41.1 |
| Hired Non Family Labour | 1-5 | 451 | 59.6 |

| | | | |
|---|---|---|---|
| | 6-10 | 306 | 40.4 |
| Monthly Earning of the Family | Rs.1 - Rs.20 Thousands | 747 | 98.7 |
| | Rs.21 Thousands - Rs.40 Thousands | 10 | 1.3 |
| **Total** | | **757** | **100** |

As presented in the Table 2 above, For the purpose of study 757 respondents taken from 3 different districts of Odisha all the three districts are having almost same frequency very closer to each other namely Bhubaneswar/ Khorda with 250 and 33%, Puri with 279 and 36.9% and Balasore with 228 and 30.1% of frequency and percentage respectively. Gender gap is high among the respondents male and female respondents are 605 and 152 in frequency whereas 79.9 and 20.1 in percentage, due to females less participation in work directly rather in household care and males are responsible for all the earning activity. The people engaged full time in vegetable farming of the respondents are categorized in 2 categories where 1 to 3 number of people group respondents are 474 equivalent to 62.6% in the study and the comparative lesser number of respondents from the other group of number 4 to 6 constituting 283 equivalent to 37.4%. The people engaged part time in vegetable farming of the respondents are categorized in 3 categories where the 1st and 3rd category showing the similarity as frequency of 384 and 311 with 50.7% and 41.1% respectively whereas the 2nd category is having much lesser number of respondents 62 as 8.2%. The people hired non family labour of the respondents are categorized in 2 categories where 1 to 5 number of people group respondents are 451 equivalent to 59.6% in the study and the comparative lesser number of respondents from the other group of number 6 to 10 constituting 306 equivalent to 40.4%. The people monthly earning of the family of the respondents are also categorized in 2 categories where Rs.1 - Rs.20 thousands number of people group respondents are 747 equivalent to 98.7% in the study and the comparative much lesser number of respondents from the other group of number Rs.21 thousands - Rs.40 thousands constituting 10 equivalent to 1.3% can be the reason people engaged in farming are much poor and earning is too less due to various reasons [21].

**Table 3: Frequency and Percentage of Vegetables in Operation for Producer**

| Parameters | | Frequency | Percentage |
|---|---|---|---|
| Duration of Vegetable Business Startup | Between 3-6 years | 142 | 18.8 |
| | More than 6 Years | 615 | 81.2 |
| Role in Vegetable Supply Chain | Farmer with small land holding | 619 | 81.8 |
| | Farmer with sufficient land holding | 138 | 18.2 |
| Vegetable in Operation- Potato | Yes | 658 | 86.9 |
| | No | 99 | 13.1 |
| Vegetable in Operation- Brinjal | Yes | 665 | 87.8 |
| | No | 92 | 12.2 |
| Vegetable in Operation- Cabbage | Yes | 634 | 83.8 |
| | No | 123 | 16.2 |
| Vegetable in Operation- Cauliflower | Yes | 628 | 83.0 |
| | No | 129 | 17.0 |
| Vegetable in Operation- Okra | Yes | 677 | 89.4 |
| | No | 80 | 10.6 |
| **Total** | | **757** | **100** |

Above Table 3, presents that for the purpose of study 757 respondents taken in the study with seven parameters where the duration of vegetable business startup of the respondents are in two categories one is between 3-6 years which is very les in number 142 as 18.8% though the other category more than 6 years is very high in number i.e. 615 as 81.2% meaning that people engaged in vegetable business are being in this for longer years. Role in vegetable supply chain parameter also has two categories farmer with small land holding as frequency of 619 as 81.8 though farmer with sufficient land holding as frequency of 138 as 8.2% shows that the farmers with small land holding are preferring to be in the vegetable cultivation compared to farmer with sufficient land holding. Next are the five parameters for the five vegetables cultivation participation with dichotomous opinion as yes or no. As the 1st is the vegetable in operation- potato has 658 respondents are in favor as 86.9% though 99 respondents are not in favor as 13.1%, the 2nd is the vegetable in operation- brinjal has 665 respondents are in favor as 87.8% though 92 respondents are not in favor as 12.2%, the 3rd is the vegetable in operation- cabbage 634 respondents are in favor as 83.8% though 123 respondents are not in favor as 16.2%, the 4th is the vegetable in operation- cauliflower has 628 respondents are in favor as 83.0% though 129 respondents are not in favor as 17.0% and the last 5th is the vegetable in operation- okra has 677 respondents are in favor as 89.4% though 80

respondents are not in favor as 10.6% shows that most of the farmers are participating in the cultivation of all the five vegetables.

