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Milk Supply and Demand of Ulaanbaatar City

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Abstract: In Mongolia, Ulaanbaatar city (UB) is not only the largest and capital city with continuously growing populations due to its own development. Current domestic liquid milk production has not met with the consumption of UB and other big cities in Mongolia. The objective of this study is to analyze market equilibrium of liquid milk market of UB city, and determine level of milk supply. Market theory, including demand and supply analyses were applied using regression analyses to estimate functional forms and other required statistical – econometrical indicators. Secondary data gathered from National Statistical Office /2004-2014/ and methodology for converting adult equivalence methodology cited from methodological guidance. The main finding is that there is comparatively big deficit of liquid milk in UB, which leads to liquid milk insecurity (794.4 t <237.8 t). The functions and elasticity(s) show clearly that the share of dried milk higher in the market. Therefore, support of domestic liquid milk producers should desirable to increase domestic liquid milk supply. More advanced development of intensified dairy farms and supports of their activities are essential in order to meet the demands. Furthermore, we have created the map of liquid milk supply in UB.

Keywords: Market analyses; Milk market of UB city; Security level of liquid milk; Statistical- econometrical indicators; Intensified dairy farm.

1. Introduction

Milk and dairy products are one of the traditional foods of the Mongolians and it is the first necessity for physiology needs. Therefore, milk is included in the nutrition strategy list of four foods for population by a new Food Law of Mongolia (Government, 2012). The Mongolian people do not use the milk directly in their food, but they add milk to tea, make yogurt and curd, additionally use the clotted cream in their food; also high contents of oil in the everyday products as melted butter, milk butter, mare's milk, drink made by thinning, acid drink, high contents of colostrum's as cheese, dried curds and dried milk products as habit to accustomed from ancient period in their life (Unur, 2013). In Mongolia with sharply continental climate, where is dominated the pasture animal husbandry it is less time to prepare the milk /about 4 months/. In warm season, it is formed excess milk. In addition, it is delicate product with high risk to blink in transportation. In cold season, it is deficiency in the milk. Because of delayed treatment of excess milk accumulated in warm season, $^{1}/_{3}$ of milk is “lost - pour out”. Depending from this in cold season the need in milk is compensated by imported milk. /There are over 18.0 million liters of milk are imported annually (Lkhagvajav, 2013). Now it is restoring manufacture branch for milk and milk products but it is impossible to supply the needs of population in milk especially for population in settlement areas, therefore it is compensated by the import goods to reserve the foodstuffs. Annually use 87.6kg of milk in urban areas but cattle-breeders 220.8 kg of milk (Jargalan, 2012). From the government in 1999 year it was approved “White Revolution” (Mongolian Government, 2006) national program with a purpose to improve milk and dairy product supply for the population. Level of the small enterprise’s technology, especially products packaging were improved; at the same time it was increased capacity to produce sterilized milk, yogurt, whipping cream, hard and soft cheese, delicious ice-cream and brand products (Unur, 2013). Even though consumers know that most of companies in Ulaanbaatar using milk powder for their packed milk advertising it as fresh liquid milk, they still are consuming these counterfeit products. Probably, consuming of powdered milk that compensating fresh milk is rather cheaper than wasting time and money for investing on establishment of dairy farms (Sukhbaatar, 2012).

