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Analysis of Supply Response for Selected Food Groups in Syria

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Abstract

The new conditions of international trade and Syrian attempts to join the World Trade Organization (WTO), to strengthen the partnership with the Europian Union (EU), and to interact within the Great Arab Free Trade Area (GAFTA) require giving priorities to food supply estimation in Syria in order to make more efficient production decisions. Therefore, this research focuses on the assessment of food supply in Syria using the econometric approach.

Thus, the major policies and activities affecting food supply in Syria are briefly presented and the trends of the factors impacting food supply are depicted giving special attention to descriptive characteristics. Furthermore, the Nerlovian models of supply response and structural models are explained taking into consideration Syrian data.

Based on above, the supply of various food groups is assessed using Syrian data. Hence, the basic parameter estimates, own-price elasticities and cross-price elasticities in both the short-run and long-run using Ordinary Leat Squares (OLS) and Seemingly Unrelated Regressions (SUR) are estimated for 7 food groups namely: cereals & legumes, vegetables, fruits, red meat, poultry meat, eggs and milk.

Finally, concluding remarks are made to use the results of this research for multiple purposes.

1. Background and objectives

Up to the mid 80s, agricultural strategies and policies were strictly geared towards assuring self-sufficiency in important and strategic food commodities comprising both vegetal and animal products. Large-scale exploitation of natural resources for agricultural production (i.e. land reclamation and expansion of irrigated areas based on infrastructures' creation) and Government intervention in agricultural activities under a central planning system led to the achievement of self-sufficiency in strategic food crops. 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. Therefore, 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.

Complying with the strategic orientation of the government to develop agricultural production and to support food security situation, there have been steady efforts to supply rural services, increase the cultivated areas (irrigated and rain-fed), provide the production requirements in time, encourage agricultural crops especially the strategic ones and livestock. As a result, self-sufficiency has been achieved in a variety of products such as wheat, legumes, cotton, vegetables, fruits, red meat, raw milk and eggs resulting in a low import dependency, with an attempt to enhance self-reliance in the other important commodities (imported ones) according to the principle of economic efficiency, such as sugar, fish, dairy products and the needed feeds for the livestock.

Based on above, the major objectives of this research are:

- Describe the evolution of the major components of agricultural production.
- Trace the trends in both agricultural production and the factors affecting it.
- Assess the elasticities of supply response both in the short-run and long-run for selected food groups comprising cereals & legumes, vegetables, fruits, red meat, poultry meat, eggs and milk.
- Depict the level of supply for the selected food groups.

2. Description of the major components of agricultural production

The diverse climatic conditions in Syria enable the production of a wide variety of agricultural products such as cereals, legumes, vegetables, fruits, and animal products, which enhances both the competitiveness of these products on the one hand and the ability to

modify the components of the crop rotation to meet the demands for both local consumers and foreign markets. Agricultural production (TAP) is performed in irrigated and rain-fed areas that are distributed among 14 governorates and five agro-ecological zones. It comprises vegetal production (VP) and animal production (AP). Table 1 traces the evolution of agricultural production, its composition and its share in total gross output (TGO) from 1980 to 2005. Over the studied period, the table shows that there are substantial improvements in TGO, TAP, VP, AP and the share of AP in TAP and the VP constitutes the major share of TAP.

Table 1. Evolution of the value of agricultural production, its composition and its relative weight at current prices, 1980-2005 (billion SP and %)

Item	Unit	1980	1985	1990	1995	2000	2005
Total gross output	Billion SP	83	139	465	976	1557	2568
Agricultural production	Billion SP	14	24	123	242	341	452
Vegetal production	Billion SP	9	15	73	149	215	288
Animal production	Billion SP	3	7	44	73	122	164
Others of TAP	Billion SP	2	2	6	20	4	0
Share of TAP in TGO	%	16.9	17.3	26.5	24.8	21.9	17.6
Share of VP in TGO	%	10.8	10.8	15.7	15.3	13.8	11.2
Share of AP in TGO	%	3.6	5.0	9.5	7.5	7.8	6.4
Share of VP in TAP	%	64.3	62.5	59.3	61.6	63.0	63.7
Share of AP in TAP	%	21.4	29.2	35.8	30.2	35.8	36.3

Source: Elaborated from Central Bureau of Statistics (CBS). *The Annual Statistical Abstract (ASA)*. Various issues.

Crop production (vegetal production)

Crop production comprises cereals, legumes, grazing crops, industrial crops, vegetables, fruits and others. Table 2 illustrates the evolution of the value of crop production and its composition during the period 1980-2005. Hence, there is a boost in crop production and its components from 1980 to 2005. The major contribution to the value of crop production comes from cereals and fruits. Decreasing shares in the value of crop production are observed for cereals, legumes and vegetables and increasing ones for the other components during the studied period.

Table 2. Evolution of the value of crop production and its composition at current prices, 1980-2005 (billion SP and %)

Item	Unit	1980	1985	1990	1995	2000	2005
Cereals	Billion SP	3.14	4.18	23.09	60.05	39.12	65.77
Legumes	Billion SP	0.33	0.84	2.43	5.10	3.31	8.08
Vegetables	Billion SP	2.49	4.06	12.99	17.44	18.71	31.05
Fruits	Billion SP	1.97	3.42	19.99	35.14	65.69	75.85
Industrial crops	Billion SP	1.10	2.37	10.03	21.52	37.41	46.14
Others	Billion SP	0.25	0.31	4.84	10.05	51.05	61.25
Total crop production	Billion SP	9.28	15.18	73.36	149.31	215.38	288.14
Cereals	%	33.85	27.56	31.48	40.22	18.20	22.83
Legumes	%	3.54	5.55	3.31	3.42	1.54	2.80
Vegetables	%	26.82	26.75	17.70	11.68	8.69	10.78
Fruits	%	21.24	22.52	27.25	23.54	30.50	26.32
Industrial crops	%	11.88	15.60	13.67	14.41	17.37	16.01
Others	%	2.68	2.02	6.60	6.73	23.70	21.26
Total crop production	%	100.00	100.00	100.00	100.00	100.00	100.00

Source: Elaborated from CBS. *The ASA*. Various issues.

Cereals comprise wheat, barley, maize, sorghum, and rice. But, the focus is on wheat only.

There are two kinds of *legumes*: food legumes and fodder legumes. But, the investigation concentrates only on *food legumes*. This group includes lentil, chick peas, dry broad beans, dry haricot beans, dry peas, and dry kidney beans and represents an important source of

vegetal protein for the Syrian population. Lentil and chickpeas are economically the most important crops because of their nutritional value and export earning potential.

