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Supply and Demand of Nutrients

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1. Introduction

The objective of food security, as defined by the Food and Agriculture Organization of the United Nations, is to assure that all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. This has to be achieved at three levels simultaneously: individual, household, and national/regional levels. According to this internationally agreed definition, food security has three main dimensions: availability, stability, and access. It implies that there is the need not only to have adequate supplies of food available, but also to maximize their stability and to secure their access.

Consequently, the major concern of both the Syrian government and the Syrian population are geared towards maintaining a balanced healthful life and diets. However, the consumption of a number of nutrients remains a public health issue because of either excessive intake levels or intake levels below recommendations. Therefore, a considerable gap sill exists between public health recommendations and consumer's actual nutrient intakes in spite of the fact that the Syrian government induces a lot of efforts to provide consumers with information to help them to make healthful choices. On the supply side, there are both a strict control on the quality of food from nutritious point of view and an enhancement of food supply. Given the supply and demand structure for food and the bundle of nutrient attributes of each product, it is possible to derive the implied relationship between the overall availability of nutrients and economic factors such as food prices, income, productivity and weather conditions. To trace such relationships, additional research is needed to improve our understanding how diet affects health and how producers' and consumers' behaviors affect food choices.

2. Objectives of the research

The objective of this study is to broaden the theoretical and methodological base of the research needed to link the determinant of food supply and availability with consequences for nutrient levels through:

- Briefly describing the policies affecting nutrient supply and availability.
- Tracing the evolution of economic factors impacting nutrient supply and availability disaggregated by selected food groups.
- Illustrating the conceptual framework.
- Assessing the supply and demand elacticities of nutrients.

3. Policies affecting nutrient supply and intakes

Food security has been constantly a major and fundamental objective of Syrian agricultural strategy. Up to the mid 80s, agricultural strategies and policies were strictly oriented towards assuring self-sufficiency in important and strategic food commodities. This goal has been attained, but accompanied with large – scale explotation of natural resources (Table 1).

Table.1. Self-sufficiency and import dependency ratios for selected products, 1996-2004 (%)

Item	Self-sufficiency ratio (%)			Import dependency ratio (%)		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Wheat	111.1	99.4	141.2	1.2	0.0	5.1
Barley	86.0	26.5	150.7	29.4	0.0	73.5
Lentil	273.9	121.0	972.5	0.3	0.0	1.5
Chickpeas	127.0	90.9	218.7	4.7	0.0	15.1
Tomato	130.6	125.5	136.1	0.5	0.0	1.5
Potato	103.6	96.1	124.6	2.4	0.0	7.0
Olives	100.0	100.0	100.1	0.0	0.0	0.0
Citrus	103.0	101.1	105.5	0.7	0.0	2.2
Red meat	120.7	93.6	207.0	3.7	0.4	10.8
Poultry meat	100.0	100.0	100.1	0.0	0.0	0.0
Fish	83.8	55.6	100.0	16.2	0.0	44.8
Milk	100.1	100.0	100.8	0.1	0.0	0.6
Eggs	101.8	100.3	103.5	0.0	0.0	0.0
Sugar	45.3	9.5	100.0	54.7	0.0	90.5

Source: Elaborated from NAPC database.

The price policies for inputs and outputs as well as other government intervention measures, particularly in marketing, introduced however serious price distortions which led to inefficiencies in resource use and proved ineffective in ensuring high levels of overall self-sufficiency. They represented also a heavy burden on government budget.

The policy reform program, introduced thereafter, aimed at removing or reducing these distortions, thus ensuring increasing efficiency in domestic resources use. Initially input subsidies were reduced, producer prices were augmented and planning intervention started being less rigid. Subsequently, toward the 90s, trade liberalization started. Crop diversification policies were also promoted and increased attention was given to the comparative advantages of Syrian agriculture. The concept of self-reliance has been gradually substituting the concept of self-sufficiency, implying a more active participation of the country in international trade. Agricultural trade expanded and played a more important role than in the past in achieving food security. Policies aiming at making exports more competitive in international markets were implemented with success. At present, agricultural trade is considered an essential element in ensuring national food security.

The Syrian government, in light of the general policy orientation to adopt the social market economy, has executed a series of economic and institutional reforms to enhance the integration with the world economy, to ease the implementation of the assigned agreements and to prepare for joining the WTO. I

The above mentioned policies affect the supply[1] and demand[2] of food products, which in turn impact the supply response and demand for nutrients.

[1] Grad Samir. *Supply analysis of selected food groups*. Working paper AW-05-07, 2007.
[2] Grad Samir. *demand analysis of selected food groups*. Working paper AW-06-07, 2007.

4. Trends in nutrient supply and nutrient intakes

It is useful to compare between the evolution of the nutrients' supply and availability over time and to describe their time series in light of the basic nutrient requirements in order to assess if there is a surplus, a deficit or a balanced situation of these nutrients. The basic nutrients are calories, protein, fat and carbohydrate.

4.1. Calorie supply and availability

Table 2 illustrates the descriptive statistics of calorie supply, availability and requirements as well as their fluctuations around the trend line from 1982 to 2005. The variations around the trend are small to moderate indicating stability in calorie supply and availability. The absolute values of calorie supply and availability underwent acceptable changes and positive annual growth during the considered period. Considering the per capita values of the aforementioned measures, however, points out to a slight decrease with the exception of the per capita net availability of calories, which witnessed a slight increase, and the per capita calorie requirement, which is constant.

Table 2. Descriptive statistics of calories, 1982-2005 (billion kcal and 000 kcal/year)