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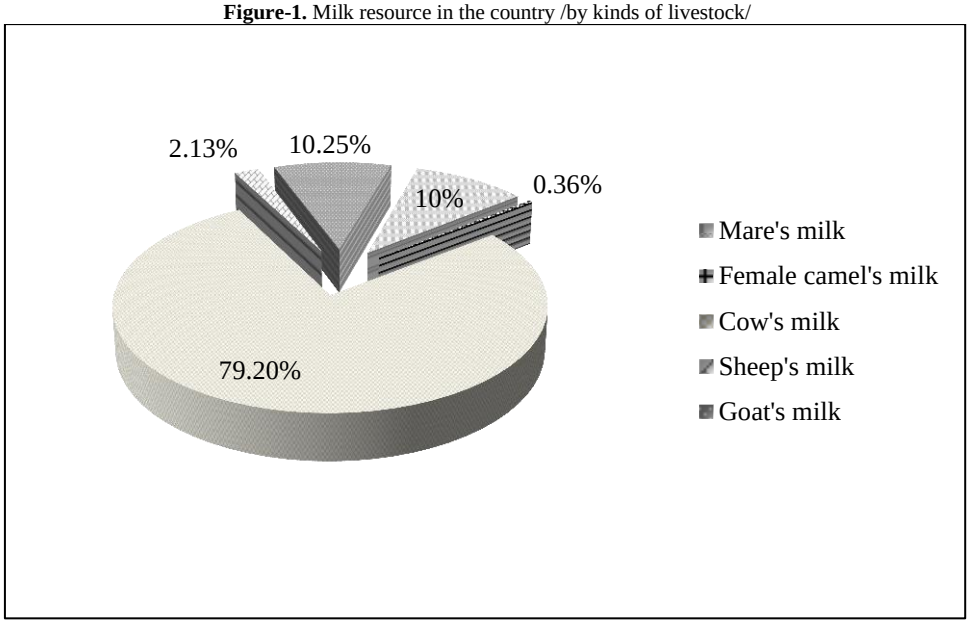
Mongolia in 2014 year has totally 51.1 million livestock, from what there are 2.9 million of horse, 3.4 million of cattle, 0.3 million of camel, 23.2 million of sheep, 22 million of goat (NSO, 2014). There are 42.8% of total livestock are dams. These are about 530.0 million liter of milk resource where 79.2 percent is cow milk (Figure 1).

Figure-1. Milk resource in the country /by kinds of livestock/



The Mongolians from ancient period engage in animal husbandry prepare different kinds of dairy products by milk of 5 kinds of livestock using in their everyday products. Accordingly to the historical stage of development of Mongolia, social-economic policy and changes made in its result development of the agricultural products, including milk and dairy products went through 3 stages of development and it is developing in harmony with the market economic policy (Damdinsuren, 2008). To mention it briefly:

First stage (1921-1940 years)

Mongolian People's Revolutionary Party in 1923 year special attention to supply milk for population in settlement areas that was prepared from the cattle-breeders in great numbers in warm season to be sold through trade in winter and spring seasons.

Second stage (1941-1960 years)

Processing the milk by industrial method was started later than other food branches. In 1941 year by assistance of the Soviet Socialist Republic it was founded the first two milk factories for processing butter with 300 divisions under the Ministry of animal husbandry.

However, the first milk factory was put into operation in 1958 year in Ulaanbaatar city /UB city/ as a result what of it was the first new stage of development for milk processing plant of Mongolia.

Third stage (1961-1990 years)

In period of 1979-1989 were built and put into operation the food manufactures with high capacity of workshops to process 5 tons of milk for a shift mainly in the aimags' center and cities. The first plant to produce the dried milk was put into operation in UB city in 1977 year with a capacity to receive 20 tons of milk dairy and a new technology of drying.

Branch failure

In period of jumping to the market condition other agricultural branches same as the milk branch were declined, dairy mechanized farms were no able to compensate their expense for their independence operation in the market conditions; some decomposed into small entities or producers, some were even closed as a result what of the milk processing plants and workshops in the central and settlement areas caught in a stagnant position due to lack of raw materials.