Industrial crops contain cotton, sugar beet, soy beans, oily sun flower, sun flower, indian millet, tobacco, pea nut, sesame, aniseed, cumin, lupines, black cumin, and others. The importance of this group for supply estimation results from both its use for the extraction of vegetable oils and sugar (cotton, soy beans, oily sun flower, sugar beet) and its inclusion of export oriented crops (cumin, black cumin and sesame). But, this paper is concerned only with the extracted oil.

Vegetables consist of green peas, green broad beans, green haricot beans, green kidney, cucumber and snake cucumber, eggplant, pumpkins, lettuce, green onion, leaf beat, cauliflower, cabbages, potatoes, tomatoes, dry onion, green pepper, okra, squash, dry garlic, water melon, and musk melon and others. Marketing of these products occurs under free market condition. Therefore, the increasing trend in trade liberalization has boosted the production of these products. The most important crops related to this group are tomatoes and potatoes.

Fruits incorporate olives, grapes, apples, pistachio, citrus, pomegranate, apricots, cherries, almonds, green plums, plums, pears, peaches, quince, nuts, figs, loquats, and palm. The most important trees are olives, citrus, apples, and grapes. The major part of olives is used for olive oil production. This group is promising because of the increasing trend in trade liberalization.

Animal production

It can be classified into 4 major groups namely: milk and dairy products, meat, eggs and others. Other products include honey, honey wax, silk cocoons, fish, skin, animal hair and wool. Table 3 gives an idea about the evolution of the value of animal production and its composition during 1980 through 2005. The table indicates that there is an enhancement in animal production and its components from 1980 to 2005 and the major shares are related to milk & its products and meat. The share of milk & its products is decreasing over the studied period, whereas the share of meat is increasing.

Table 3. Evolution of the value of animal production and its composition at current prices, 1980-2005 (billion SP and %)

Item	Unit	1980	1985	1990	1995	2000	2005
Milk and its products	Billion SP	1.5	3.1	22.2	30.2	42.4	64.2
Meat	Billion SP	1.1	2.6	16.6	34.2	67.3	82.3
Eggs	Billion SP	0.5	0.8	3.3	5.3	6.4	9.3
Others	Billion SP	0.2	0.5	1.7	3.7	5.6	8.4
Total animal production	Billion SP	3.3	7.0	43.8	73.4	121.7	164.2
Milk	%	45.5	43.7	50.6	41.1	34.9	39.1
Meat	%	34.8	37.8	37.8	46.6	55.3	50.1
Eggs	%	14.4	11.3	7.6	7.2	5.2	5.7
Others	%	5.3	7.2	4.0	5.1	4.6	5.1
Total animal production	%	100.0	100.0	100.0	100.0	100.0	100.0

Source: Elaborated from CBS. *The ASA*. Various issues.

3. Trends in agricultural production and its affecting factors

3.1. Background

Policies to increase food production and domestic supplies comprise measures in the following fields (FAO, Training manual 40):

- Land reform.
- Agricultural research, training and extension.

- Agricultural input supply.
- Mechanization and irrigation.
- Rural infrastructure and institutions.
- Agricultural marketing and pricing policies.
- Agricultural credits.

Based on above, food production can undergo a series of constraints namely:

Land constraints

These constraints can be alleviated through introducing of policies in the fields of irrigation, mechanization, research & extension, land reform, erosion control and natural resource conservation.

Technological constraints

To overcome these constraints the following policy measures are important:

- Intensification of agricultural research.
- Promotion of agricultural extension and training.
- Promotion of agricultural mechanization.
- Improved input supply.
- Irrigation.
- Agricultural credits.

Manpower & management constraints

The policy measures to avoid these constraints are:

- Promotion of mechanization.
- Agricultural research and extension to promote technical change.

Infrastructural & institutional constraints

These constraints can be solved through introducing the following policy measures:

- Improvement of rural infrastructure (e.g. roads, road maintenance, water supply).
- Improvement of rural institutions (e.g. input supply, extension, marketing services, co-operatives).

Marketing constraints

To improve the effectiveness of the agricultural marketing system the following policies are from considerable interest:

- Investments in rural infrastructure.
- Institutional reform.
- Consistent marketing & pricing policies.
- Special subsidies.
- Credits for marketing operations including storage.

Insufficient production incentives

These constraints can be alleviated through putting the following policies in place:

- Reducing production costs, e.g. by:
    - ❖ Improving input price and supply policies.
    - ❖ Promoting applied research.

- ❖ Enhancing technical changes.
- ❖ Improving rural infrastructure.
- ❖ Reforming and simplifying agricultural credits procedures.

- Increasing economic returns, e.g. by:
  - ❖ Promoting marketing activities.
  - ❖ Improving producer price policies.

3.2. *Policies*

The Syrian Agricultural Strategy (2001-2010) and the Ten Five year Plan (2006-2010) propose the following policies:

- Improve the use of agricultural natural resources (land, water, forest and pastures), make benefit of them in the light of their sustainability and protect them from deterioration, overexploitation and pollution.
- Meet the domestic demand for the stable food commodities (wheat, legumes, etc…) and achieve food security by developing the productivity of crops that have comparative advantage and are capable to compete in the local and foreign markets.
- Develop and modernize agriculture by improving the agricultural scientific research, extension, human resource education and introduction of the new techniques via definite timetables due to their importance for optimal solving the most problems of agricultural production.
- Encourage the process of marketing and processing agricultural products to get benefit from the value added and to improve the efficiency of agricultural production.
- Improve the credit and banking systems to contribute to develop agricultural production.
- Offer the agricultural production requirements in good quality, time and suitable prices, and improve their usage and distribution as well.
- Adopt price policies which protect the environment and resource sustainability and increase the production to meet the needs with high quality.
- Adopt structural adjustments which are capable to meet the development objectives.
- Reduce the agricultural production risk especially that related to agricultural production and price fluctuations.

Hence, policies were proposed in the fields of crop and animal productions as follows:

The proposed policies in the field of crop production

- Enhancing the vertical expansion as the major means to increase crop production.
- Reducing the production costs by adopting advanced technologies to improve both productivity and quality.
- Maintaining soil fertility.
- Encouraging the cultivation of the products that enjoy comparative advantage and improving their competitiveness by reducing the production costs and discriminating among the products in the light of the productivity of water.
- Improving the management of agricultural operations and the efficiency of input use to both increase the productivity and reduce the cost per unit of area.
- Adopting the use of cheap energy sources like sun energy to decrease the cost.
- Developing and adopting of high yielding and drought resisting varieties.
- Adapting the crop rotations towards more legumes and fodder crops.
- Improving the productivity per unit of area by adopting of organic fertilizer.

