Volume: 2, Issue: 4
Page: 707-717
2018

ISSN 2520-4750 (Online) & ISSN 2521-3040 (Print)

International Journal of Science and Business

Cobweb Model for the Stabilization of Vegetable Prices in Some Selected Villages of Noakhali District

Binata Rani Sen, Md. Maznur Rahman & Mohammad Iqbal Hossain

Abstract:

In this paper, a linear Cobweb model is used to analyze the phenomenon of commodity price fluctuations of vegetables in some selected villages of Noakhali district. The fluctuation of vegetable prices is normal in the market economy. The level of the price and the fluctuation not only has a significant influence on farmers and consumers, but a reasonable and stable price also has an irreplaceable effect on the safe running of the vegetable market. The assumptions for the model are (i) vegetables have no equal substitutes; (ii) there is no foreign competition. The analysis found that the slope of the demand function of the price was smaller/larger than the slope of the supply function of the price which means that the price and quantity supplied of the fresh vegetables would oscillate/indicate around a fixed price and also spiral inward/outward.

IJSB
Accepted 15 November 2018
Published 19 November 2018
DOI: 10.5281/zenodo.1491286

Keywords: Vegetable Prices, Cobweb Model, Price Fluctuation, Market economy, Noakhali district

About Author

Binata Rani Sen, (Corresponding Author) Department of Economics, Noakhali Science and Technology University, Noakhali, Bangladesh
Md. Maznur Rahman, Department of Economics, Noakhali Science and Technology University, Noakhali, Bangladesh
Mohammad Iqbal Hossain, Department of Economics, Noakhali Science and Technology University, Noakhali, Bangladesh

1. Introduction

As vegetables is one of the most important consumer goods for residents, the fluctuation of the prices has a direct impact on people's daily life. Especially in recent years, the continuous increase in vegetable prices has drawn much attention from the government as well as the people. Noakhali is low lying land which is situated southern bank of the Bay of Bengal. The economy of Noakhali predominantly depends on agriculture. In Noakhali, mainly small holder household mostly produce vegetables and they cultivate seasonal vegetables in two periods (summer and winter) in a year. Most farmers of the village often run into village because of lack of capital, lack of secured ready market during bumper harvest period and absence of proper post-harvest management. Technological knowledge also unavailable in the area and most of the vegetable farmers are uneducated. As vegetables are perishable products, lack of processing and storage system in the village constitute critical obstacle to the commodity's inter market arbitrage by traders. The purpose of this paper is to oversee the phenomenon of commodity price fluctuations by the use of cobweb model. Price fluctuation is most important matter in agricultural economics. In the thirties, cobweb model was founded by observing of regularly recurring cycles in the production and prices of particular commodities. (Ezekiel, 1938). This model describes price fluctuations in a single market for vegetables that takes one unit of time to produce. Supply depends on the expectations of the producers about next period's price and market prices are driven by these expectations. There are three types of cobweb model. These are (i) A 'convergent' cobweb model (ii) A 'divergent' cobweb model and (iii) A 'neutral' cobweb model. The cobweb model has been studied in many ways since Ezekiel (1938) developed it to explain the corn-hogs cycle that had been observed in the United States. The cobweb model has difficulty in explaining the irregular fluctuations observed in the actual data. Thus, explaining variations in production requires including uncertain or stochastic factors like good or bad weather or complicated factors like multi-period production lags. The recent literature, which takes account of developments in nonlinear economic dynamics, demonstrates that the cobweb model can generate irregular fluctuations of price or output if the demand curve and/or the supply curve have strong nonlinearities (Homes, 1994). These findings indicate that irregular fluctuations may arise from the intrinsic working of pure economic factors (i.e., demand and supply) in the deterministic cobweb model (Matsumoto, 1998).

Fluctuations are therefore proposed to arise based on the following two main explanations.

1.1. The Exogenous Factors Explanation: The exogenous factors (Cafiero & Wright, 2006; Deaton & Laroque, 2003; 1992) such as weather shocks or any other factors outside the economic environment could perturb supply. For example, climatic fluctuations may be responsible of price fluctuations. In Noakhali, floods hamper the production of kharif-2 seasons vegetable when price of vegetables become very high rate. In 2014, because of less importing of vegetables from other districts of the country due to political unrest, prices of vegetables had been increased which indicates the price fluctuation.