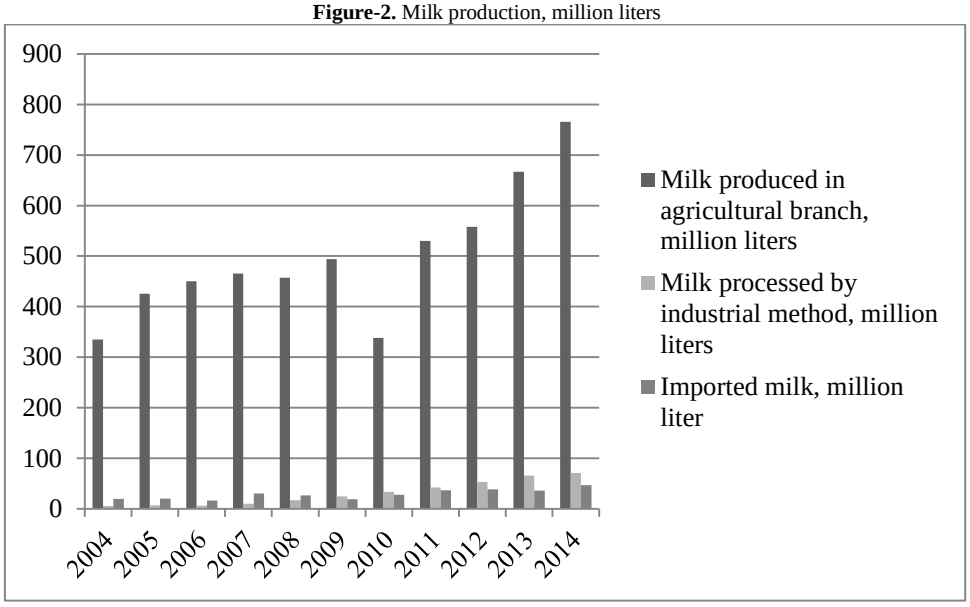
Branch revival

From the government in 1999 year it was approved "White Revolution" (Government, 2006) national program with a purpose to improve milk and dairy product supply for the population. Level of the small enterprise's technology, especially products packaging were improved; at the same time it was increased capacity to produce sterilized milk, yogurt, whipping cream, hard and soft cheese, delicious ice-cream and brand products. (Unursaikhan, 2012)

The government program "Supporting intensified animal husbandry" (Mongolia, 2003) national programs "Milk" (Mongolia, 2006) and "Food Guarantee" (Government, 2009) were directed to make investment for citizens and entities that produce milk and milk products, also to provide real financial assistance. (MFA, 2010)

Figure 2 shows the milk production since implementation program for "Supporting intensified animal husbandry" (Damdinsuren, 2008).

Figure-2. Milk production, million liters

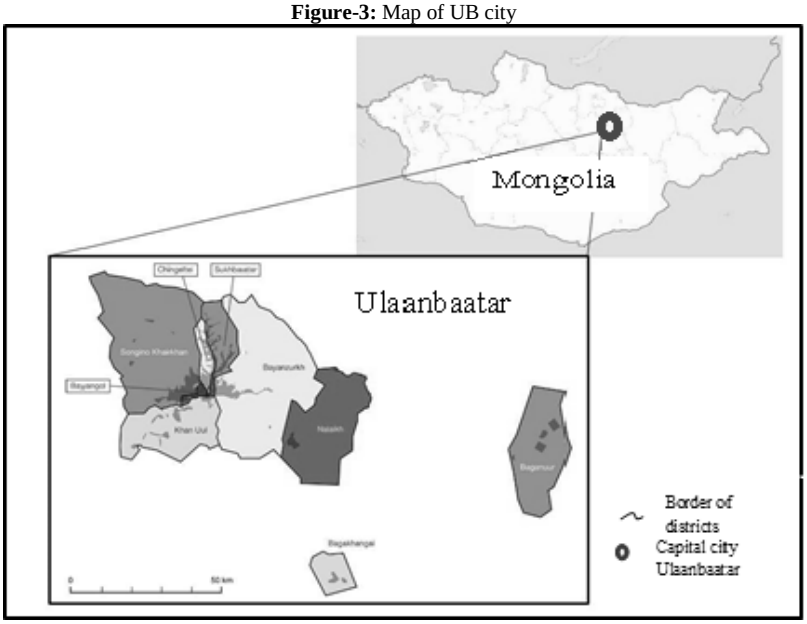


2. Description

2.1. Study Area

UB is the capital city of Mongolia and only city of million population in the country on the one hand, and an area called Ulaanbaatar the capital (briefly the capital), which has 4,704.4 square km area and 9 districts, 3 of which are separate cities according to new organizational divisions in 1992. As of 2014, there were 1.3 million populations in the capital (wikipedia.org., 2010). UB city is situated in eastern central body of Mongolia, surrounded with soums of Tuv aimag (Figure 3).