- Diversifying the improved seeds for the single product to improve quality, to reduce cost and to produce the appropriate varieties for processing, export and consumption.
- Adjusting the wheat cultivation towards more hard wheat.
- Studying the possibility of introducing alternative crops in the crop rotation via economic returns and the results of agricultural scientific research.

The proposed policies in the field of animal production

- Balancing the integration between vegetal and animal production.
- Enhancing the agricultural scientific research in the field of introducing and adopting new improved breeds.
- Improving the productivity of livestock (meat, milk, wool and eggs) through the use of improved breeds and adequate fodder management.
- Providing adequate and sufficient services for the livestock.
- Developing the rural industry via the possessing of livestock products and its distribution in high production areas.
- Enhancing the cooperative sector to concentrate the supply and to reduce the cost.

3.3. Climatic conditions

Syria is considered a semi arid country with an annual average rainfall of less than 250 mm. Therefore, the distribution of rainfall in time and space has considerable effects on agricultural activities and output. This is especially the case in Syria, where more than 70% of the cultivated area is rain-fed. Table 4 illustrates the distribution of rainfall by rainfall stations pointing out to a decreasing rate of precipitation from 2000 to 2005.

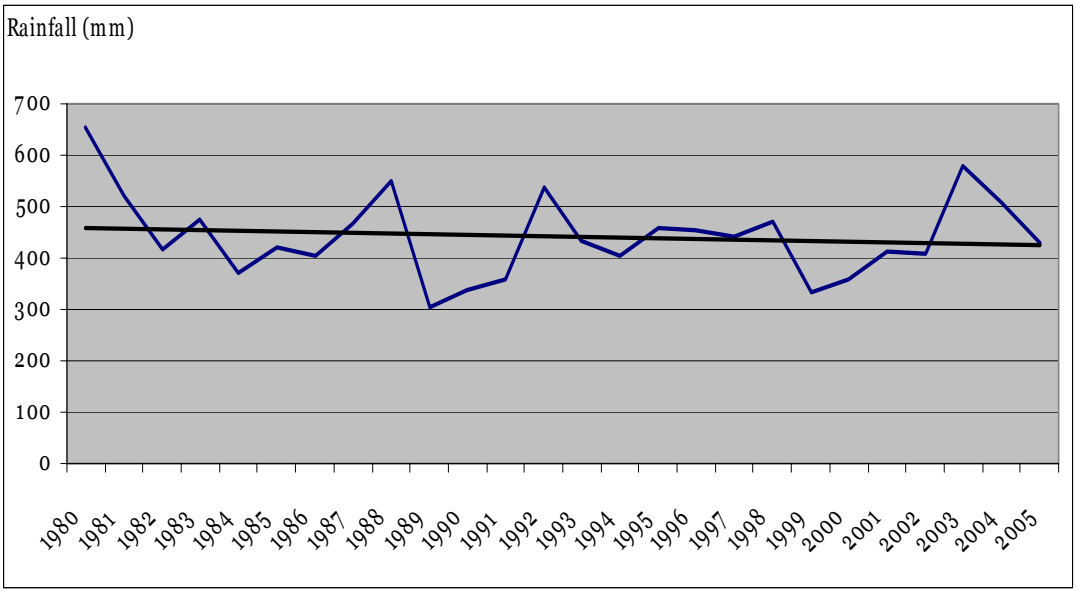
Table 4. Distribution of precipitation by rainfall stations, (2000, 2004, and 2005)

Item	Precipitation rate (mm)			Percentage of average (%)		
	2000	2004	2005	2000	2004	2005
Dar'a	220	187	179	86	72	69
Damascus International	117	125	74	87	92	55
Damascus Mazeh		248	140		125	71
Homs	330	511	424	74	114	95
Palmyra	116	176	83	88	134	63
Hama	327	401	319	96	117	93
Lattakia	534	695	550	67	87	69
Safieta	981	1071	1156	86	89	101
Aleppo	286	346	247	85	103	74
Dair-Ezzor	135	162	117	85	101	73
Kameshly	259	464	199	58	117	44

Source: Elaborated from: The CBS. *The ASA*. Various issues. mm: millimeter.

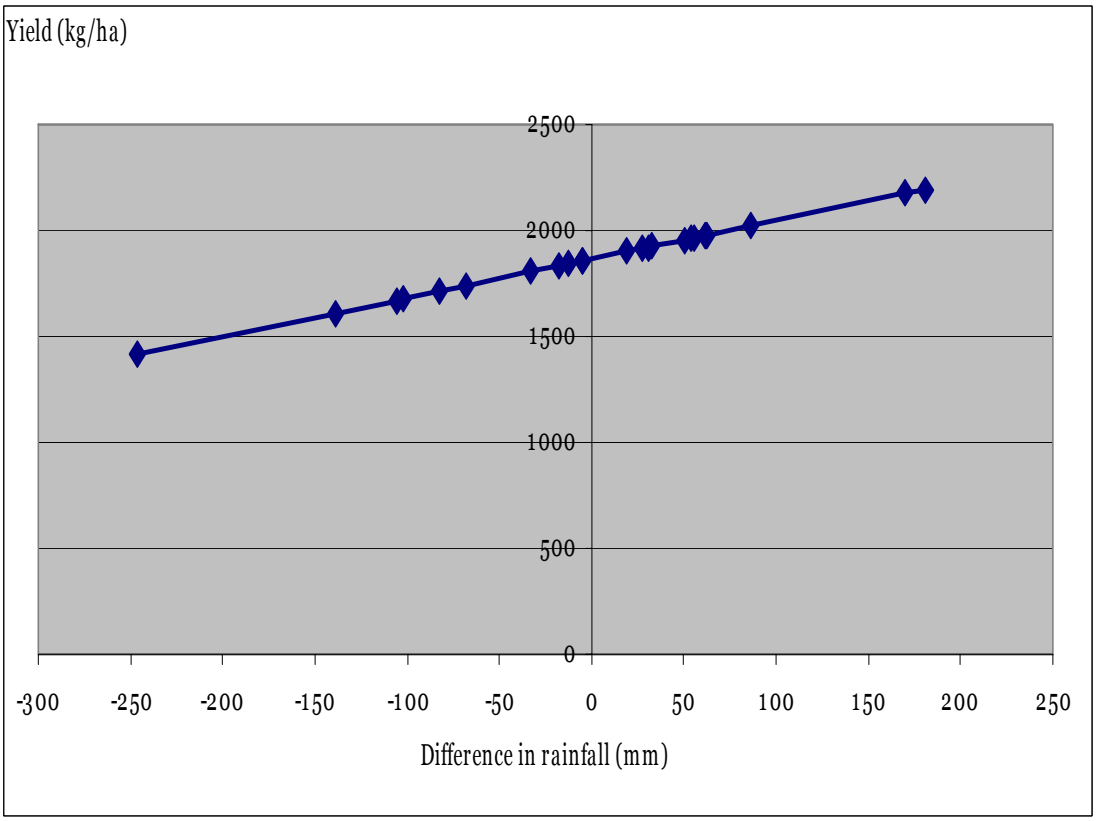
Figure 1 illustrates the evolution of rainfall from 1980 to 2005, which indicates a decreasing trend and considerable fluctuations around the trend line. Figure 2 illustrates the impact of the difference in rainfall on the yield of cereals & legumes holding all other factors affecting yield fixed from 1982 to 2005. The figure shows a positive relationship between the two measures. Figure 3 illustrates also the interrelationship between the difference in rainfall and the yield of vegetables holding all other factors impacting yield constant from 1982-2005 indicating also a positive relationship but more responsiveness than the yield of cereals & legumes.