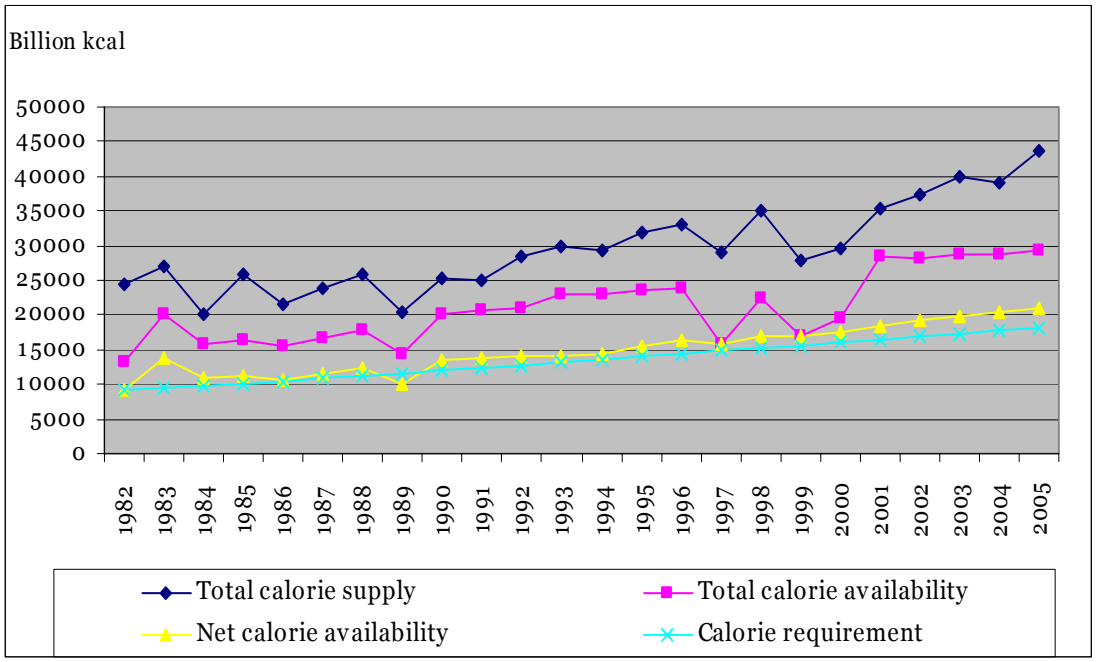
Item	Unit	Mean	Min	Max	Change %	AGR %	CV %
Total domestic supply of calories (TSC)	Billion kcal	29,526	20,161	43,594	86	3	11
Total availability of calories	Billion kcal	20,944	13,222	29,179	89	3	14
Net availability of calories (NAC)	Billion kcal	14,888	9,256	21,088	110	3	10
Calorie requirement	Billion kcal	13,485	9,207	18,090	102	3	10
Per capita TSC	000 kcal/year	2,172	1,729	2,796	-11	-1	11
Per capita TAC	000 kcal/year	1,538	1,051	2,068	-8	0	14
Per capita NAC	000 kcal/year	1,087	846	1,427	2	0	9
Per capita calorie requirement	000 kcal/year	986	986	986	0	0	0
Per capita NAC (person /day)	kcal/day	2,978	2,318	3,910	2	0	9
Per capita calorie requirement(person/day)	kcal/day	2,701	2,701	2,701	0	0	0

Source: Elaborated from MAAR and NAPC database as well as from CBS, ASA, Various issues.
Change and AGR are calculated for the period 1982-2005 considering the trend line.

Figure 1 traces the evolution of calorie supply, availability and requirements from 1982-2005. The figure indicates that the recommended level of calories is maintained and the domestic supply of calories is well above the requirements. The net availability of calories represents the calorie intake after deducting wastage & loses, non-human consumption and the changes in stocks for cereals.

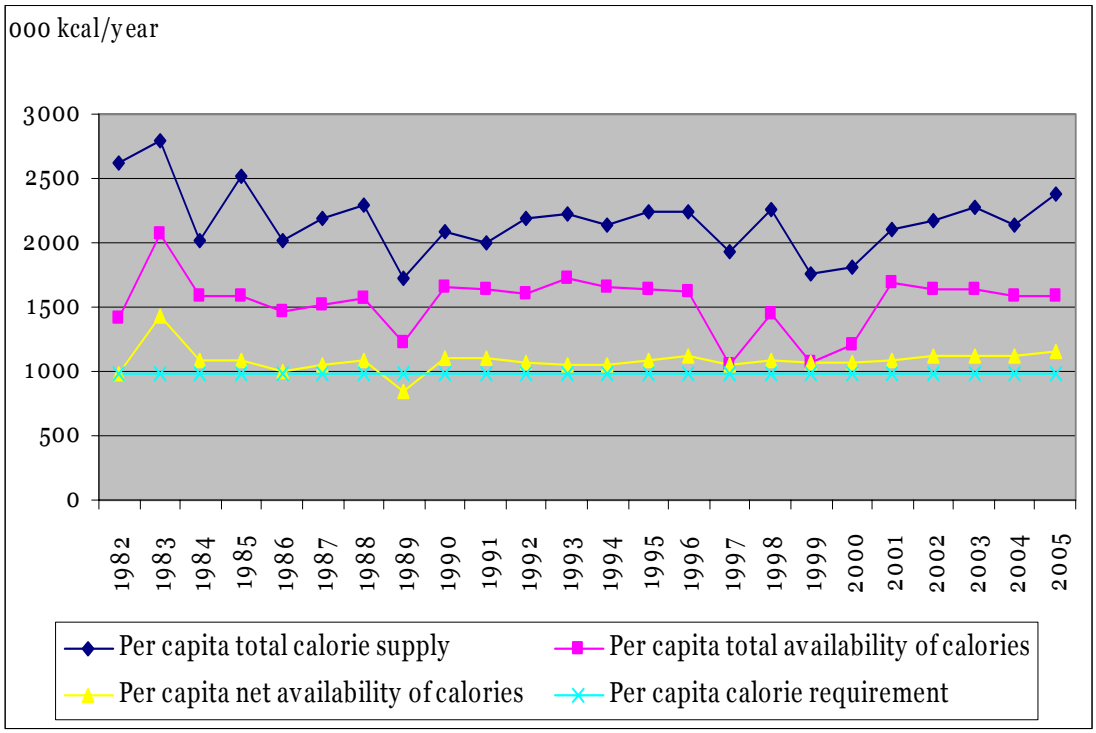
Figure 2 illustrates the evolution of the aforementioned measures at per capita basis indicating also that the recommended requirements are met.

Figure 1. Evolution of calorie supply, availability and requirements, 1982-2005 (billion kcal)



Source: Elaborated from MAAR database.

Figure 2. Evolution of the per capita calorie supply, availability and requirements, 1982-2005 (000 kcal/year)



Source: Elaborated from MAAR database.

4.2. Protein supply and availability

Table 3 illustrates the descriptive statistics of protein supply, availability and requirements as well as the fluctuations around the trend line from 1982 to 2005. The variations around the trend are small to moderate indicating stability in protein supply and availability. The absolute values of protein supply and availability underwent acceptable changes and positive annual growth during the considered period.

Table 3. Descriptive statistics of protein, 1982-2005 (000 tons and kg/year)

Item	Unit	Mean	Min	Max	Change %	AGR %	CV %
Total supply of protein (TSP)	000 tons	713	366	1,025	136	3.8	13.8
Total availability of protein (TAP)	000 tons	741	519	1,267	124	3.6	19.1
Net availability of protein (NAP)	000 tons	444	358	581	33	1.3	10.4
Protein requirement	000 tons	375	256	502	102	3.1	1.1
Per capita TSP	kg/year	52	35	60	15	0.6	13.3
Per capita TAP	kg/year	54	43	69	-0.4	-0.02	16.9
Per capita NAP	kg/year	33	27	48	-37	-2	12
Per capita protein requirement	kg/year	27.4	27.4	27.4	0	0	0
Per capita NAP (person/day)	g/day	90	74	132	-37	-2	12
Per capita protein requirement (person /day)	g/day	75	75	75	0	0	0

Source: Elaborated from MAAR and NAPC database as well as from CBS, ASA, Various issues.
Change and AGR are calculated for the period 1982-2005 considering the trend line.

Considering the per capita values of the aforementioned measures, however, points out to a slight increase in protein supply and slight decline in protein availability, but the supply and availability of protein at per capita basis are still well above the recommended level of protein.

Figure 3 traces the evolution of protein supply, availability and requirements from 1982-2005. The figure indicates that the recommended level of protein is maintained and the domestic supply of protein is well above the protein requirements. The net availability of protein represents the protein intake after deducting wastage & loses, non-human consumption and the changes in stocks for cereals.