Figure-3: Map of UB city



3. Methodology

Relying on the data from Statistical Year book (NSO, 2014) of Mongolia (2004-2014) necessary materials were collected and the study was performed in 2 stages.

3.1. Annual consumption and supply of milk for populations of UB city

It estimated by using Methodology to calculate statistical indicators of food security and safety (NSO, 2008).

3.2. Market Equilibrium of Liquid Milk Market of UB City

At second stage, milk market equilibrium of liquid milk of UB city were determined on the basis of demand and supply theory (Orosoo and Bakey, 2012)

4. Results and Discussion

4.1. Table 1 shows milk supply of UB city population could not be completely, provided use imported milk (Anne and Manfred, 1997)

Table-1. Liquid milk supply rate of equivalent population in UB city

year	annual milk demand of equivalent population of year, t	consumption of liquid milk, t	supply rate	
			domestic manufac-turing	import
2004	61.0	6	9.8	90.2
2005	63.4	8	12.6	87.4
2006	65.3	5.1	7.8	92.2
2007	67.7	10.1	14.9	85.1
2008	68.7	16.9	24.6	75.4
2009	71.3	20.6	28.9	71.1
2010	74.9	26.7	35.6	64.4
2011	77.8	33.3	42.8	57.2
2012	78.8	37	46.9	53.1
2013	81.2	36.9	45.5	54.5
2014	84.11	37.2	44.2	55.8
total	**794.4**	**237.8**		

4.2. Use MS-Excel (Bolormaa, 2013) equilibrium of liquid milk market was calculated relying on total consumption of liquid milk (mil L), supply (mil L), consumers' price (MNT per liter), annual household income (thousand MNT) of UB city and producers' price (MNT per liter).

4.2.1 Liquid milk demand (1) and supply function (3) s (Based data analysis reports (table 2, table 3)) are:

$Q_D = 50.9879 - 0.0236 \cdot P_D + 0.0325 \cdot R; \quad r^2 = 0.95; \quad (1)$

From demand function (1), increase of consumers' price one liter milk by 1 MNT resulted in decrease of consumption by 0.0236 million liter, increase annual family income by 1000 MNT leads to increase of milk consumption by 0.0325 million liter. Fisher value F=78.12 expresses confidence probability of the equation is 0.95.

If R of the equation (1) is replaced with household income of 2014: $R_{2014} = 1519.8$ demand function is

$Q_D = 100.4437 - 0.0236 \cdot P_D; \quad (2)$

Table-2. Data analysis report

Regression Statistics				
Multiple R	0.9753416			
R Square	0.9512912			
Adjusted R Square	0.939114			
Standard Error	2.0887962			
Observations	11			
ANOVA				
	Df	***SS***	***MS***	***F***
Regression	2	681.6918448	340.84592	78.120674
Residual	8	34.90455519	4.3630694	
Total	10	716.5964		
	Coefficients	*Standard Error*	*t Stat*	
Intercept	50.987928	1.993247585	25.580329	
P_D	-0.0236204	0.025957966	-0.909948	
R	0.032549	0.02205866	1.9184313	

Table-3. Data analysis report

Regression Statistics				
Multiple R	0.9501861			
R Square	0.9028536			
Adjusted R Square	0.8920595			
Standard Error	4.3210219			
Observations	11			
ANOVA				
	Df	***SS***	***MS***	***F***
Regression	1	1561.729615	1561.7296	83.643636
Residual	9	168.0410754	18.671231	
Total	10	1729.770691		
	Coefficients	*Standard Error*	*t Stat*	
Intercept	-17.505185	4.472074378	-3.9143322	
Ps	0.0544823	0.00595716	9.1456895	

$Q_S = -17.5052 + 0.0549 \cdot P_S;\ \ r^2 = 0.90;$ . . . . . (3)

From supply function, increase of producers' price one liter milk by 1 MNT resulted in increase of production by 0.055 million liter. Fisher value F=83.64 expresses confidence probability of the equation is 0.95.