Figure 1. Evolution of rainfall, 1980-2005 (mm)



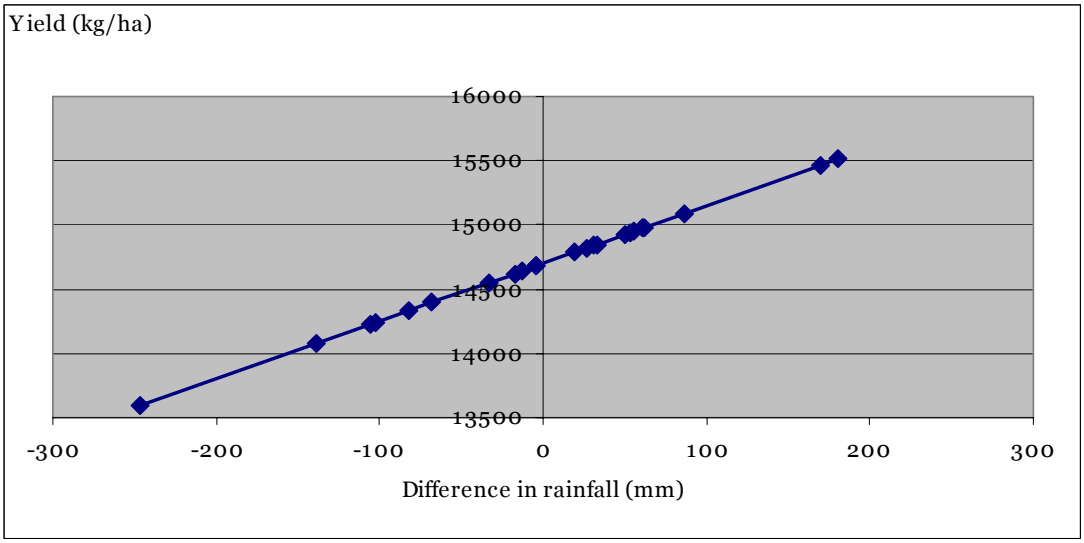
Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 2. Linear yield response of cereals & legumes with respect to the difference in rainfall, 1982-2005 (kg)



Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 3. Linear yield response of vegetables with respect to the difference in rainfall, 1982-2005 (kg)



Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Syria is divided into 5 Stabilization Zones (Box 1), which differ by the precipitation rate and land use.

Box 1. Climatic Zones

First Climatic Zone: Its precipitation rate exceeds 350 mm annually. It is divided into 2 Zones:

- ***Zone A:*** Its Precipitation rate exceeds 600 mm annually. Rain-fed crops are planted safely.
- ***Zone B***: Its precipitation rate varies between 350-600 mm annually. The observed precipitation rate is not less than 300 mm annually for 2/3 of the observed years. Therefore, 2 seasons are assured each three years. The major crops are wheat, legumes and summer crops.

Second Climatic Zone: Its precipitation rate varies between 250-350 mm annually and is not less than 250 mm for 2/3 of the observed years. Therefore, 2 barley seasons are safe each 3 years. The major crops are barley, wheat, legumes and summer crops.

Third Climatic Zone: Its precipitation rate doesn't exceed 250 mm annually and is not less than 250 mm for a half of the observed years. Therefore, 1-2 barley seasons are secured each 3 years. The major crop is barley. Wheat and legumes can be also cultivated.

Fourth Climatic Zone (marginal land): Its precipitation rate varies between 200-250 mm annually and is not less than 200 mm for a half of the observed years. Therefore, it is designated for barley and pastures.

Fifth Climatic Zone (steppe): It includes the rest of the land of the country. Rain-fed crops can not be cultivated.

Source: Elaborated from: CBS. The *ASA 2005;* NAPC. *SOFAS 2005*.

A good part of the country is subject to large differences between night and daytime temperatures. Such differences in summer may reach 23 degrees in the inland and 13 degrees in the coastal region. Temperatures can reach more than 45 degrees in summer and fall short below zero degree in winter.

3.4. Development of the measures of production

The performance of agricultural production relies on the effectiveness of its both sub-sectors namely: vegetal and animal production. The level of crop production is determined by the progress attained by both the area (horizontal expansion) and yield (vertical expansion). Animal production is impacted by both the number and productivity of livestock.

3.4.1. Development of the area

Past policies gave a great attention to the horizontal expansion by increasing the share of cultivable land through a series of projects concerned with land reclamation. However, as the time passes, land resources have been a scarce resource. Therefore, the area expansion has been a very difficult task to perform. The area of the Syrian Arab Republic amounts to 18518 thousand hectares (ha) of which 33% is cultivable (6032 thousand ha). 75% of cultivable land is actually invested (4545 thousand ha). The actual cultivated area is divided into 21% irrigated (940 thousand ha) and 79% rain-fed (3605 thousand ha).

Table 5 illustrates the descriptive statistics of the cultivable land during 1980-2005. During the studied period, the table shows a decreasing trend for the cultivable land and increasing ones for the actual cultivated, irrigated and rain-fed areas. The fluctuations around the trend line are small. Such progress points out to a good performance of the horizontal expansion.