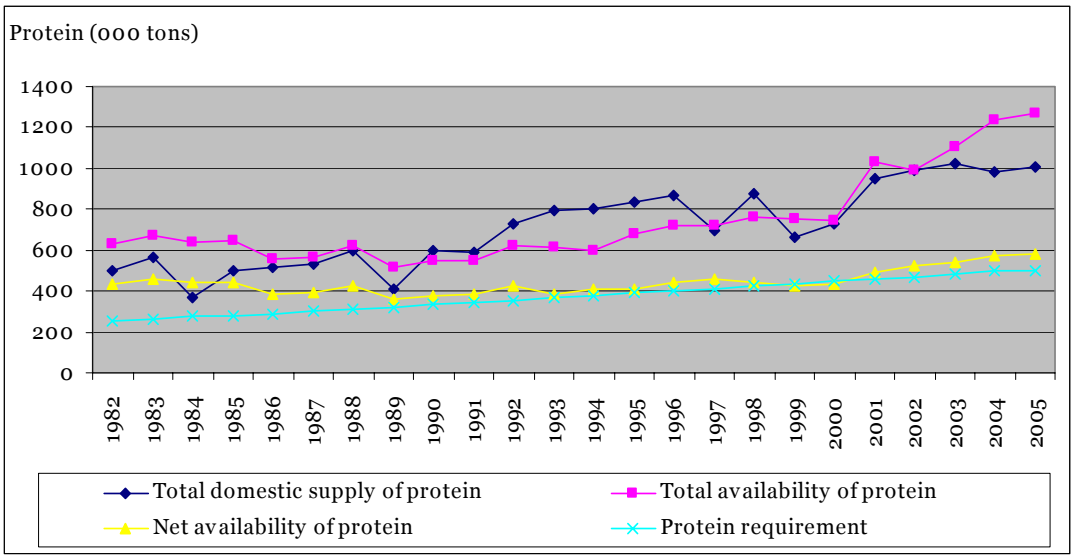
Figure 4 illustrates the evolution of the aforementioned measures at per capita basis indicating also that the recommended requirements are met.

4.3. Fat supply and availability

Table 4 illustrates the descriptive statistics of fat supply, availability and requirements as well as fluctuations around the trend line from 1982 to 2005. The variations around the trend are small to moderate indicating stability in fat supply and availability. The absolute values of fat supply and availability underwent acceptable changes and positive annual growth during the considered period. Considering the per capita values of the aforementioned measures, however, points out to a slight decrease in the per capita total supply of fat. All other per capita indicators are increasing. They indicate that the recommended per capita requirement of fat is met.

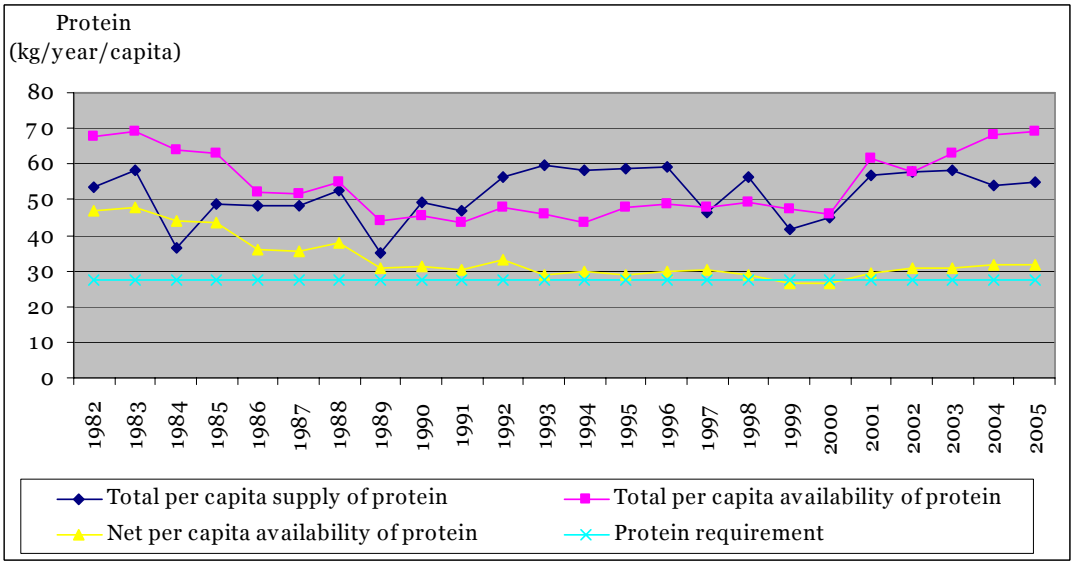
Figure 5 traces the evolution of fat supply, availability and requirements from 982-2005. The figure indicates that the recommended level of fat is maintained and the domestic supply of fat is well above the requirements. The net availability of fat represents the fat intake after deducting wastage & loses, non-human consumption and the changes in stocks for cereals.

Figure 3. Evolution of protein supply, availability and requirements, 1982-2005 (000 tons)



Source: Elaborated from MAAR database.

Figure 4. Evolution of the per capita protein supply, availability and requirements, 1982-2005 (kg/year)



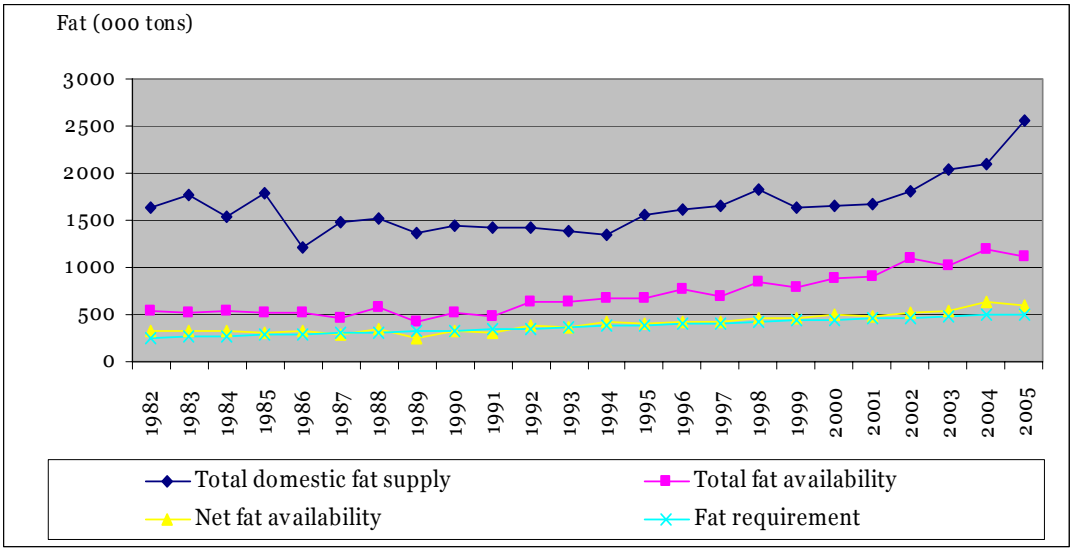
Source: Elaborated from MAAR database.