1.2. The endogenous price fluctuation: The endogenous factors explanation is tricky, but more plausible. Expectations of producers about future prices are assumed to be based on observations of previous prices. According to Ezekiel (1938), erroneous expectations lead to over- or under- supply since, in both cases, an inelastic demand magnifies imbalances and creates large and detrimental price fluctuations. (Nerlove, 1958) further made the assertion that agents only use recent past data to form their price expectations and make systematic forecast errors, which lead to over or under supply. These errors are what lead to

endogenous fluctuations in the cobweb model. Nerlove (1958) states that while assuming that farmers look back at the most recent prices in order to forecast future prices might seem very reasonable, this backward-looking forecasting (which is called adaptive expectations) turns out to be crucial for the model's fluctuations. When farmers expect high prices to continue, they produce too much and therefore end up with low prices, and vice versa. According to (Evans & Honkapohja, 2001) in regards to adaptive expectations, people form their expectations about what will happen in the future based on what has happened in the past.

1.3. Stabilization of Price: Stabilizing fluctuations is another important subject in agricultural economics. In order to regulate prices, to guarantee producers' incomes, and to iron out variations in production, the governments in many economies constantly intervene in agricultural markets in various ways. The intervention takes forms of the minimum and/or maximum price, tariff and quotas, subsidies, and production restriction. In consequence, government stabilization policy greatly affects prices and quantities of agricultural goods produced (Matsumoto, 1998).

1.4. Vegetables in selected villages: The name of summer (Kharif-I) vegetables are – Snake Gourd, Balsam Apple, Bottle Gourd, Zuccuni, Cucumber, Green Cucumber, Gourd, Basil, Rige Gourd, Bird weed, Pumpkin, Chilli, Bitter gourd, Stiring bean, Papayaa, Arums wax ground etc. And the winter (Rabi crops) are – Cauliflower, Cabbage, Turnip, Red leafy, Spinach, Pumpkin, Bean, Brinjal, Tomato, Gourd, Balsam Apple, Radish, Coriender, Sweet Potato, Cabbage, Cauliflower, Raddish, Tomato, Soyabean, Bean, Cucumber, Red amaranth, Spinach, Bringal, Carrot, gourd, Calabash, Red Amaranth, Aubergines, Potato etc. The goal of our study is to investigate the phenomenon of vegetable price fluctuations using the cob web model incorporating for stabilizing price of all vegetables on the limited time of supply and continuous consumption. The supply and demand function price of all vegetables using time series analysis would also be characterized. Detecting sources of price fluctuations is one of the most important subjects in agricultural economics.

2. Methodology

2.1. Data Sources

A primary sectional research design was used to undertake the study where the five villages like Matipur, Binodpur, Banglabazar, 66- shewla, Kalitara in Noakhali district was selected as a study Area. The design involved intensive analysis of the phenomenon in the selected village within a specified time. The villages consists of about 5000 householders and among them about 80% households are engaged in agricultural production though most of are older farmer who are not enough interested in survey. 30% households produce only for their personal needs, 45% are small farmers, 20% households are medium farmers and the large farmers are 5% who regulate the production chain in these villages. Most of the farmers have no higher educational background so still there is less application of new agricultural technology. Purposive and simple random sampling techniques were used to pick a sample of 150 respondents including farmers from selected villages. Multiple approaches including questionnaire, interviews and documentary review were used to gather primary data from the householders of these villages. Data were analyzed through applying qualitative techniques that involved the use of interpretive and reflexive approaches while quantitative techniques involved utilization of descriptive statistics. Here, SPSS software is used for result analysis.

We collect the production quantity and prices of all vegetables of **2012-2017** and calculate the average production of vegetables in kilograms (Kg.). Data are given below in Table 1, 2, 3 and 4.