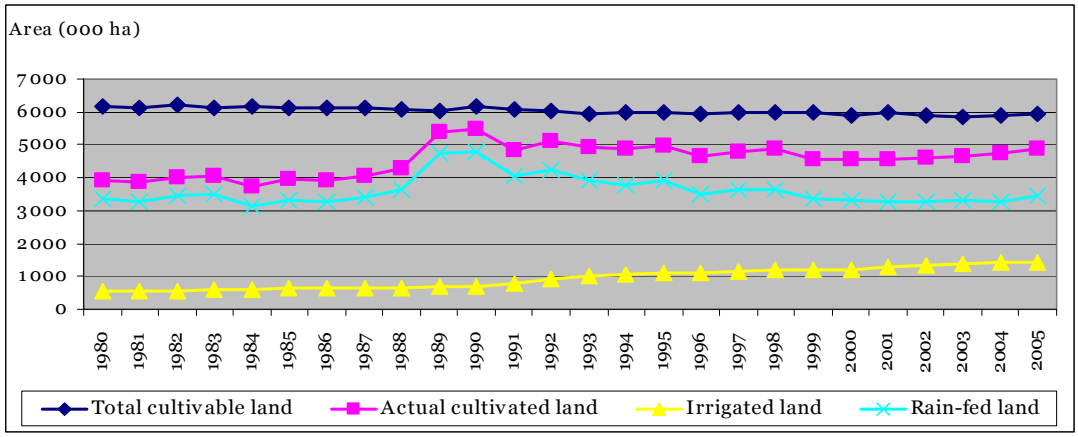
Table 5. Descriptive statistics of the area, 1980-2005 (000 ha)

Item	Mean	Minimum	Maximum	AGR %	CV %
Total cultivable land	6,032	5,863	6,195	-0.19	0.68
Actual cultivable land	4,545	3,735	5,466	0.80	9.02
Irrigated land	940	539	1,439	4.85	9.10
Rain-fed land	3,605	3,117	4,773	0.01	12.05

Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.
AGR: Annual Growth Rate calculated according to the trend line from 1980-2005 (base 1980).
CV: Coefficient of variation calculated according to the trend line.

Figure 4 traces the evolution of the aforementioned area from 1980 to 2005, which complies with the results reported in Table 5 It shows a steady progress in irrigated areas.

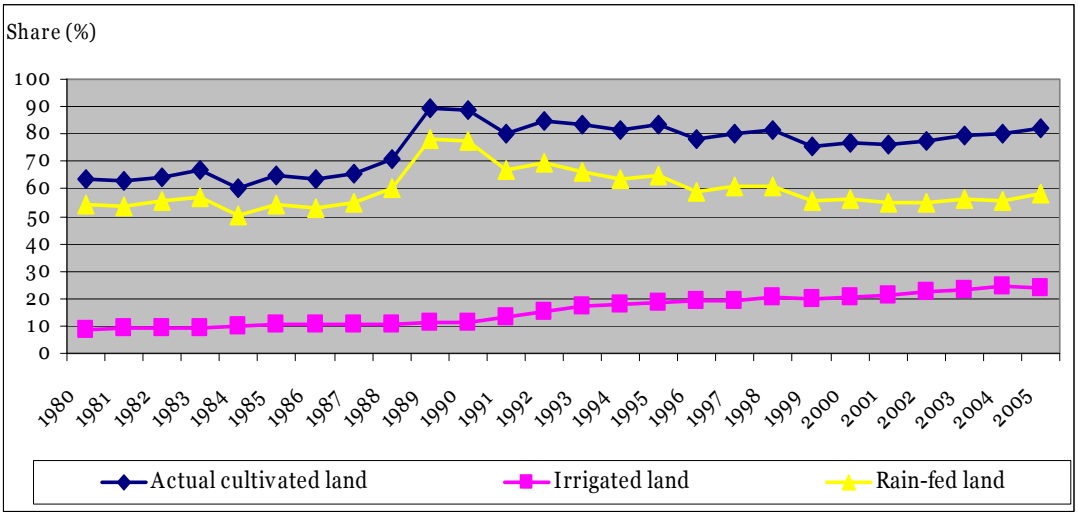
Figure 4. Evolution of the various types of land, 1980-2005 (000 ha)



Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 5 illustrates the evolution of the shares of the various lands in total cultivable land. The figure indicates an increasing trend for the various types of lands.

Figure 5. Evolution of the various shares of lands in total cultivable land, 1980-2005 (%)



Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Table 6 depicts the evolution of the various kinds of land from 2000 to 2005 taking into consideration the original observations. Accordingly during the studied period, there are slight improvements in the total cultivable, cultivated and rain-fed lands pointing out to a limited horizontal expansion. The improvement however was considerable for the irrigated land indicating a positive impact on the productivity of land.

Table 6. Evolution of the various kinds of land, 2000-2005 (000 ha)

Item	2000	2001	2002	2003	2004	2005	Change %	AGR %
Total cultivable land	5,905	5,988	5,911	5,863	5,910	5,933	0.47	0.09
Actual cultivable land	4,546	4,549	4,591	4,661	4,729	4,783	5.21	1.02
Irrigated land	1,210	1,267	1,333	1,361	1,439	1,426	17.85	3.34
Rain-fed land	3,326	3,282	3,258	3,300	3,290	3,447	3.64	0.72

Source: Elaborated from MAAR. *The AASA 2005*.
Change and AGR are calculated for the period 2000-2005 (base 2000).

Table 7 gives an idea about the descriptive statistics of the area for the major components of vegetal production from 1980 to 2005 taking into account the trend line and the fluctuations around it. The AGR is small and positive for all groups excluding vegetables. The CV (fluctuations around the trend line) is small to moderate. Again, the horizontal expansion for these groups represents a difficult task.

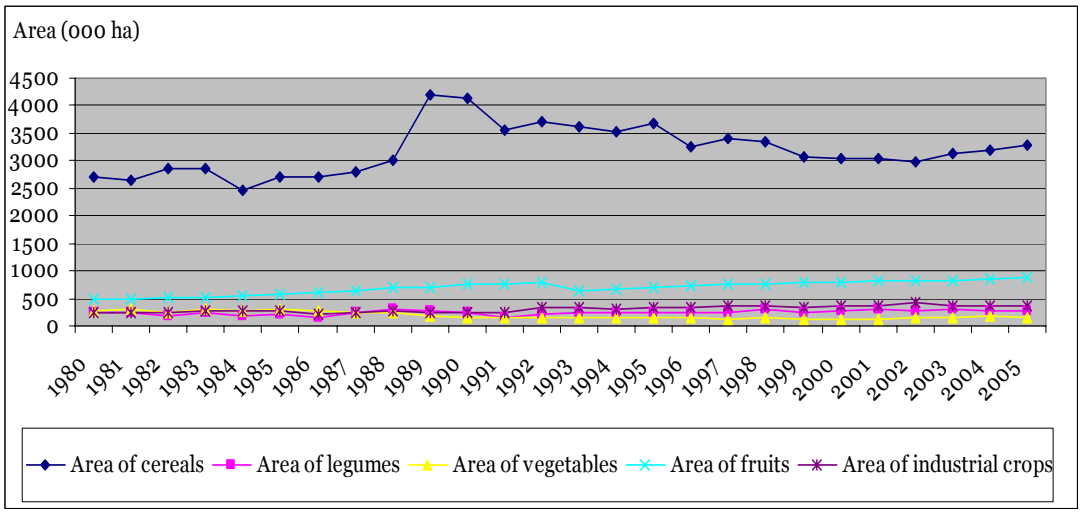
Table 7. Evolution of the area for the major components of vegetal production, 1980-2005 (000 ha)

