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Extent and Determinants of Vertical Market Integration of Tomato: A Case Study in Assam

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A B S T R A C T

The study of market integration has almost exclusively referred to events resulting in price changes since prices are the main reflectors of marketing system. Market integration can be horizontal and vertical. Vertical integration is measured by the relationship of prices prevailing at different stages of marketing or at different points of time during a marketing season. The paper looks into the extent and determinants of vertical market integration of tomato in Assam. For analyzing the extent and determinants of vertical market integration, primary data has been collected from three districts of Assam. The prices received by the farmers have been compared to the wholesale prices and retail prices prevailing in the nearest market. Ratio of these prices has been taken to form an index called as Price Realization Index. This index gives an idea of the extent of vertical market integration. The factors significantly affecting vertical integration of markets have been analyzed by fitting a Logistic regression model with the help of primary data. In case of tomato, price realization has been found to be moderate and hence the extent of vertical integration is found to be moderate. The farmers have been found to achieve better price realization if they sell their outputs themselves in village huts and markets and also if they deliver their outputs to traders rather than collected by traders from them. Educated farmers and large farmers achieve better price realization.

***Key words*:** Market integration, Vertical integration, Price realization, Farmer price, Wholesale price, Retail price

Market integration is gaining special significance in the current economic literature. If the markets of commodities are closely interrelated i.e., the price formation in one market is related to the prices in other markets, this interrelation between price movements in the markets is defined as market integration. The operational definition of market integration is known as the Law of One Price (LOP) which means that identical products sell at uniform price across different markets [1]. The study of market integration has almost exclusively referred to events resulting in price changes since prices are the main reflectors of marketing system.

Market integration can be horizontal and vertical. Horizontal integration or spatial integration is measured by the relationship in prices prevailing in spatially separated market places. Vertical integration is measured by the relationship of prices prevailing at different stages of marketing or at different points of time during a marketing season. Vertically three types of prices are prevailed, farm gate price, wholesale price and retail price [2].

The present paper will focus on the vertical integration of tomato in Assam. Tomato occupies a major portion of Assam's agriculture in terms of its importance, area cultivated and production. The area under cultivation of tomato gradually increases over time [3]. The total area covered for tomato cultivation in Assam, which was 13970 hectares in 2003-04 increased to 16634 hectares in 2010-11, and then to 16954 hectares in 2011-12 and then increased to 19450 hectares in 2018-19. The total production of tomato in Assam has been increasing gradually since 2003-04 i.e., from 326 thousand tonnes in 2003-04 to 485 thousand tonnes in 2018-19 [4]. The average yield of tomato is found to be in between the range (4320 – 6250) kg per hectare during the period 2003-04 to 2018-19.

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MATERIALS AND METHODS

The required data for the present study has been collected from primary source. For collecting primary data, a multi stage sampling design has been adopted. In the first stage, three non-contiguous districts of Assam i.e., Golaghat, Barpeta and Darrang have been selected on the basis of analysis of secondary data. In the second stage, from each district, three development blocks have been selected purposively as broad locations for field survey. The development blocks selected from Golaghat district are Golaghat East, Golaghat North and Golaghat South development blocks. The development blocks selected from Barpeta district are Mondia, Pakabatbari and Bhabanipur development blocks. The development blocks

selected from Darrang district are Dalgaon Sealmari, Sipajhar and Pachim Mangaldoi development blocks. Third stage consisted of selection of one village from each of these blocks on the basis of connectivity (having good connectivity, moderate connectivity and low connectivity). Therefore, the universe in this study was the farmers participating in the marketing of crops in nine sample villages basically the sellers. From this universe, 10 to 15 percent of farm households in each village have been selected depending on the number of farm households in the sample villages. The sample was purposively selected for coverage of farmers of different size and farmers' tenural status. Two schedules have been framed; one was for village level data and another for farm household level data. Village level schedule has been constructed for primary understandings of basic infrastructural facilities, social and community networks, major crops grown, prices prevailed in nearest market etc. Farm household schedule has been framed for primary understandings of production and sale of outputs, the mode of disposal, prices received, time of disposal etc. A total of 220 farm households have been interviewed during this process.