Equilibrium state (figure 4):

$100.4437 - 0.0236 \cdot P_D = -17.5052 + 0.0549 \cdot P_S;$ . . . . . (4)

Equilibrium price: $0.0785 \cdot P^* = 117.9489$; $P^* = 1502.534$ MNT per liter

Equilibrium quantity is $Q^* = 100.4437 - 0.0236 \cdot P^* = 64.9533$ million liters

Figure-4. Equilibrium liquid milk market of UB city

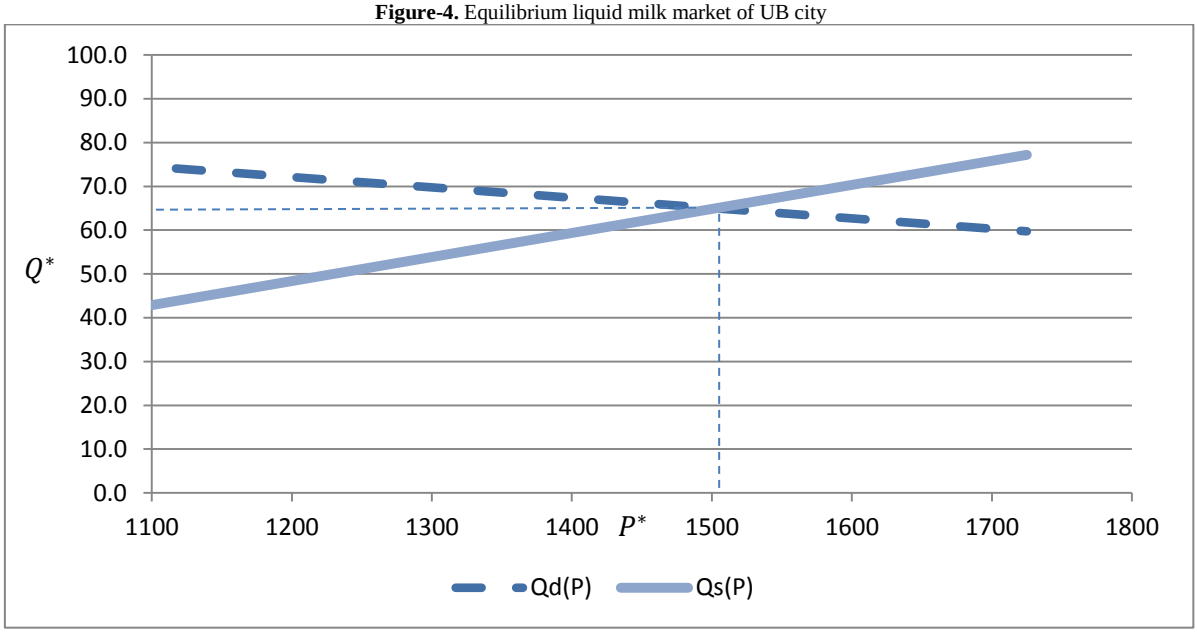


Table-4. Statistical and econometrical significance levels

parameters	Demand function	Supply function
$F_{actual} > F_{theoritical}$	78.12>5.12	83.64>5.32
$t_b > t_{0.95}$	-0.2024<2.2622	-3.97<2.2622
$t_a > t_{0.95}$	0.8977<2.306	9.69>2.2622
correlation coefficient	R=0.99	R=0.94
R square	R^2=0.98	R^2=0.88

Liquid milk demand and supply functions were confident (table 4), use them calculated forecast of interval error (Nyambat, 2014)

4.2.1.1. For demand function $Q_D = 100.4437 - 0.0236 \cdot P_D$:

a. Milk consumers' price is similar to 2014 and if it was $P_{Dk} = P_{D2014} = 1375$ MNT per liter; $m_{\bar{Q}_{D2014}} = S_{\bar{Q}_{D2014}} \cdot \sqrt{1 + \frac{1}{n} + \frac{(P_{2014} - \bar{P}_D)^2}{\sum (P_D - \bar{P}_D)^2}} = 2.3372;$ . . . . . (5)

Forecast error, million liters:

$\varepsilon = t_{0.95} \cdot m_{\tilde{Q}_{D2014}} = 2.3372 \cdot 2.2010 = 5.1442$; . . . . . (6)

$\tilde{Q}_D - \varepsilon = 67.9657 - 5.1442 \leq Q_D^* \leq \tilde{Q}_D + \varepsilon = 67.9657 + 5.1442$ . . . (7)

When consumer's price is similar to 2014, liquid milk demand is between the below interval: $62.8214 \leq Q_D^* \leq 73.1099$ million liters.

b. Considering it is greater by 25% than 2014 or $P_{D2014} = 1718.75$ MNT per liter, if the error is estimated, it is clear that:

$m_{\tilde{Q}_{D2014}} = S_{\tilde{Q}_{D2013}} \cdot \sqrt{1 + \frac{1}{n} + \frac{(P_{2014} - \bar{P}_D)^2}{\sum (P_D - \bar{P}_D)^2}} = 2.6666$ . . . . . (8)

Forecast error, million liters:

$\varepsilon = t_{0.95} \cdot m_{\tilde{Q}_{D2014}} = 2.2010 \cdot 2.6666 = 5.8692$ . . . (9)

$\tilde{Q}_D - \varepsilon = 59.8416 - 5.8692 \leq Q_D^* \leq \tilde{Q}_D + \varepsilon = 59.8416 + 5.8692$ . . . (10)

When consumers' price is greater by 25% than 2014 or $P_{D2014} = 1718.75$ MNT per liter, liquid milk demand is between the below interval: $53.9769 \leq Q_D^* \leq 65.7154$ million liters.

4.2.1. For supply function $Q_S = -17.5052 + 0.0549 \cdot P_S$:

a. Milk producers' price is similar to 2014 and if it was $P_{Sk} = P_{S2014} = 1013$ MNT per liter; $m_{\tilde{Q}_{S2014}} = S_{\tilde{Q}_{S2014}} \cdot \sqrt{1 + \frac{1}{n} + \frac{(P_{2014} - \bar{P}_S)^2}{\sum (P_S - \bar{P}_S)^2}} = 6.0287$; . . . . . (11)

Forecast error, million liters:

$\varepsilon = t_{0.95} \cdot m_{\tilde{Q}_{S2014}} = 6.0287 \cdot 2.2010 = 13.263;$ . . . . . (12)

$\tilde{Q}_S - \varepsilon = 37.6854 - 13.2692 \leq Q_S^* \leq \tilde{Q}_S + \varepsilon = 37.6854 + 13.2692$ . . . (13)

When consumers' price is similar to 2014, liquid milk supply is between the below interval: $24.4223 \leq Q_S^* \leq 50.9485$ million liters.

b. Considering it is greater by 25% than 2014 or $P_{Sk} = P_{S2014} = 1266.25$ MNT per liter, if the error is estimated, it is clear that:

$m_{\tilde{Q}_{S2014}} = S_{\tilde{Q}_{S2014}} \cdot \sqrt{1 + \frac{1}{n} + \frac{(P_{2014} - \bar{P}_S)^2}{\sum (P_S - \bar{P}_S)^2}} = 5.2572;$ . . . . . (14)

Forecast error, million liters:

$\varepsilon = t_{0.95} \cdot m_{\tilde{Q}_{S2014}} = 5.2572 \cdot 2.2010 = 11.5711$; . . . . . (15)

$\tilde{Q}_S - \varepsilon = 51.4831 - 11.5711 \leq Q_S^* \leq \tilde{Q}_S + \varepsilon = 51.4831 + 11.5711$ . . . (16)

When producers' price is greater by 25% than 2014 or $P_{Sk} = 1266.52$ MNT per liter, liquid milk supply is between the below interval: $39.912 \leq Q_S^* \leq 63.0542$ million liters.

There is an illustration that liquid milk is delivered in two ways to final consumers of UB city (Damdinsuren, 2008). Both ways depend on their origins. Milk originated from dairy farms around UB city reaches to final consumers via dairy processing plants (more than 15 to 20% of milk produced in agriculture sector). However, milk produced by herders with pasture livestock living both closer to and far from the urban areas reaches to final consumers via intermediate traders. Such milk does not meet the hygienic, sanitary, storage and protection requirements, and also expensive. Because milk sold via this way does not fit the storage and shipping, supply of liquid milk (fresh milk produced in agriculture sector) is relatively lower.