Table 1: Average winter (Robi) productions of vegetables in Kg: modified

Year	Production (Binodpur)	Production (66- shewla)	Production (Bangla bazar)	Production (Kalitara)	Production (Matipur)	Total production
2012	435873	720	1246.7	210	333.611	438383.31
2013	640051	730	1543.97	230	349.111	642904.08
2014	665055	734	2228.802	250	372.853	668640.66
2015	673440	738	2461.81	300	375.043	677314.85
2016	692540	814	2874.32	356	390.214	696974.534
2017	716253	865	3106.54	410	402.325	721036.865

Source: Primary data collected from a field survey

Table 2: Average Summer (Kharif-I & II) productions of vegetables in kg: modified

Year	Production (Binodpur)	Production (66- shewla)	Production (Bangla bazar)	Production (Kalitara)	Production (Matipur)	Total production
2012	148800	600	730	1790.02	402.736	152322.756
2013	150453	675	760	1924.06	462.313	154274.373
2014	154835	705	746	2048.211	378.285	158712.496
2015	166200	750	715	2096.58	473.267	170234.847
2016	171235	801	774	2148.95	565.536	175524.486
2017	178638	862	845	2256.74	642.26	183244

Source: Primary data collected from a field survey

Table 3: Average winter (Robi) prices of vegetables (Tk Per Kg.)

Year	Price (Binodpur)	Price (66-shewla)	Price (Bangla bazar)	Price (Kalitara)	Price (Matipur)	Average Price
2012	11.389	18	34	21	20.14	19
2013	12.504	19	37.07	22	21.1	22
2014	19.941	21	46.34	23	22.6	24
2015	13.644	24	39.1	26	21.56	28
2016	21.452	26	50	28	23	31.5
2017	23.362	28.5	56	33	25.5	34.24

Source: Primary data collected from a field survey

Table 4: Average summer (Kharif-I & II) prices of vegetables (Tk Per Kg.)

Year	Price (Binodpur)	Price (66-shewla)	Price (Bangla bazar)	Price (Kalitara)	Price (Matipur)	Average price
2012	15.559	21	32.635	24	33.89	25.4168
2013	16.926	24	34.38	25.5	41.46	28.4532
2014	26.718	26	36.29	26.5	36.8	30.4616
2015	20.099	28	39.29	29	44.22	32.1218
2016	23	27.5	42	33	46	34
2017	25	30	45	35	48	36

Source: Primary data collected from a field survey

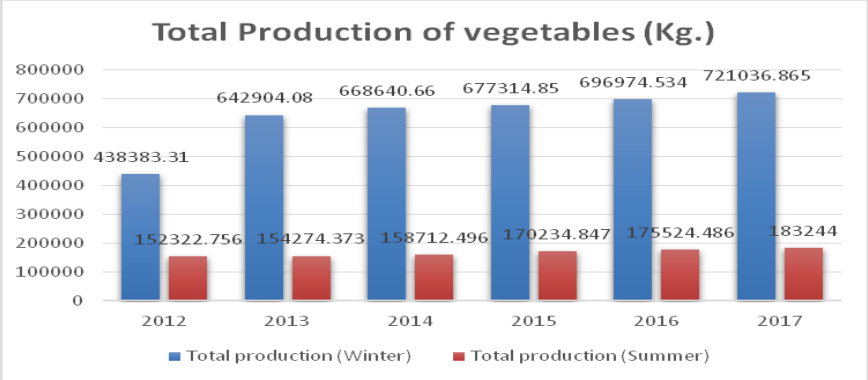

Fig 1: Winter and Summer Vegetable Production (In Kg.)

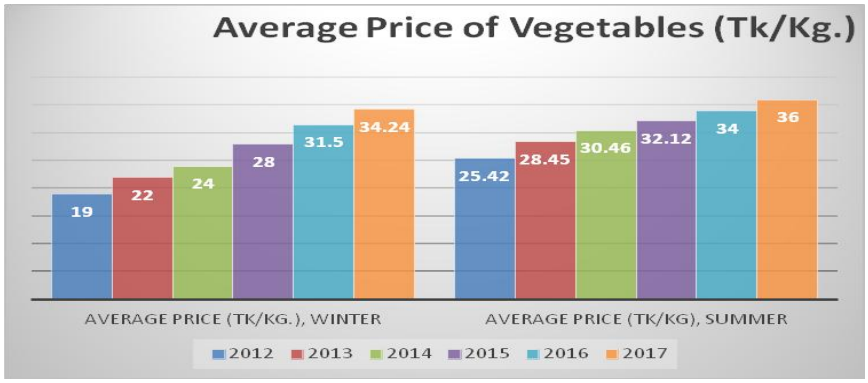

Fig 2: Winter and Summer Vegetable Prices (Tk. Per Kg.)