RESULTS AND DISCUSSION

Analysis of the extent of vertical market integration

For the purpose of the study of vertical integration of tomato, primary data pertaining to farmer price of tomato have been collected from the farmers through household schedule. Data pertaining to wholesale price and retail price of tomato prevailing in the nearest market have been collected through village schedule. For the purpose of analysis, farmer price has been compared with the wholesale price and retail price prevailing in the nearest market. Ratios of these prices have been considered to construct an index called as Price Realization Index (PRI). This index gives an idea of the extent of price realization of the farmers and thereby the extent of vertical integration. Two types of Price Realization Index have been constructed [5]. One index is the ratio of farmer price and wholesale price and the other index is the ratio of farmer price and retail price. The formula for calculating the two indices is:

$$\text{Price Realization Index (PRI) 1} = \frac{Farmer\ Price}{Wholesale\ Price}$$

$$\text{Price Realization index (PRI) 2} = \frac{Farmer\ Price}{Retail\ Price}$$

The values of these two indices lie in between 0 and 1. If this value is closer to 0, then the price realization of the farmers is poor and hence the extent of integration is low. On the other hand, if this value is closer to 1, then the price realization of the farmers is adequate and hence the extent of integration is high.

For the purpose of analysis, the relationship between value of Price Realization Index and the extent of integration is categorized in five ways as shown in (Table 1).

Table 1 Price realization index and the extent of integration

Value of PRI	Extent of integration
0 – 0.2	Very low
0.2 – 0.4	Low
0.4 – 0.6	Moderate
0.6 – 0.8	High
0.8 – 1.0	Very high

In case of tomato, the farmer price varies among individuals and hence Price Realization Index also varies among individuals. (Fig 1) presents minimum, maximum and average Price Realization Index 1 of tomato cultivating farmers of Golaghat, Barpeta and Darrang districts. The maximum Price Realization Index 1 is found to be 0.92 for farmers of Golaghat, 0.94 for farmers of Barpeta and 0.86 for farmers of Darrang. The minimum Price Realization index 1 is found to be 0.33 for farmers of Golaghat, 0.42 for farmers of Barpeta and 0.38 for farmers of Darrang [6]. The average Price Realization index 1 of farmers of Barpeta is found to be the highest (0.68) followed by that of Darrang (0.62) and Golaghat (0.57).

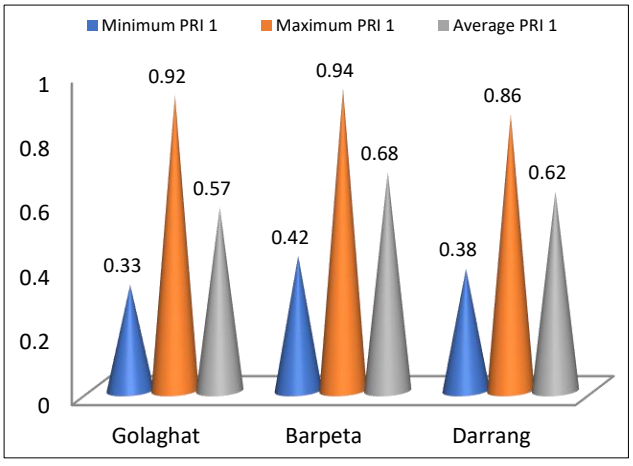

Fig 1 Minimum, maximum and average price realization index 1 of tomato cultivating farmers

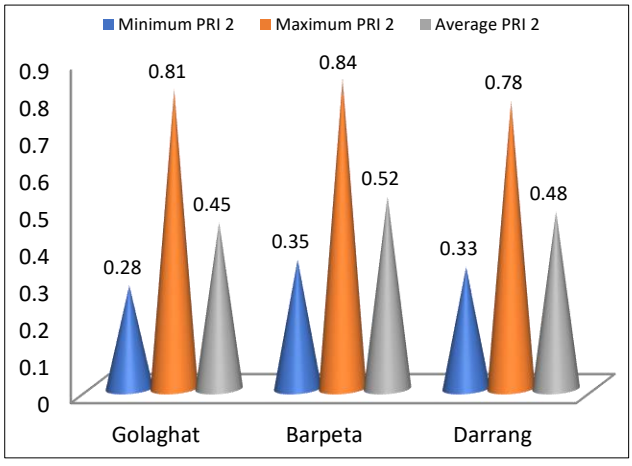

Fig 2 Minimum, maximum and average price realization index 2 of tomato cultivating farmers

(Fig 2) presents minimum, maximum and average Price Realization Index 2 of tomato cultivating farmers of the three districts. The maximum Price Realization Index 2 is found to be 0.81 for farmers of Golaghat, 0.84 for farmers of Barpeta and 0.78 for farmers of Darrang. The minimum Price Realization index 2 is found to be 0.28 for farmers of Golaghat, 0.35 for farmers of Barpeta and 0.33 for farmers of Darrang. The average Price Realization index 2 of farmers of Barpeta is found to be the highest (0.52) followed by that of Darrang (0.48) and Golaghat (0.45). From the analysis it is observed that in case of cultivation of tomato, farmers of Barpeta achieve better price realization than that of Darrang and Golaghat.