Table 4. Descriptive statistics of fat, 1982-2005 (000 tons and kg/year)

Item	Unit	Mean	Min	Max	Change %	AGR %	CV %
Total supply of fat (TSF)	000 tons	1,642	1,216	2,561	40	1.5	14.2
Total availability of fat (TAF)	000 tons	708	414	1,194	180	4.6	16.5
Net availability of fat (NAF)	000 tons	407	257	638	113	3.3	11.9
Fat requirement	000 tons	375	256	502	102	3.1	1.1
Per capita TSF	Kg/year	123	97	182	-35	-1.8	15.6
Per capita TAF	Kg/year	51	35	66	25.6	1	12.9
Per capita NAF	Kg/year	30	22	35	0.4	0.02	10.5
Per capita fat requirement	Kg/year	27.4	27.4	27.4	0	0	0
Per capita NAF (person/day)	g/day	82	60	96	0.4	0.02	10.5
Per capita fat requirement (person/day)	g/day	75	75	75	0	0	0

Source: Elaborated from MAAR and NAPC database as well as from CBS, ASA, Various issues.
Change and AGR are calculated for the period 1982-2005 considering the trend line.

Figure 5. Evolution of fat supply, availability and requirements, 1982-2005 (000 tons)



Source: Elaborated from MAAR database.

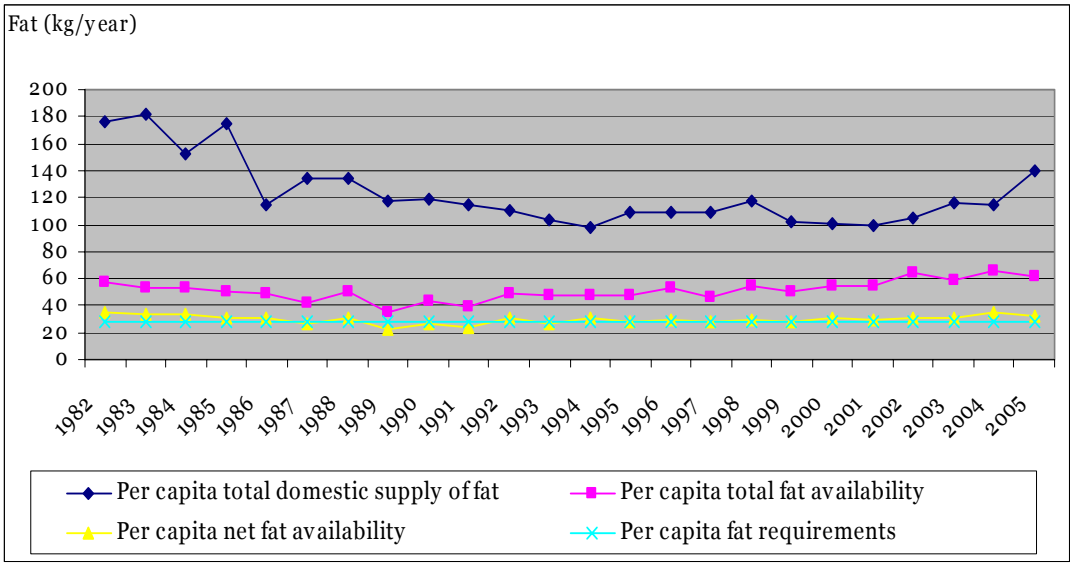
Figure 6 illustrates the evolution of the aforementioned measures at per capita basis indicating also that the recommended requirements are met.

4.4. Carbohydrate supply and availability

Table 5 illustrates the descriptive statistics of carbohydrate supply, availability and requirements as well as the fluctuations around the trend line from 1982 to 2005. The variations around the trend are small to moderate indicating stability in carbohydrate supply and availability. The absolute values of carbohydrate supply and availability underwent acceptable

changes and positive annual growth during the considered period. Considering the per capita values of the aforementioned measures, however, points out to a slight decrease in the per capita total availability of carbohydrate. All other per capita indicators are increasing. They indicate that the recommended per capita requirement of carbohydrate is met.

Figure 6. Evolution of the per capita fat supply, availability and requirements, 1982-2005 (kg/year)



Source: Elaborated from MAAR database.

Table 5. Descriptive statistics of carbohydrate, 1982-2005 (000 tons and kg/year)

Item	Unit	Mean	Min	Max	Change %	AGR %	CV %
Total domestic supply of carbohydrate (TSCH)	000 tons	2,714	1,177	3,950	150	4.1	16.3
Total availability of carbohydrate (TACH)	000 tons	3,169	1,947	4,374	71	2.4	17.7
Net availability of carbohydrate (NACH)	000 tons	2,358	1,135	3,347	128	3.6	13
Carbohydrate requirement	000 tons	1,798	1,228	2,412	102	3.1	1.1
Per capita TSCH	Kg/year	196	117	236	22	0.9	16.2
Per capita TACH	Kg/year	234	144	342	-15.6	-0.74	17.7
Per capita NACH	Kg/year	171	122	234	11.5	0.47	12.5
Per capita carbohydrate requirement	Kg/year	131	131	131	0	0	0
Per capita NACH(person/day)	g/day	468	334	641	11.5	0.47	12.5
Per capita carbohydrate requirement (person/day)	g/day	359	359	359	0	0	0

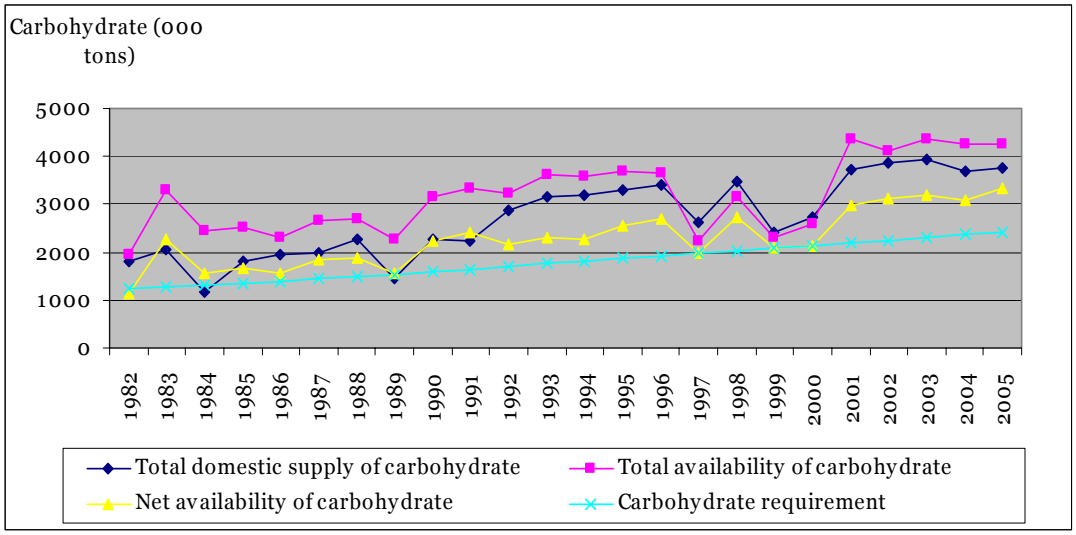
Source: Elaborated from MAAR and NAPC database as well as from CBS, ASA, Various issues.
Change and AGR are calculated for the period 1982-2005 considering the trend line.