2.2 The Cobweb Model

The cobweb theory is one kind of dynamic balance analysis the western economists carried on in 1930s according to whether the equilibrium state is stable or not. In the theory taking the factor of temporal variation into consideration, after examining the interactions of the demands, supply volumes and the prices during different period, the relevant persons can discuss the actual undulation process and results of the output and price of such commodities with comparatively longer production cycle as agricultural products and products of animal husbandry after deviating from the equilibrium state. Combining the market equilibrium

theory and elasticity theory, the cobweb theory then involves examinations of the change in the market price and the yield, namely using the law of demand and supply to explain the repeatedly variation of the price and yield and impact on each other when the demand and supply of some commodities with long production cycle become imbalanced. The main products studied in the cobweb theory need a long production cycle from the manufacturing to its appearing in the market. Furthermore, once the scale of production is ascertained, it can't be changed on half-way until the manufacturing process finishes. And consequently the variation of the market price can just affect the output in the following cycle. Also the output this cycle depends on the price last cycle and in the same way the price this cycle will decide the output next cycle. There are three types of cobweb model which are given below.

2.2.1. Convergent cobweb

When the elasticity of supply is less than that of demand, the extent of effect of the change in the market price on supply volumes will be less than that on demand. In this case, the effect of price fluctuation on the output will be increasingly weak and the fluctuation range of the price and yield will be smaller and smaller ultimately towards equilibrium spontaneously. Reflected in the graphics, it will be a cobweb with contraction inward and convergence in equilibrium point, and hence named convergent cobweb. In figure 1(a) convergent curve is shown and in fig 1(b) price up-down through the time is shown. See in figure 1.

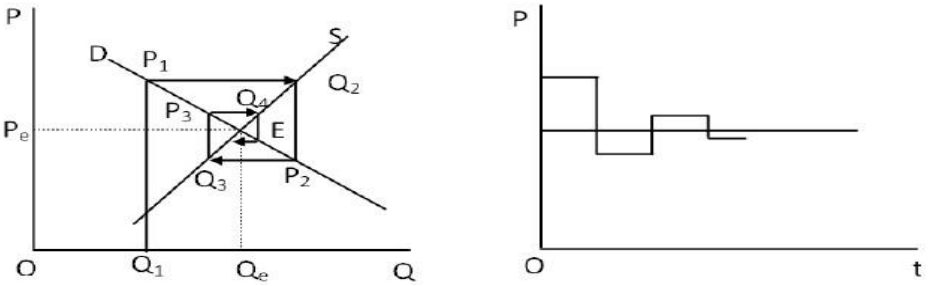

Fig 3(a) Fig 3(b)

Fig 3: Convergent cobweb model

2.2.2 Divergent cobweb

When the elasticity of supply is greater than that of demand, the extent of effect of the change in the market price on supply volumes will be larger than that on demand. In this case, the effect of price fluctuation on the output will be increasingly strong and the fluctuation range of the price and yield will be greater and greater ultimately farther and farther from the equilibrium point. Reflected in the graphics, it will be a cobweb spreading out and far from the equilibrium point, and therefore called divergent cobweb. . In figure 2(a) divergent curve is shown and in fig 2(b) price up-down through the time is shown. See in figure 2.

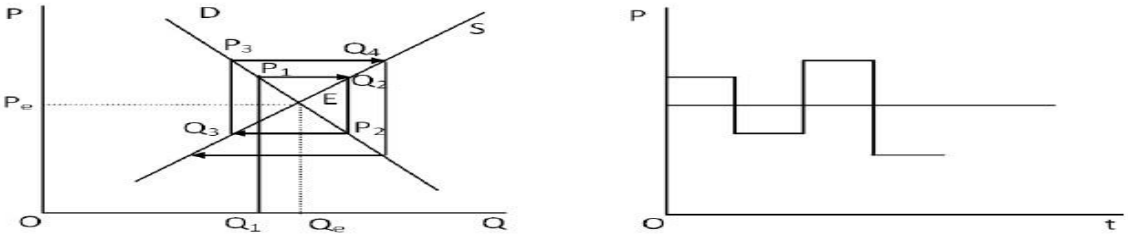

Fig 4(a) Fig 4(b)