The data depicted in (Table 2) shows percentage distribution of sample tomato cultivating farm households under different size classes of Price Realization index 1 and (Table 3) shows percentage distribution of sample tomato cultivating farm households under different size classes of Price Realization Index 2 [7].

Table 2 Percentage distribution of tomato cultivating households under different classes of PRI 1

Value of PRI 1	Percentage of farmers
0 - 0.2	nil
0.2 - 0.4	5.82
0.4 - 0.6	50.24
0.6 - 0.8	36.34
0.8 - 1	7.6

Table 3 Percentage distribution of tomato cultivating households under different classes of PRI 2

Value of PRI 2	Percentage of farmers
0 - 0.2	nil
0.2 - 0.4	10.28
0.4 - 0.6	66.5
0.6 - 0.8	21.32
0.8 - 1	1.9

The (Table 2) reveals that majority of tomato cultivating households are in size classes of 0.4-0.6 (50.24 percent) and 0.6-0.8 (36.34 percent) values of PRI 1. Data in (Table 3) shows a high concentration of households in size class of 0.4 – 0.6 (66.5 percent) values of PRI 2. Therefore, the extent of vertical integration is found to be moderate in case of tomato. From this analysis, it can be concluded that farmers cultivating tomato achieve moderate price realization [8].

Moderate vertical integration of tomato can be explained diagrammatically through Price Realization Index series as shown in (Fig 3-4). Both the (Fig 3-4) reveal moderate level of vertical integration in case of tomato.

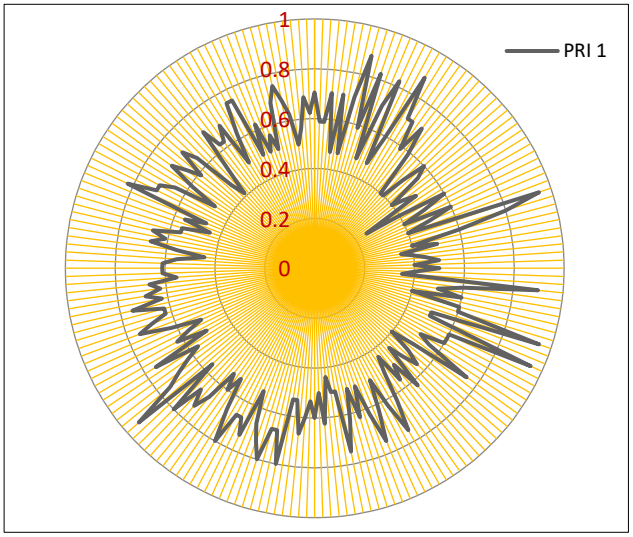

Fig 3 Price realization index 1 series for tomato

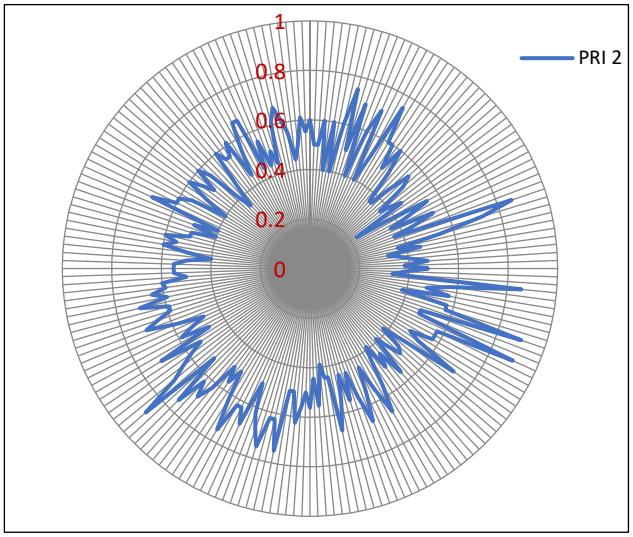

Fig 4 Price realization index 2 series for tomato

Determinants of vertical integration

After discussing the extent of vertical integration, it is necessary to determine the factors affecting it. In other words, the factors responsible for achieving better price realization of farmers need to examine separately. In this context, we have constructed a regression model in order to verify the relative influence of the factors on price realization of the farmers.