Figure 7 traces the evolution of carbohydrate supply, availability and requirements from 1982-2005. The figure indicates that the recommended level of carbohydrate is maintained and the domestic supply of carbohydrate is well above the requirements. The net availability of

carbohydrate represents the carbohydrate intake after deducting wastage & loses, non-human consumption and the changes in stocks for cereals.

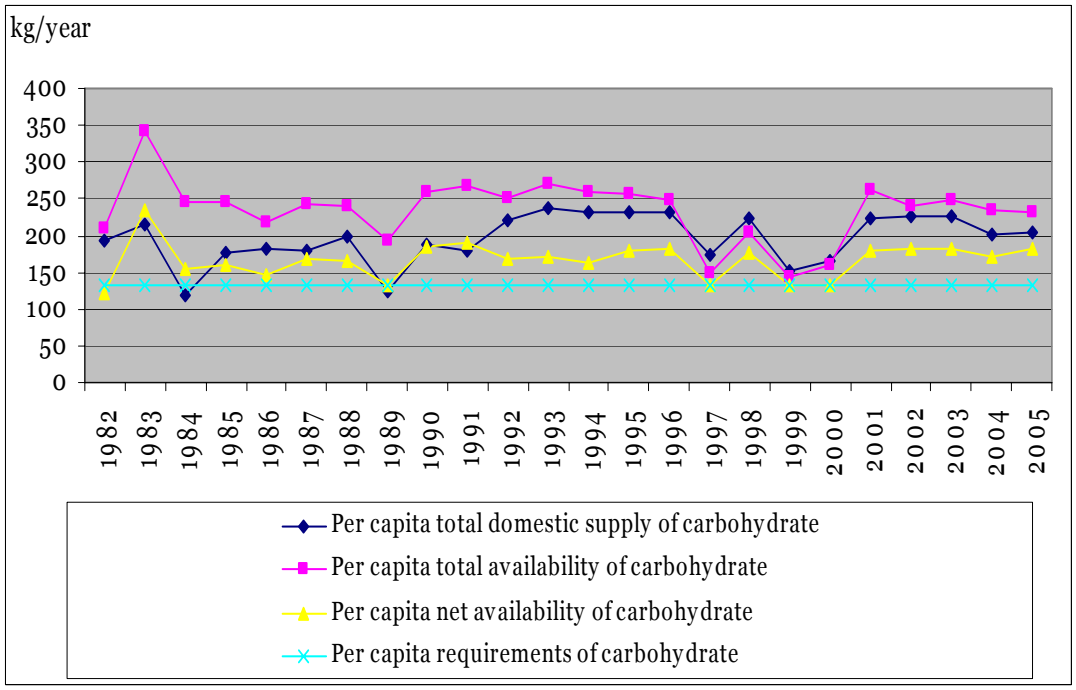
Figure 8 illustrates the evolution of the aforementioned measures at per capita basis indicating also that the recommended requirements are met.

Figure 7. Evolution of carbohydrate supply, availability and requirements, 1982-2005 (000 tons)



Source: Elaborated from MAAR database.

Figure 8. Evolution of the per capita carbohydrate supply, availability and requirements, 1982-2005 (kg/year)



Source: Elaborated from MAAR database.

5. Methodological notes

The same methodological guidelines mentioned in supply and demand analysis applies here to the assessment of supply and demand for nutrients with the difference that the dependent variables are the various nutrients (see foot notes 1 and 2).

Perali (2003) and Sadoulet and de Janvry (1995) defined the calorie elasticities with respect to the price of food and income. As a result, there are substitutions between quantity of calories and quantity of food as income increases, leading to a shift to higher nutrient cost foods and the income elasticity of calorie intake is smaller than the income elasticity of food expenditure. Makoul and Arbash (2002) investigated the additional income needed to improve the quality of food. Huang (1999) conducted a research how food prices and consumer income affect food choices and the availability of nutrients in the context of a complete food demand system. The model is developed to estimate how the availability of 28 nutrients would change as consumers alter their food purchases in response to changes in food prices and income. It is useful to apply such models on the Syrian consumers to improve the nutritional quality of consumer diets.

The calorie or nutrient elasticities with respect to prices are calculated from the following equations:

$E_{ci} = (d_c/c)/(dp_i/p_i) = \sum_j a_{ci}\, q_i\, E_{ji} / \sum_j a_{cj}\, q_j$

$\pi_{cj} = \sum_j E_{ij}\, a_{ci}\, q_i/Ø_c$

$Ø_c = \sum_j a_{ci}\, q_i$

Where:

E_{ci} – Calorie elasticity with respect to price; d_c – Change in calorie intake; c- Calorie intake, dp_i – Change in price; p_i – Price; a_{ci} – Calorie content of each food i; q_i – Quantity demanded of each food i; E_{ji} – Own and cross price elasticities; π_{ci} – Calorie elasticity with respect to price; $Ø_c$ – Calorie availability.

The calorie elasticities with respect to income are calculated from the following equations:

$\eta_{cy} = (d_c/c)/(d_y/y) = \sum_j a_{cj}\, q_j\, \eta_j / \sum_j a_{cj}\, q_j$

$\rho_c = \sum_i \eta_i\, a_{ci}\, q_i/Ø_k$

Where:

ηcy – Calorie elasticity with respect to income; ηi – Income elasticity; ρ_c – Calorie elasticity with respect to income; $s = ac_i\, q_i/Ø_c$ – Share of each food's contribution to calorie intake; d_y – Change in income; y – Income.

Consequently, the change in calorie availability ($d_{Øc}/Ø_c$) is calculated as follows:

$d_{Øc}/Ø_c = \sum_j \pi_{cj}\, (dp_j/p_j) + \rho_c\, (d_y/y)$

For estimating the supply of nutrients the following equation was used in the research at hand:

$Qs_i = a_i + b_i\, Qs_{i-1} + \sum c_{ij}\, LP_j + d_i\, t,$

where:

Qs_i – Quantity supplied of nutrient i, where i denotes calories, protein, fat or carbohydrate,
Q_{i-1} – Quantity produced previous year of nutrient i,
LP_j – Deflated lagged price of food group j (relied on stone price index of the various food groups),
t- time trend, a_i, b_i, c_{ij} and d_i – Parameters to be estimated.

Demand estimation, on the other hand, relied on the following equation:

$Q_{di} = a_i + \sum b_{ij} P_j + c_i y + d_i t$,

where:

Q_{di} – Quantity demanded of nutrient i, P_j – Deflated retail price of food group j,
y – Total deflated expenditure per capita,

6. Empirical results

The supply and demand assessment is performed for calories and protein only.