Item	Mean	Minimum	Maximum	AGR %	CV%
Area of cereals	3,189	2,457	4,196	0.60	13.48
Area of legumes	245	162	313	1.29	14.84
Area of vegetables	194	118	314	-3.93	20.77
Area of fruits	699	480	868	2.09	6.67
Area of industrial crops	307	224	415	2.22	8.86

Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.
AGR and CV are calculated for the period 1980-2005 (base 1980).

Figure 6 illustrates the evolution of the area for the aforementioned groups during the period 1980-2005. The figure indicates that the major share of the area is devoted to cereals and fruits, which shows an increasing trend. The area devoted to cereals increased dramatically until 1990, and then started to decrease.

Figure 6. Evolution of the area of the major groups of vegetal production, 1980-2005 (000 ha)



Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Table 8 traces the evolution of the area devoted to the aforementioned groups from 2000 to 2005 considering the original observations. The table shows increasing trends for all groups with the exception of industrial crops during the studied period. Substantial change and fair annual growth are to watch for vegetables.

Table 8. Evolution of the area of various vegetal groups, 2000-2005 (000 ha)

Item	2000	2001	2002	2003	2004	2005	Change %	AGR %
Area of cereals	3,055	3,054	2,974	3,117	3,183	3,286	7.56	1.47
Area of legumes	269	292	286	295	264	281	4.46	0.88
Area of vegetables	119	119	148	146	170	158	32.77	5.83
Area of fruits	800	813	817	829	847	868	8.50	1.64
Area of industrial crops	371	373	415	360	362	365	-1.62	-0.33

Source: Elaborated from MAAR, The AASA 2005.
Change and AGR are calculated for the period 2000-2005 (base 2000).

3.4.2. Development of the productivity

The vertical expansion is considered among the basic questions of the Syrian Agricultural Strategy and the Ten Five Year Plan because of the limited possibilities of the horizontal spreading out. The level of yield or productivity of livestock is relying on the progress in agricultural supporting services to a great extent especially the agricultural scientific research and extension services.

Table 9 illustrates the descriptive statistics of the yield for the main food groups of crop production as well as the productivity of the livestock comprising milk and eggs from 1980 to 2005. The changes in the productivity were considerable for cereals, vegetables, fruits and industrial crops, moderate for milk and small for legumes and eggs. The AGR was low for all groups compared with the planned figures. The CV was high for cereals, moderate for legumes and industrial crops, small for vegetables and fruits and even much smaller for the productivity of livestock. The trend was positive for all groups pointing out to a good performance thank the public policies and the agricultural supporting services.

Table 9. Descriptive statistics of the productivity, 1980-2005

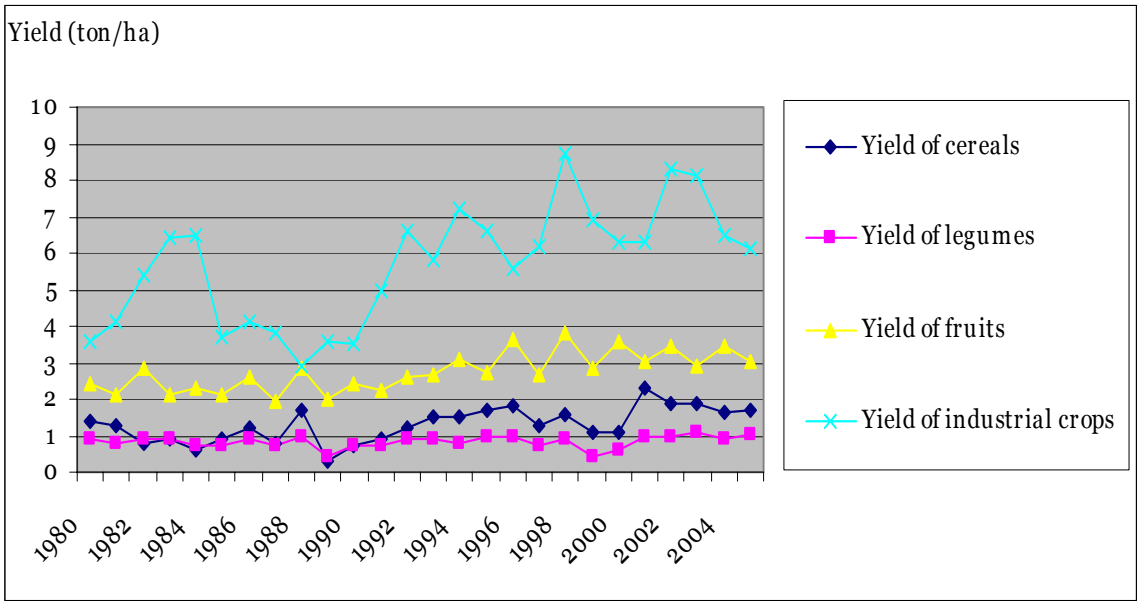
Item	Unit	Mean	Min	Max	Change %	AGR %	CV %
Cereals	Ton/ha	1.3	0.3	2.3	116.0	3.1	32.5
Legumes	Ton/ha	0.8	0.4	1.1	14.9	0.6	21.2
Vegetables	Ton/ha	14.8	11.1	21.7	87.9	2.6	11.8
Fruits	Ton/ha	2.7	1.9	3.8	73.5	1.8	13.7
Industrial crops	Ton/ha	5.7	2.9	8.7	57.2	2.5	23.1
Milk	Kg/head	148.3	114.0	174.0	36.8	1.3	6.8
Eggs	Egg/hen	175.0	153.3	195.8	13.1	0.5	5.0

Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Change, AGR and CV are calculated for the period 1980-2005 (base 1980) based on the trend line.

Figure 7 traces the evolution of yield for some groups of crop production over the period 1980-2005. It indicates an increasing trend for all groups and small to moderate fluctuations in the yield.