The nature of the dependent variable i.e., Price Realization Index is such that it takes values between 0 and 1. Hence, the linear functional form of regression model is not appropriate for the present purpose, as the predicted value of the dependent variable in a linear regression model would not necessarily be confined between 0 and 1. Hence the following logistic function has been specified as the basic model.

$$Y = \frac{1}{1 + e^{-z}}$$

Where, Y = Value of Price Realization Index
Z = Linear combination of explanatory variables and
$Z = \alpha + \sum \beta_i X_i + U$
Where, α = constant term
β_i = coefficients of the explanatory variables
u = random disturbance term

It may be noted that as Z goes from - ∞ to + ∞, Y goes from 0 to 1. In spite of the basic model which is non linear in nature, its parameters can be estimated by the linear regression technique by using Z as the repressor. For running regression, the values of Z can be constructed from values of Y by using the following transformation formula:

$$\ln\left\{\frac{Y}{(1-Y)}\right\} = Z$$

In case of tomato, the regression model is:

$$\ln\left\{\frac{Y_i}{(1-Y_i)}\right\} = \alpha + \beta_1 AREA_i + \beta_2 TIME_i + + \beta_3 EDU_i + \lambda_1 MOD_{1i} + \lambda_2 MOD_{2i} + \gamma_1 TOD_{1i} + \gamma_2 TOD_{2i} + \delta_1 TS_{1i} + \delta_2 TS_{2i} + \mu_1 L_{1i} + \mu_2 L_{2i} + U_i$$

Explanation of the explanatory variables

Area cultivated (Area): This variable represents the total area used for cultivation of tomato by the sample farm households. Large farmers are likely to get better price realization whereas the small farmers are likely to get less price realization. Hence, we expect the coefficient of the variable to bear a positive sign.

Time (Time): This variable represents time taken by the farmer to reach nearest market. A farmer is likely to achieve better price realization if the time taken by him to reach nearest market is less. Hence, we expect the coefficient of the variable to bear a negative sign.

Education (Edu): This variable represents the level of education of the head of the farm household. Education is a categorical variable with - 0: illiterate; 1: below primary; 2: primary to high school; 3: matriculate and undergraduate and 4: graduate and above. Education creates awareness among farmers and hence, higher is the level of education, better will be the price realization. Hence, we expect the coefficient of the variable to bear a positive sign.

Mode of disposal dummies (MOD_1, MOD_2)

Taking collected by traders as reference category, two mode of disposal dummies have been used, viz., MOD_1 and MOD_2

Where;

MOD_1 = 1, for delivered to traders

= 0, otherwise

MOD_2 = 1, for sold by themselves in village huts and markets

= 0, otherwise

The sign of the coefficient of MOD_1 cannot be predicted. It may bear either positive or negative sign. However, we expect the coefficient of MOD_2 to bear a positive sign because the farmers may achieve better price realization if they sell their output themselves rather than collected by traders from them.

Time of disposal dummies (TOD_1 & TOD_2)

In case of potato, no farmers are found who dispose their outputs in more than one month. Taking this consideration, two time of disposal dummies have been used. Here, "immediately after harvesting" has been used as reference category. The two dummies are:

TOD_1 = 1, for within one week

= 0, otherwise

TOD_2 = 1, for within one month

= 0, otherwise

The coefficients of the variable may bear either positive or negative signs.

Tenural status dummies (TS_1 & TS_2)

Taking owner operator as the reference category, two tenural status dummies have been used, viz., TS_1 and TS_2

Where;

TS_1 = 1, for owner operator cum tenant

= 0, otherwise

TS_2 = 1, for pure tenant

= 0, otherwise

The coefficients may bear either positive or negative sign.

Location dummies (L_1 & L_2): Taking Golaghat as the reference category, two location dummies have been used, viz., L_1 and L_2

Where;

L_1 = 1, for Barpeta

= 0, 0therwise

L_2 = 1, for Darrang

= 0, otherwise

The sign of the coefficients of L_1 and L_2 cannot be predicted. They may bear either positive or negative signs.