Fig 4: Divergent Cobweb Mode

2.2.3 Enclosed cobweb

When supply elasticity is less than demand elasticity, the influence of market price development on supply quantity is equal to that on demand quantity. On this occasion, the price and volume of production undergo the same fluctuation, neither close to the equilibrium point, nor far away from it. Price and production keep fluctuating around the equilibrium point in endless loop. As reflected in the picture, it forms a cobweb end to end, namely, the enclosed cobweb. . In figure 3(a) enclosed curve is shown and in fig 3(b) price up-down through the time is shown. See in Fig 3.

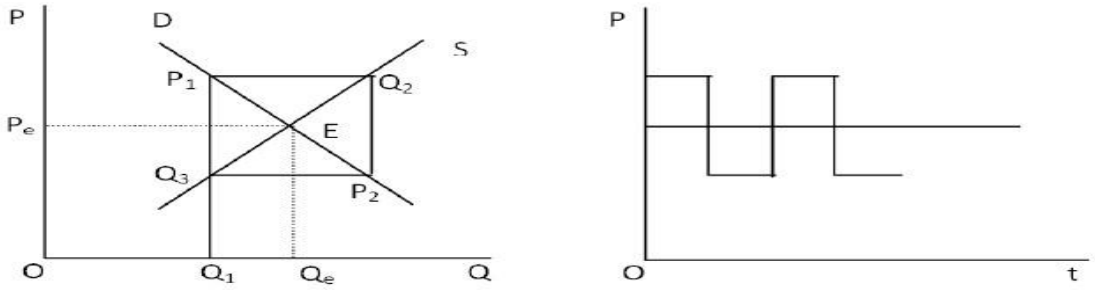

Fig 5(a) Fig 5(b)

Fig 5: Enclosed cobweb model

2.3. Mathematical Explanation of Cobweb Model

The supply and demand functions of prices of fresh vegetables were obtained based on the following assumptions relative to consecutive time periods:

a. The supply in period k (where t = 1, 2, 3,…) is a linear function of the price in previous period k-1, with the supply increasing when prices increases.
b. The demand in period t is a linear function of the price in period k, with the demand decreasing when price increases.
c. The market price is determined by the available supply, with the transaction taking place at the price which makes the demand equal to the supply.

For t = 0, 1, 2, 3, …… let

S_t = {number of units of the commodity supplied in the t-th period}

D_t = {number of units of the commodity demand in the t-th period}

P_t = {price of a unit of the commodity in the t-th period} (Ghatak et al, 1984)

Let the demand and supply curves be linear and let demand be inversely related to the current price whereas supply be given by past period's price. Hence we have equation (1) and (2):

$$D_t = a_0 - a_1 P_t \quad \text{.....(i)}$$

$$S_t = b_0 + b_1 P_{t-1} \quad \text{.....(ii)}$$

Thus from market clearing equation (iii):

$$a_o - a_1 P_t = b_0 + P_{t-1} \quad \text{..... (iii)}$$

Equation (iii) is useful to evaluate the equilibrium price (= P^e). Then if the initial price $P_0 \neq P^e$ we want to know the time trajectory of price that eventually goes back to equilibrium price.

In the equilibrium, we have,

$P^e = P_t = P_{t-1}$ ..... (iv)

We can now rewrite equation (iii) as,

$a_0 - a_1 P_e = b_0 + b_1 P^e$ ..... (v)

The solution for P^e is then given by:

$a_0 - b_0 = b_1 P^e + a_1 P^e$ .....(vi)

or $a_0 - b_0 = (b_1 + a_1) P^e$

or $P^e = \frac{a_o - b_0}{a_1 + b_1}$ .....(vii)