Figure 7. Evolution of the yield for the major groups of crop production, 1980-2005 (ton/ha)



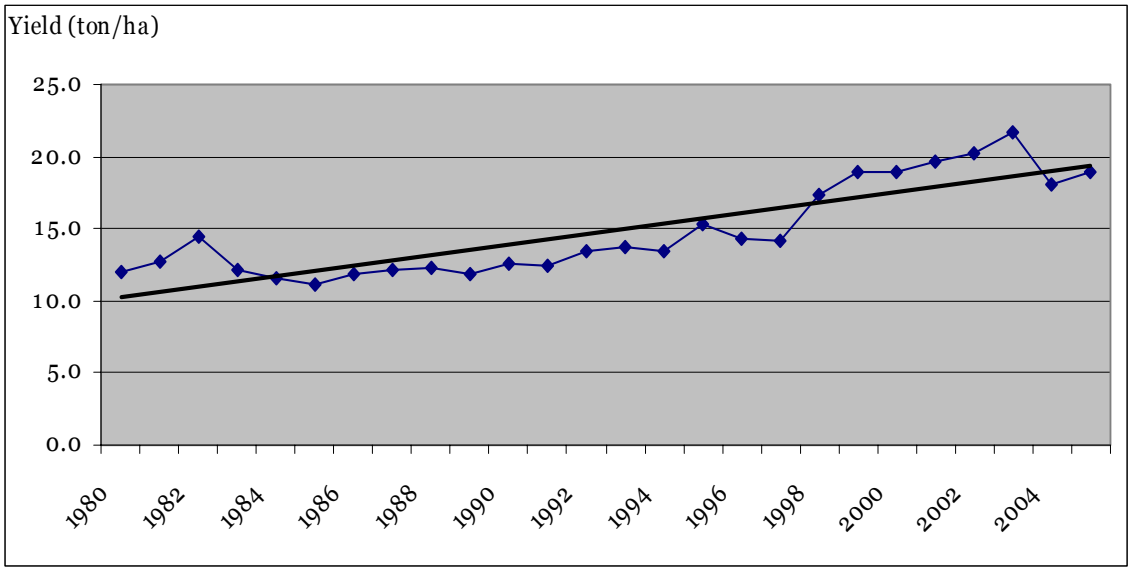
Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 8 illustrates the evolution of the yield for vegetables. It shows an upward sloping trend for all groups and small to moderate fluctuations in the yield.

Figure 9 depicts the evolution of the productivity for milk and eggs over the period 1980-2005 indicating an increasing trend and small fluctuations.

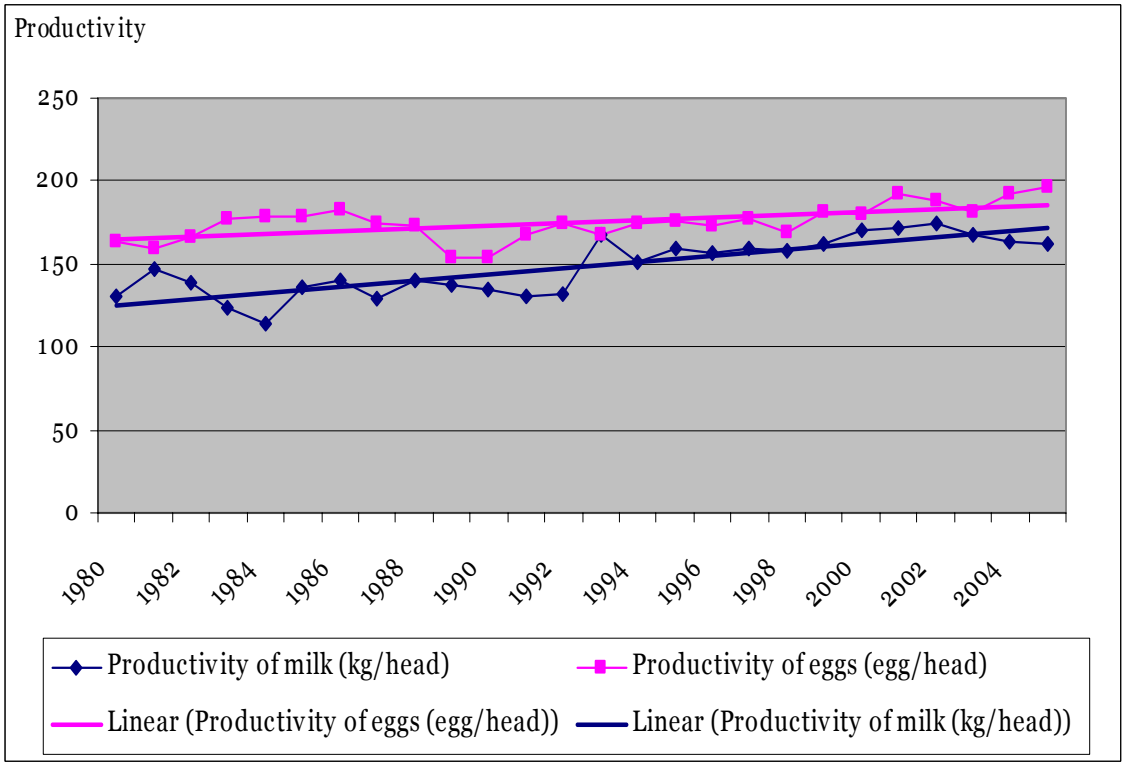
Figure 10 illustrates the annual changes in the yield for the major groups of crop production from 1980-2005 indicating the highest annual changes for cereals and legumes and a stability of changes between 2003 and 2005. Figure 11 traces the changes for milk and eggs for the same period pointing out to higher changes for milk before 1994, stability of changes thereafter and smaller variations in productivity compared with the fluctuations of yield for crop production.

Figure 8. Evolution of the yield for vegetables, 1980-2005 (ton/ha)