The results of the regression analysis have been summarized in (Table 4-5). Before estimating the model, Breusch-Pagan test has been applied to check the presence of heteroscedasticity. The results of the test as shown in tables 4 and 5 reveal the presence of heteroscedasticy in the data set. It has been corrected by estimating Robust standard error.

The coefficient of the variable AREA is found to be significant with a positive sign in both the results. Thus, with respect to the variable AREA, the results imply that large tomato cultivating farmers tend to achieve better price realization.

The coefficient of the variable EDU is found to be significant with a positive sign in both the results. The results imply that educated farmers tend to achieve better price realization.

The coefficient of the variable MOD_1 is found to be significant with a positive sign in both the results. The significance of the variable implies that difference in price realization between tomato cultivating farmers who deliver their outputs to traders and those from whom traders collect outputs, is statistically significant. The positive sign implies that the tomato cultivating farmers achieve better price realization if they deliver their outputs to traders rather than collected by traders from them.

Table 4 Results of regression analysis taking PRI 1 as dependent variable (for tomato)

Breusch – Pagan test for heteroscedasticity
Chi ^{2} [1] = 16.25
Prob. = 0.0000***
Result: Presence of heteroscedasticity

Variables / constant	Estimates of the coefficients / values
AREA	.1238562** (.0437126)
TIME	.0028935 (.0042178)
EDU	.3124562** (.1456123)
MOD_1	.2417357** (.0842791)
MOD_2	.7835428*** (.1901236)
TOD_1	-.1678124 (.0809456)
TOD_2	.0282415 (.1901678)
TS_1	.0945673 (.1183567)
TS_2	.1178954 (.3125673)
L_1	.1924614 (.1723134)
L_2	.1213546 (.1213124)
Constant	-.1367458 (.1421753)
R^2	0.3286
F [11,180]	8.16***

Table 5 Results of regression analysis taking PRI 2 as dependent variable (for tomato)

Breusch – Pagan test for heteroscedasticity
Chi ^{2} [1] = 8.27
Prob. = 0.0026***
Result: Presence of heteroscedasticity

Variables / constant	Estimates of the coefficients / values
AREA	.1134257** (.0631789)
TIME	.0038654 (.0031527)
EDU	.2134657** (.0903428)
MOD_1	.2415681** (.0901802)
MOD_2	.5286533*** (.0818204)
TOD_1	-.1451289 (.0810912)
TOD_2	-.0489123 (.1418578)
TS_1	.0708256 (.1321456)
TS_2	.0893613 (.1928425)
L_1	.2034962* (.1921312)
L_2	.0829023 (.0821378)
Constant	-.3128753*** (.1421362)
R^2	0.3456
F [11,180]	7.59***

Figures in ( ) and [ ] are Robust standard errors and degrees of freedom respectively
***, **, * indicate significant at 1, 5 and 10 percent respectively

The coefficient of the variable MOD_2 is also found to be highly significant with a positive sign as shown in the two results. The results imply that price realization achieved by the tomato cultivating farmers who sell their outputs themselves in

village huts and markets significantly differ from the farmers from whom the trader's collect outputs. The positive sign indicates that the tomato cultivating farmers achieve much better price realization if they sell their outputs themselves in village huts and markets rather than collected by traders from them [9].

The coefficient of the variable L_1 is significant with a positive sign as shown in (Table 5). This implies that price realization achieved by the farmers of Barpeta significantly differ from the price realization achieved by the farmers of Golaghat. The positive sign implies that tomato cultivating farmers of Barpeta district achieve better price realization than the farmers of Golaghat district.

The other variables are found to be insignificant and hence play no role in determining price realization of tomato cultivating farmers and thereby the extent of vertical integration of tomato [10].

CONCLUSION

From the entire analysis it has been observed that farmer price differs among individuals and locations for the same crop. In case of tomato, price realization has been found to be moderate and hence the extent of vertical integration is found to be moderate in case of tomato. It may be due to degree of storability since tomato is perishable in nature. Therefore, emphasis should be given more to post harvest technologies such as storage facilities. The farmers have been found to achieve better price realization if they sell their outputs themselves in village huts and markets and also if they deliver their outputs to traders rather than collected by traders from them. Famers may organize to sell their outputs rather than involving with traders. Reducing the number of middlemen by operating through organization like farmers' cooperative will increase the share of the farmers in the crops market.

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