To find out the line trajectory prices, beginning with $P = P_0$, we must find a solution for the first order difference equation given by equation (iii). Here, we consider price in t period as a function of price in the initial period, P_0. This yields equation (viii) for P_t,

$$P_t = \frac{a_0 - b_0}{a_1 + b_1} + \left(-\frac{b_1}{a_1}\right)\left(P_0 - \frac{a_0 - b_0}{a_1 + b_1}\right)$$

$$P_t = P^e + \left(-\frac{b_1}{a_1}\right)\left(P_0 - P^e\right)$$ .....(viii)

And three cases emerge as we analyze function (8):

(i) If $b_1 < a_1$, then the price and quantity will go up and down around the equilibrium price and quantity, and the fluctuating scope will become smaller and smaller, and finally converge to the equilibrium point.

(ii) If $b_1 > a_1$, then the price and quantity will go up and down around the equilibrium price and quantity, and the fluctuating scope will become bigger and bigger, and will never converge to the equilibrium point.

(iii) If $a_1 = b_1$, then price and quantity will go up and down around the equilibrium price and quantity, and the fluctuating scope will remain the same and will never converge to the equilibrium point (Ruize, 2010).

3. Results and Discussion

The general objective of this study is to investigate the phenomenon of commodity price fluctuations in the context of the cobweb model of mathematical economics.

SPSS was used to model and estimate the model parameters of the demand and supply functions of price.

3.1. Demand and Supply Function and Equilibrium Price:

3.1.1. In Rabi

From Table 5 and 6 (see Appendix) we found that,

a_0 = 267803.262 a_1 = 14101.264

b_0 = 533385.963 b_1 = 5943.303

So, the demand function is, $D_t = 267803.262 + 14101.264 P_t$

And, the supply function is, $S_t = 533385.963 + 5943.303 P_{t-1}$

Now putting the values into equation (vii) we have the equilibrium price in Robi,

$$P^e = \frac{267803.262 - 533385.963}{14101.264 + 5943.303}$$
$$= \frac{-265582.701}{20044.567}$$
$$= -13.25 \text{ Tk per Kg.}$$

The negative price is an indication that government always has to buy stocks from the market.

So the equilibrium level of price is 13.25 Tk per Kg.

We can also find the equation for trajectory price by putting the values into equation (viii),

$$P_t = 13.25 + \left(-\frac{5943.303}{14101.264}\right)(P_0 - 13.25)$$
$$= 13.25 - 0.4215(P_0 - 13.25)$$
$$= 13.25 - 0.4215P_0 + 5.5849$$
$$= 18.8349 - 0.4215P_0$$

Here, $a_1 > b_1$, then the price and quantity will go up and down around the equilibrium price and quantity, and the fluctuating scope will become smaller and smaller, and finally converge to the equilibrium point.

Here, average prices are Tk 19, 22, 24, 28, 31.5 and 34.24 in 2012, 2013, 2014, 2015, 2016 and 2017 respectively. And our equilibrium price is 13.25. So, we can see that the prices are fluctuating outward from the equilibrium price.

In 2017, price is more than (34.24 Tk – 13.25 Tk) = 18.94 Tk from the equilibrium price which was 5.75 Tk in 2012. To reduce these difference necessary steps should be taken like giving input subsidy, improving market system etc.

3.1.2. In Kharif -I and II

From Table 7 and 8 (see Appendix) we found that,

$a_0 = 68116.240$	$a_1 = 3140.814$
$b_0 = 62525.773$	$b_1 = 3518.440$

So, the demand function is, $D_t = 68116.24 + 3140.814P_t$

And, the supply function is, $S_t = 62525.773 + 3518.44P_{t-1}$

Now putting the values into equation (vii) we have the equilibrium price in Kharif –I & II,

$$P^e = \frac{68116.24 - 62525.773}{3140.814 + 3518.44}$$
$$= \frac{5590.467}{6659.254}$$
$$= 0.8395$$