**Table 4: Regression (Market & Selling to Vertical Coordination) for Producer**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .971[a] | .943 | .943 | .15884 |

a. Predictors: (Constant), Market & Selling

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 314.655 | 1 | 314.655 | 12471.642 | .000[b] |
| | Residual | 19.048 | 755 | .025 | | |
| | Total | 333.703 | 756 | | | |

a. Dependent Variable: Vertical Coordination

b. Predictors: (Constant), Market & Selling

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -.568 | .033 | | -17.422 | .000 |
| | Market & Selling | 1.043 | .009 | .971 | 111.677 | .000 |

a. Dependent Variable: Vertcal Coordination

As presented in above Table 4, The Model Summary table here providing the R (0.971) and $R^2$ (0.943) values. The R (0.971) is representing the strength of the simple correlation, which is good by [16]. The $R^2$ (0.943) and Adjusted $R^2$ (0.943) indicates that dependent variable, "Vertical Coordination ", can be explained by the

independent variable, "Market & Selling" as 94%. 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 Market & Selling contributing significantly to the model by [3].

**Table 5: Regression (Constraints to Vertical Coordination) for Producer**

**RegressionModel Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .005[a] | .000 | -.001 | .66481 |

a. Predictors: (Constant), Constraints

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .009 | 1 | .009 | .020 | .886[b] |
| | Residual | 333.694 | 755 | .442 | | |
| | Total | 333.703 | 756 | | | |

a. Dependent Variable: Vertical Coordination

b. Predictors: (Constant), Constraints

**Coefficients[a]**

| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **t** | **Sig.** |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.010 | .060 | | 49.779 | .000 |
| | Constraints | .005 | .034 | .005 | .143 | .886 |

a. Dependent Variable: Vertical Coordination

The Table 5 presented above, the Model Summary table here providing the R (0.005) and $R^2$ (0.000) values. The R (0.005) is representing the strength of the simple correlation, which is very poor by [12]. The $R^2$ (0.000) and Adjusted $R^2$ (-0.001) indicates that dependent variable, "Vertical Coordination", cannot be explained by the independent variable, "Constraints" The ANOVA table indicates that the regression model predicts the outcome variable is significantly not acceptable. Coefficients, provides us with information on predictor variable and showing that only the constant contributing significantly to the model but not the constraints by [21]

**Table 6: Regression (Credit & Stock to Vertical Coordination) for Producer**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .452[a] | .205 | .204 | .59291 |

a. Predictors: (Constant), Credit & Stock

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 68.288 | 1 | 68.288 | 194.251 | .000[b] |
| | Residual | 265.415 | 755 | .352 | | |
| | Total | 333.703 | 756 | | | |

a. Dependent Variable: Vertical Coordination

b. Predictors: (Constant), Credit & Stock

**Coefficients[a]**

| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **t** | **Sig.** |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.474 | .113 | | 13.061 | .000 |
| | Credit & Stock | 1.109 | .080 | .452 | 13.937 | .000 |

a. Dependent Variable: Vertical Coordination

The table 6 presented, The Model Summary table here providing the R (0.452) and $R^2$ (0.205) values. The R (0.452) is representing the strength of the simple correlation, which is good by Schmidt, F. L. (1971). The $R^2$ (0.205) and Adjusted $R^2$ (0.204) indicates that dependent variable, "Vertical Coordination ", can be explained by the independent variable, "Credit & Stock" as 20%. 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 Credit & Stock contributing significantly to the model by [20].