6.1. Calorie estimates

Table 6 illustrates the supply and demand estimates for calorie intake using SUR comprising the regression coefficients, testing results and elasticities. The supply equation explains 77% of the variations in calorie supply. All regression coefficients are statistically insignificant at the 5% of significance with the exception of the intercept, the coefficient of the lagged price of vegetable oils & fats and the coefficient of time trend. The joint test of all regression coefficients indicates that they are statistically significant at the 5% level of significance. The elasticities point out to an inverse relationship between the calorie supply and both the lagged price of cereals & legumes and the lagged price of vegetable oils & fats and to a positive relationship between the calorie supply and the other factors this is due to the linkages between product supply and calorie supply where the product supply has been affected by price factors and non-price factors such as production plan, technology (vertical expansion) which in turns has an impact on calorie supply. Moreover, the results indicate that calorie supply are produced from the high value of nutrient products such as vegetables, fruits, meat & eggs and dairy products. The elasticities indicate also a rigid supply response both in the short-run and the long-run.

Table 6. Estimates of supply and demand for calorie intakes, 1982-2005

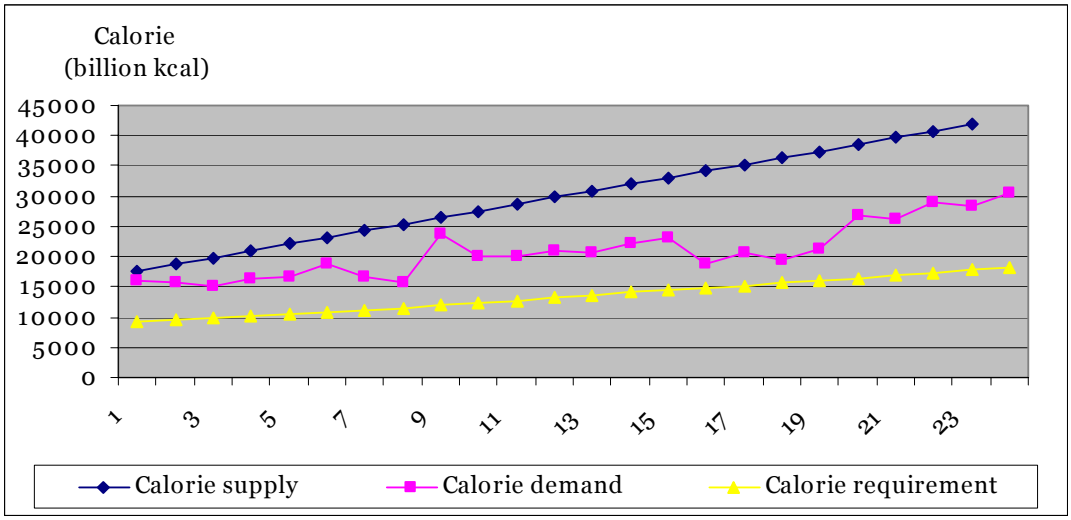
Item	Coefficient	Standard error	P-value	Elasticity	Long-run elasticity
Supply				**Short-run**	
Intercept	18,323	3010.44	0.0000		
Lagged CI	0.11	0.11	0.3413	0.11	0.12
LP_CL	-745.32	1416.05	-0.6069	-0.22	-0.25
LP_Veg	353.85	286.50	0.2371	0.17	0.19
LP_Fruits	232.28	181.72	0.2220	0.19	0.22
LP_ME	63.44	52.02	0.2427	0.23	0.26
LP_Milk	57.88	862.29	0.9474	0.02	0.02
LP_Oils	-254.23	92.72	0.01589	-0.56	-0.63
Time	1099.01	295.95	0.0023	0.44	0.50
Demand					
Intercept	4341.80	2340.85	0.0834		
P_CL	-1567.61	842.48	0.0825	-0.67	
P_Veg	-217.44	226.78	0.3528	-0.15	
P-Fruits	-149.14	116.06	0.2183	-0.19	
P_ME	58.94	38.88	0.1503	0.31	
P_Milk	807.71	715.26	0.2765	0.43	
P-Oils	-68.40	75.58	0.3798	-0.22	
y	4.64	1.13	0.0009	0.92	
Time	601.38	234.84	0.0217	0.36	

Source: Elaborated by the author.
CI: Calorie intake. LP_CL: Lagged price of cereals & legumes. LP_Veg: Lagged price of vegetables. LP_Fruits: Lagged price of fruits. LP_ME: Lagged price of meats & eggs. LP_Milk: Lagged price of milk. LP_Oils: Lagged price of vegetable oils & fats. P_CL: Price of cereals & legumes. P_Veg: Price of vegetables. P_Fruits: Price of fruits. P_ME: Price of meats & eggs. P_Milk: Price of milk. P_Oils: Price of vegetable oils & fats. y: Total per capita food expenditure.

The demand equation explains 90% of the variations in calorie demand. The intercept and the regression coefficient of the price of cereals & legumes are statistically significant at the 10% level of significance. The regression coefficients of the per capita total expenditure and time trend are statistically significant at the 5% level of significance. All other regression coefficients are statistically insignificant. The joint test of all regression coefficients indicates that they are statistically significant at the 5% level of significance. The elasticities indicate an inverse relationship between the demand for calorie intake and the prices of cereals & legumes, vegetables, fruits and vegetable oils & fats as well as a positive relationship between the demand for calories and the other variables comprising the prices of meats & eggs, milk, due to non price determents such as consumer preferences and per capita total food expenditure and time trend. Consumer will switch to consume products that have high value of nutrients. The elasticities imply also a rigid demand for calorie intake.

Figure 9 illustrates the calorie supply and demand curves compared with requirements over time from 1982-2005 indicating that supply and availability of calories are well above the requirement.

Figure 9. Supply and demand curve of calorie with respect to time, 1982-2005 (billion kcal)



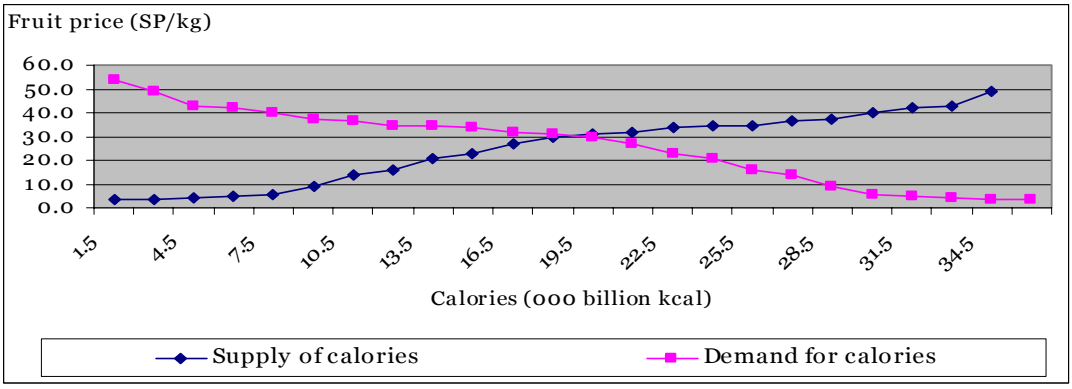
Source: Elaborated by the author.

Figure 10 traces the evolution of both the inverse supply and demand curves with respect to fruit price indicating an upward sloping supply curve and a downward sloping demand curve.