We can also find the equation for trajectory price by putting the values into equation (viii),

$$P_t = 0.8395 + \left(-\frac{3518.44}{3140.814}\right)(P_0 - 0.8395)$$

$$= 0.8395 - 1.1202(P_0 - 0.8395)$$
$$= 0.8395 - 1.1202P_0 + 0.9404$$
$$= 1.78 - 1.1202P_0$$

Here, $b_1 > a_1$.
So, the price and quantity will go up and down around the equilibrium price and quantity, and the fluctuating scope will become bigger and bigger, and will never converge to the equilibrium point. Here, average prices are Tk 25.4168, 28.4532, 30.4616, 32.1218, 34 and 36 in 2012, 2013, 2014 2015, 2016 and 2017 respectively. And our equilibrium price is 0.8395 Tk. So, we can see that the prices are fluctuating outward from the equilibrium price.
In 2017, average price is more than (36 – 0.8395) = 35.1605 Tk from the equilibrium price which was 24.1605Tk in 2012. To reduce these difference necessary steps should be taken like giving input subsidy, improving market system etc.

4. Conclusion and Recommendation

The analysis detects that the slope of demand function of price is smaller/larger than slope of supply function of price which means that demand for vegetables is elastic/inelastic to the price of the commodity. In this condition, it is possible for producers to make expectations error. The model performed on the assumptions that vegetables have no equal substitutes and that there is no foreign competition and also no exogenous shocks needed to generate price fluctuations. It is recommended that linear cobweb model could be used for the assessment of impact of policy decisions such as price stabilization programs.
We can improve the vegetables market of Noakhali by taking two steps like –

1. **Actively promote the systematic construction of the circulation of vegetable plants under the background of urban-rural coordination:** The biggest constraint is logistics system in the market system of vegetable production and marketing. Therefore, it is a better channel to decrease the price of vegetables by strengthening the logistics system construction of vegetable. The construction involves two aspects: one is the of farm products, the other is the means of production of vegetable's popularity in countries.
   i. Facilitate vegetable plants go into town; positively explore the docking mechanism of supermarkets and countryside.
   ii. Actively implement measures to promote relevant consumption goods on vegetable production go into towns, establish agricultural supermarket.
   iii. Develop modern logistic and facilitate the circulation of agricultural products.
2. **Actualizing the diversification and differentiation of production vegetable products, and increasing the market value of agricultural products:** On the one hand, with the growth in the living standard, the demand of vegetable products becomes more diversified and high-end. On the other hand, vegetable products are very seasonal and alternative products. Therefore, we should make out corresponding strategy of product differentiation in accordance with the preference in the market to increase the value of agricultural products.

   i. Establishing the quality standard system, producing healthy and organic vegetable production.
   ii. Developing brand advantage, applying for registering brand-name products and opening up high-end consumption market.

3. **Strengthening the construction of the rural cooperative organization management, and establishing an effective vegetable production market system:** Farmers unify the production, processing and marketing of vegetables to realize the unification of "production, processing, marketing" integration through the establishment of their own cooperation organization. Farmer is the producers as well as the vendors. It can greatly reduce the cost of vegetable products circulation, and vegetable growers can share the profits of rising prices of vegetables.

   i. Improving the overall level of rural cooperative organizations, and regulating the rural professional cooperation organization operation mechanism.
   ii. The government supporting vegetable trading market information and large-scale construction.

References

Xu, L. et al (2012), The Analysis of the Vegetables' Price Fluctuation with Cobweb Model, Interdisciplinary journal of contemporary research in Business.

Anokye, M. et al (2012), Cobweb Model with Buffer Stock for the Stabilization of Tomato Prices in Ghana, Canadian Center of Science and Education.

Pashigian, B. P. (2008). "Cobweb Theorem". 2nd Edition, The New Palgrave Dictionary of Economics.

Ridler, D. (2008), Imperfect Competition and the Cobweb Theorem: A Vegetable Case, Journal of Agricultural Economics.

Ezekiel, M. (2012), The Cobweb Theorem, Oxford University Press.

Muth, J. F. (1961). "Rational Expectations and the Theory of Price Movements". Econometrica (3): 315–35.

Cite this article:

Binata Rani Sen, Md. Maznur Rahman & Mohammad Iqbal Hossain (2018). Cobweb Model for the Stabilization of Vegetable Prices in Some Selected Villages of Noakhali District. *International Journal of Science and Business*, *2*(4), 707-717. doi: https://doi.org/10.5281/zenodo.1491286

Retrieved from http://ijsab.com/wp-content/uploads/289.pdf

Published by

IJSB International