Based on the current situation of liquid milk supply and price ceilings (Damdinsuren, 2013) we are suggesting the following scheme to determine the supply of liquid milk in UB city, as shown in figure 5.

Figure-5. Scheme of supply liquid milk in UB city

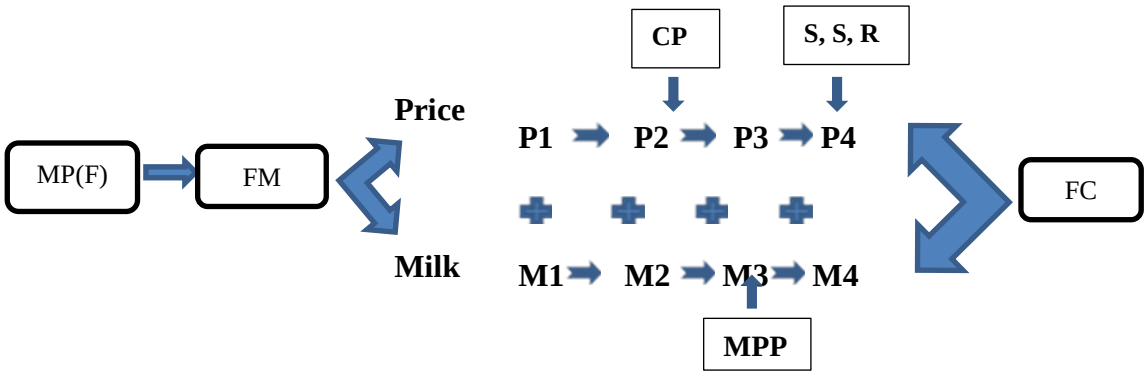


Illustration:

MP (F) – Milk producers (farmers)

FM- Fresh milk

CP- Cooling Point 

MPP- Milk processing plant 

S, S, R- Supermarkets, stores, retailers 

FC- Final consumer 

a. Price1 (P1): Price including the production by herders
   Milk 1 (M1): Fresh whole milk
b. Price 2 (P2): First cow + transport cost
   Milk 2 (M2): Chilled in refrigerator at required temperature and certified
c. Price 3 (P3): Price + production cost + profit
   Milk 3 (M3): processed and packaged by industrial way, wholesome, certified
d. Price 4 (P4): Price + 300
   Milk 4 (M4): processed and packaged by industrial way, wholesome, certified milk, shipped with proper transport means
e. Consumer: It is possible to consume daily cheaper, fresh milk produced domestically

5. Conclusion

According to the study results, main finding was comparatively bigger (supply (production) <consumption or 794.4 t <237.8 t) deficit of liquid milk market UB warn weak position of food security level. Therefore, support of domestic liquid milk producers should be desirable to improve market condition as well as national food security issue.

Determined function of liquid milk demand and supply function (2), (3) s for UB city demonstrate demand elasticity is higher, while supply elasticity is weak. From above it is clear imported powder milk is diluted and then it is sold in large amounts. Consumption of liquid milk is similar to that in 2014, probability of equation of consumers' price to purchase milk (7) and consumption is greater by 25% than those in 2014, probability of equation of consumers' price 1 liter liquid milk (10) and supply is similar to that in 2014, while probability of equation of producers' price of 1 liter milk (13) and supply is greater by 25% than those in 2014, probability of equation of producers' price 1 liter liquid milk (16) is 0.95.

Calculated function and parameter report (Table 4) shows demand and supply function regression coefficient (-0.2042<2.2622), (-3.97<2.2622) and a coefficient of supply function 0.8977<2.2622) are not confident, while supply function regression coefficient (9.6940>2.2622) is confident. Functions correlation coefficients closer to +1 indicates correlation density is good, while determination coefficient (R^2) closer to +1 reveals proper selection of linear function.

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