Figure 11 depicts the supply and demand curve of calories compared with the requirements implying that the supply and demand intersection is well above the requirement, which impacts positively the food security situation.

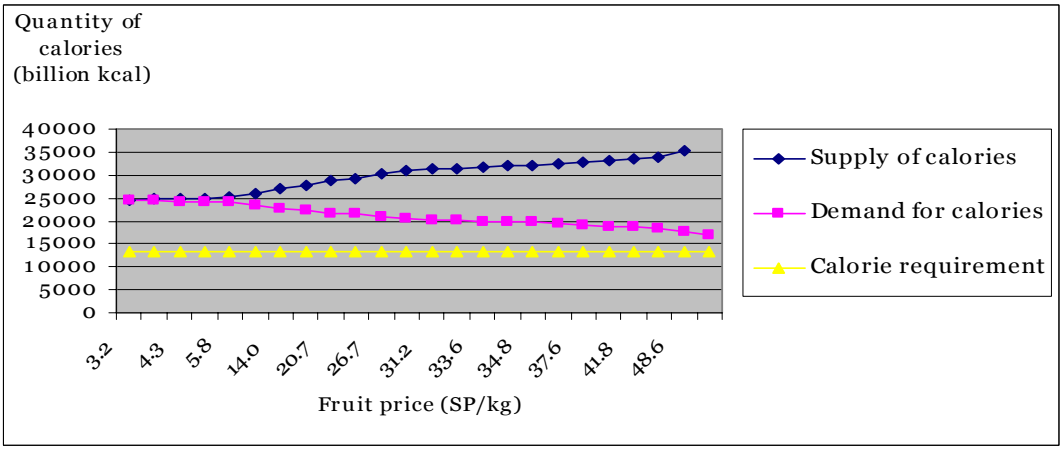
Figure 12 traces the relationship between the quantity demanded of calories and the per capita total food expenditure indicating an upward sloping demand curve, which means as the per capita expenditure increases the calorie consumption increases. The income elasticity of demand for calories amounts to 0.92.

Figure 10. Inverse supply and demand curve of calories with respect to price of fruits, 1982-2005 (billion kcal)



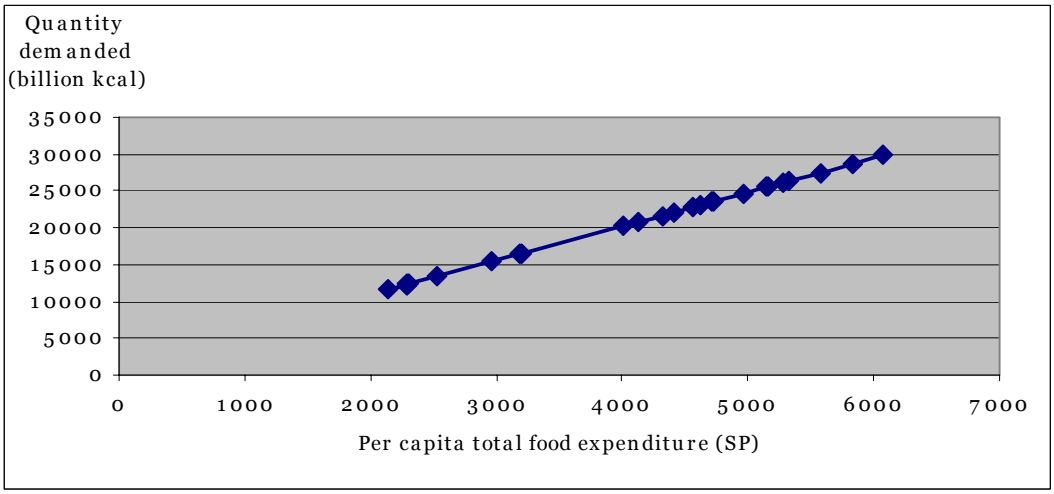
Source: Elaborated by the author.

Figure 11. Supply and demand curve of calories with respect to price, 1982-2005 (billion kcal)



Source: Elaborated by the author.

Figure 12. Demand curve for calories with respect to expenditure, 1982-2005 (billion kcal)



Source: Elaborated by the author.

6.2. Protein estimates

Table 7 illustrates the supply and demand estimates for total protein intake using SUR comprising the regression coefficients, testing results and elasticities. The supply equation explains 81% of the variations in protein supply. The intercept, the regression coefficient of the lagged price of vegetable oils & fats and the coefficient of time trend are statistically significant at the 5% level of significance. The regression coefficient of the lagged price of fruit is statistically significant at the 10% level of significance. All other regression coefficients are statistically insignificant. The elasticities point out to an inverse relationship between the protein supply and both the lagged price of cereals & legumes and the lagged price of vegetable oils & fats as well as to a positive relationship between the protein supply and the other variables due to the mentioned former reasons. The elasticities indicate also a rigid supply response both in the short-run and the long-run.

Table 7. Estimates of supply and demand for protein intakes, 1982-2005

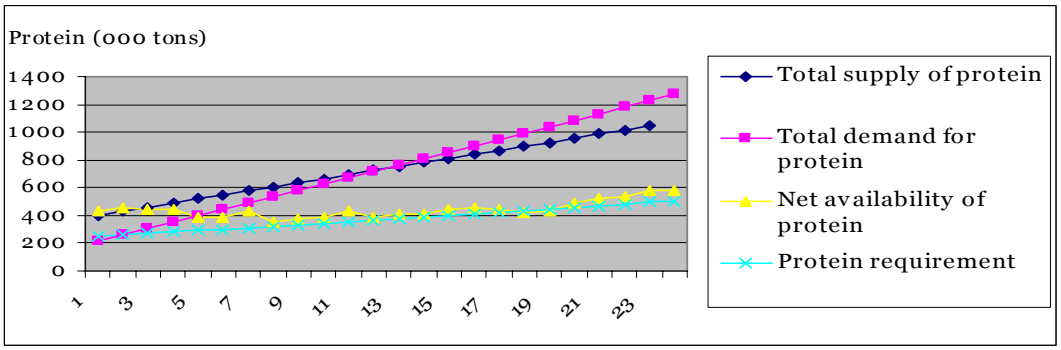
Item	Coefficient	Standard error	P-value	Elasticity	Long-run elasticity
Supply				**Short-run**	
Intercept	305.57	64.48	0.0003		
Lagged PI	0.14	0.11	0.2465	0.13	0.16
LP_CL	-54.67	40.22	0.1956	-0.67	0.77-
LP_Veg	11.23	8.05	0.1850	0.22	0.25
LP_Fruits	9.92	5.08	0.0714	0.34	0.40
LP_ME	2.00	1.48	0.1974	0.29	0.34
LP_Milk	38.43	24.32	0.1363	0.58	0.67
LP_Oils	-8.98	2.61	0.0040	-0.81	0.94-
Time	29.12	8.49	0.0041	0.48	0.56
Demand					
Intercept	374.25	67.70	0.0001		
P_CL	-23.23	24.37	0.3556	-0.28	
P_Veg	-2.83	6.56	0.6724	-0.05	
P-Fruits	-0.99	3.36	0.7715	-0.04	
P_ME	2.94	1.12	0.0196	0.43	
P_Milk	-51.99	20.69	0.0239	-0.78	
P-Oils	-1.90	2.19	0.3994	-0.17	
y	0.11	0.03	0.0047	0.61	
Time	46.07	6.79	0.0000	0.78	

Source: Elaborated by the author.
PI: Protein intake.