**Table 7: Regression (Prices & Transaction Cost to Vertical Coordination) for Producer**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .196[a] | .038 | .037 | .65199 |

a. Predictors: (Constant), Prices & Transaction Cost

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 12.757 | 1 | 12.757 | 30.011 | .000[b] |
| | Residual | 320.945 | 755 | .425 | | |
| | Total | 333.703 | 756 | | | |

a. Dependent Variable: Vertical Coordination

b. Predictors: (Constant), Prices & Transaction Cost

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4.968 | .357 | | 13.921 | .000 |
| | Prices & Transaction Cost | -.448 | .082 | -.196 | -5.478 | .000 |

a. Dependent Variable: Vertical Coordination

The Model Summary table here providing the R (0.196) and $R^2$ (0.038) values. The R (0.196) is representing the strength of the simple correlation, which is good by [12]. The $R^2$ (0.038) and Adjusted $R^2$ (0.037) indicates that dependent variable, "Vertical Coordination ", can be explained by the independent variable, "Prices & Transaction Cost" as 3%. 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 Prices & Transaction Cost contributing significantly to the model by [21]

## 9. Findings and Conclusion

The research problem get solved with the data analysis keeping all objectives in mind and extensively testing all hypothesis observed. In this process the efficiency of the vertically coordinated agricultural [2]supply chain assessed considering the contribution of market and selling, constraints, credit and stock strategy and transaction cost as four different variables from producer side. Research objectives formulated and reached by using regression analysis, where the first objective full filled having a strong relationship except constraints which is very weak separately each as shown in above tables presented as R. The second objective reached, where all variables have a high effect of vertical coordinated agricultural supply chain except the constraints the same way presented in tables above shown as $R^2$. The last objective is presented below as equation model considering separately showing the effect as econometric model.

*Vertical Coordination= -0.568 + 1.043 (Market & Selling) ……..Equation 1*
*Vertical Coordination= 3.010 + 0.005 (Constraints) ……..Equation 2*
*Vertical Coordination= 1.474 + 1.109 (Credit & Stock) ……..Equation 3*

*Vertical Coordination= 4.968 + (- 0.048) (Prices & Transaction ……..Equation 4*
Further all hypotheses tested and presented below with results as Table 8

**Table 8: Hypothesis test result**

| *Hypotheses* | *Independent Variable* | *Dependent Variable* | *Result* |
|---|---|---|---|
| *H1:* | *Market & Selling* | *VC Variables* $\beta=0.971^*$, $R^2=0.943$ | *Accepted* |
| *H2:* | *Constraints* | *VC Variables* $\beta=0.005$, $R^2=0.000$ | *Rejected* |
| *H3:* | *Credit & Stock* | *VC Variables* $\beta=0.452^*$, $R^2=0.205$ | *Accepted* |
| *H4:* | *Prices & Transaction Cost* | *VC Variables* $\beta=0.342^*$, $R^2=0.128$ | *Accepted* |

*95% Level of confidence

As the conceptual model presented four hypotheses and result presented above concludes that, Market and selling has a positive impact on vertically coordinated agricultural supply chain is accepted as a concept. Vertically coordinated agricultural supply chain is strongly associated and affected by constraints in the specific case of producers is conceptually not accepted based on the responses of farmers. Credit and stock strategy is an important and most considerable criteria that affects vertically coordinated agricultural supply chain is considerably accepted as the concept though it is comparatively weak in relationship and effect. Farmers are strongly considering the prices and transaction cost as the criteria that effects vertically coordinated agricultural supply chain for the successful implementation is the weakest in relationship and effect still it is accepted concept for the research. The current research has the novelty of applying econometric assessment model for the agricultural supply chain which can be a common technique for the applicability in agribusiness. Although many research have suggested conceptually uses of econometric model but variables and dimensions considered here are innovative at its level. Especially in this research the dimensions considered are Market & Selling, Constraints, Credit & Stock, and Prices & Transaction are not common in earlier studies but here the main concern is to assess these dimensions with the application of econometric model.

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