The demand equation explains 89% of the variations in protein demand. The intercept and the regression coefficients of the price of meats & eggs, the price of milk, the per capita total food expenditure and the time trend are statistically significant at the 5% level of significance. The other regression coefficients are statistically insignificant. The joint test of all regression coefficients indicates that they are statistically significant at the 5% level of significance. The elasticities indicate an inverse relationship between the demand for protein intake and the prices as well as a positive relationship between the demand for protein intake and both the per capita total food expenditure and the time trend. The elasticities imply also a rigid demand for protein intake.

Figure 13 illustrates the protein supply and demand curves compared with requirements over time from 1982-2005 indicating that supply and availability of protein are well above the requirement.

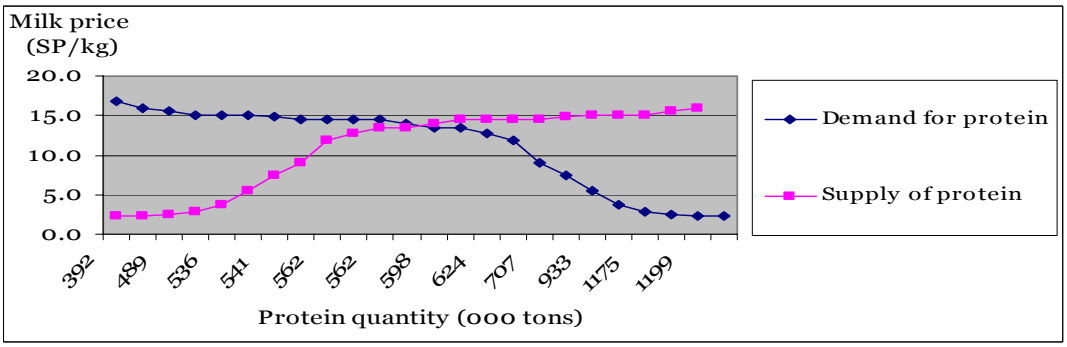
Figure 13. Supply and demand curve of protein with respect to time, 1982-2005 (000 tons)



Source: Elaborated by the author.

Figure 14 traces the evolution of both the inverse supply and demand curves with respect to fruit price indicating an upward sloping supply curve and a downward sloping demand curve.

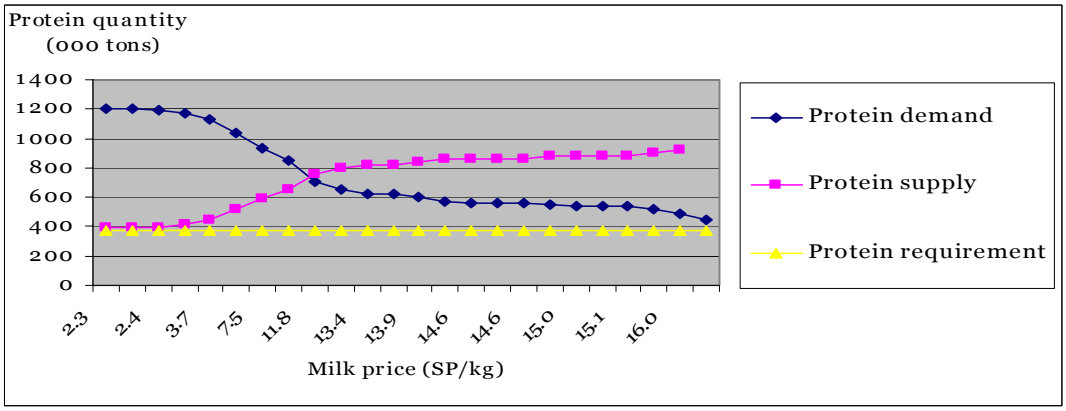
Figure 14. Inverse supply and demand curve of protein with respect to price of milk, 1982-2005 (000 tons)



Source: Elaborated by the author.

Figure 15 depicts the supply and demand curve of protein compared with the requirements implying that the supply and demand intersection is well above the requirement, which impacts positively the food security situation.

Figure 15. Supply and demand curve of protein with respect to price, 1982-2005 (000 tons)

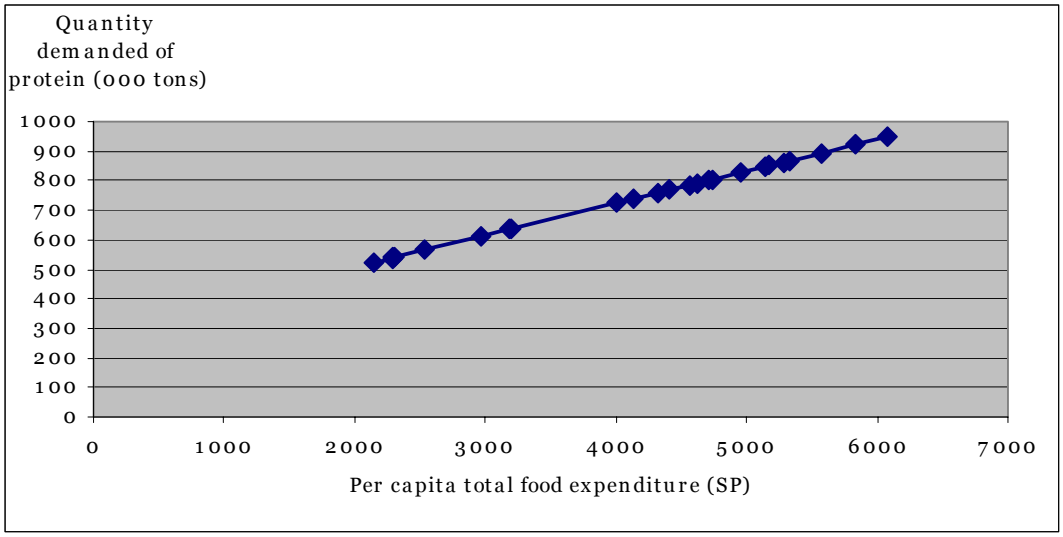


Source: Elaborated by the author.

Figure 16 traces the relationship between quantity demanded of protein and the per capita total food expenditure indicating an upward sloping demand curve, which means as the per capita

expenditure increases the protein consumption increases. The income elasticity of demand for protein amounts to 0.61.

Figure 16. Demand curve for protein with respect to expenditure, 1982-2005 (000 tons)



Source: Elaborated by the author.

7. Concluding remarks

This research paper describes the nutritional situation in light of calorie, protein, fat and carbohydrate intakes. The paper focuses also on establishing a research methodology to conduct more detailed nutrient analysis in future relying on the methodology developed in the papers of supply and demand analysis. The proposed methodology was applied only on two nutrients namely calories and protein. More nutrients will be included in the forthcoming papers such as fat, carbohydrate, vitamins, sodium and calcium. As a result, the price and income elasticities of these two nutrients were assessed to be used in future expectations and policy analysis of food.

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