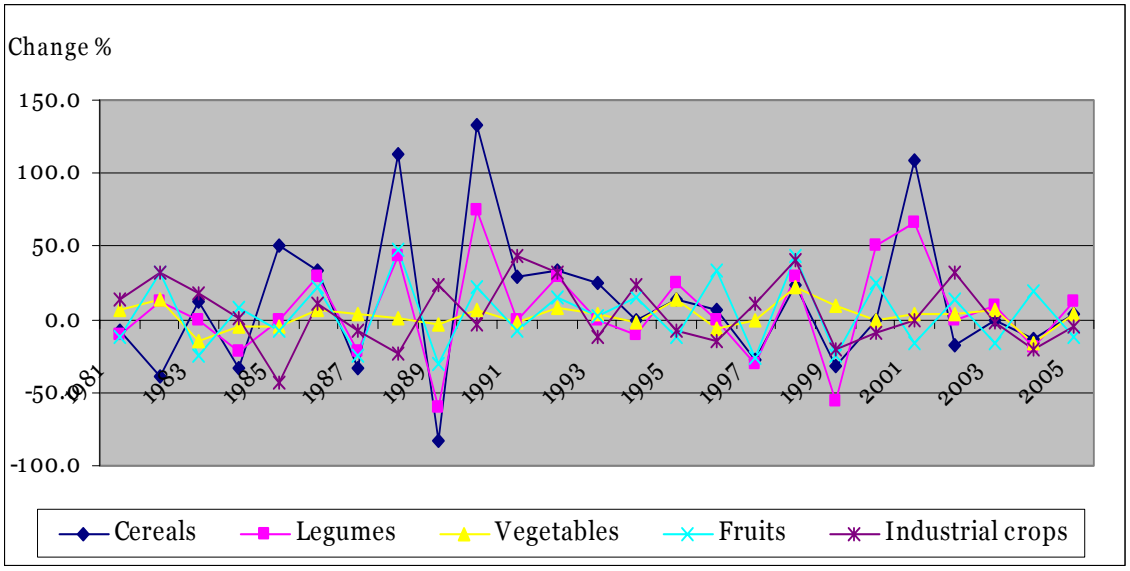
Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 9. Evolution of the productivity for milk and eggs, 1980-2005 (kg/head and egg/hen)



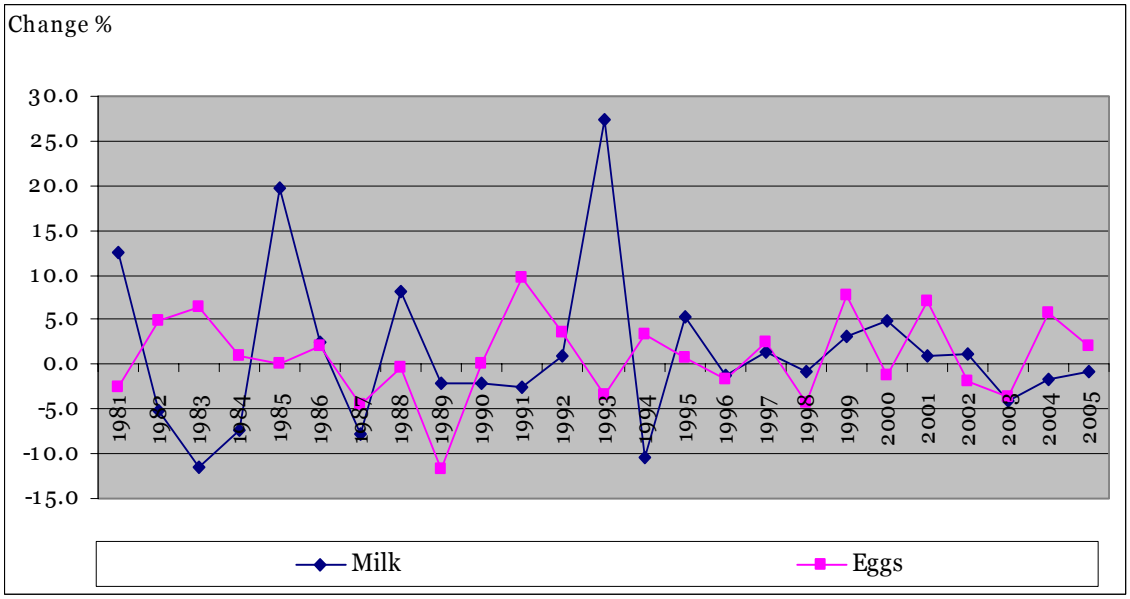
Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 10. Evolution of the annual changes in yield for major food groups, 1980-2005 (%)



Source: Elaborated from: CBS. *Time series of the agricultural sector.* 1970, 1975-2003; MAAR. *The AASA 2005.*

Figure 11. Evolution of the annual changes in productivity for milk and eggs, 1980-2005 (%)



Source: Elaborated from: CBS. *Time series of the agricultural sector.* 1970, 1975-2003; MAAR. *The AASA 2005.*

Table 10 traces the evolution of the yield of crop production and the productivity of livestock over the period 2000-2005 considering the original observations. The changes were positively high for cereals and legumes and small for eggs. No changes were observed for vegetables. The other groups underwent negative changes. These trends apply also for the AGR.

Table 10. Evolution of the productivity for major food groups, 2000-2005

Item	Unit	2000	2001	2002	2003	2004	2005	Change %	AGR %
Cereals	Ton/ha	1.1	2.3	1.9	1.9	1.7	1.7	54.5	9.1
Legumes	Ton/ha	0.6	1.0	1.0	1.1	0.9	1.0	66.7	10.8
Vegetables	Ton/ha	18.9	19.6	20.3	21.7	18.1	18.9	0.0	0.0
Fruits	Ton/ha	3.6	3.0	3.4	2.9	3.5	3.0	-16.7	-3.6
Ind. crops	Ton/ha	6.3	6.3	8.3	8.1	6.5	6.1	-3.2	-0.6
Milk	Kg/head	170	172	174	167	164	163	-4.1	-0.8
Eggs	Egg/hen	180	192	188	181	192	196	8.9	1.7

Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

3.4.3. Development of the production

The components of horizontal and vertical expansion (area and yield) affect to a great extent the level of production. Therefore, any improvement in the area and yield induces positive effects on the level of production and vise versa.

Table 11 illustrates the descriptive statistics of the production for the main food groups of crop production as well as the production of the livestock from 1980 to 2005. The changes in production were positively considerable for all groups with the exception of vegetables, which grew downward. The AGR was positive for all groups except for vegetables, but these growth rates were well below the planned figures excluding industrial crops and white meat, which came close to the planned targets. The CV was high for cereals, legumes and industrial crops, moderate for vegetables and eggs and small for fruits, red meat and milk.

Table 11. Descriptive statistics of the production, 1980-2005 (000 tons)

Item	Mean	Min	Max	Change %	AGR %	CV %
Cereals	4,164	1,403	6,919	150	3.7	30.3
Legumes	205	100	322	66	2.0	29.2
Vegetables	2,727	1,907	3,837	-28	-1.3	19.8
Fruits	1,956	1,069	1,966	175	4.1	13.1
Industrial crops	1,817	766	3,443	244	5.1	30.1
Milk	1,427	907	2,358	118	3.2	9.4
Eggs (million)	2,130	1,354	4,002	176	4.1	17.1
Red meat	168	114	242	96	2.7	12.1
White meat	99	45	189	226	4.8	22.5

Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*. Change, AGR and CV were calculated for the period 1980-2005 (base 1980) based on the trend line.

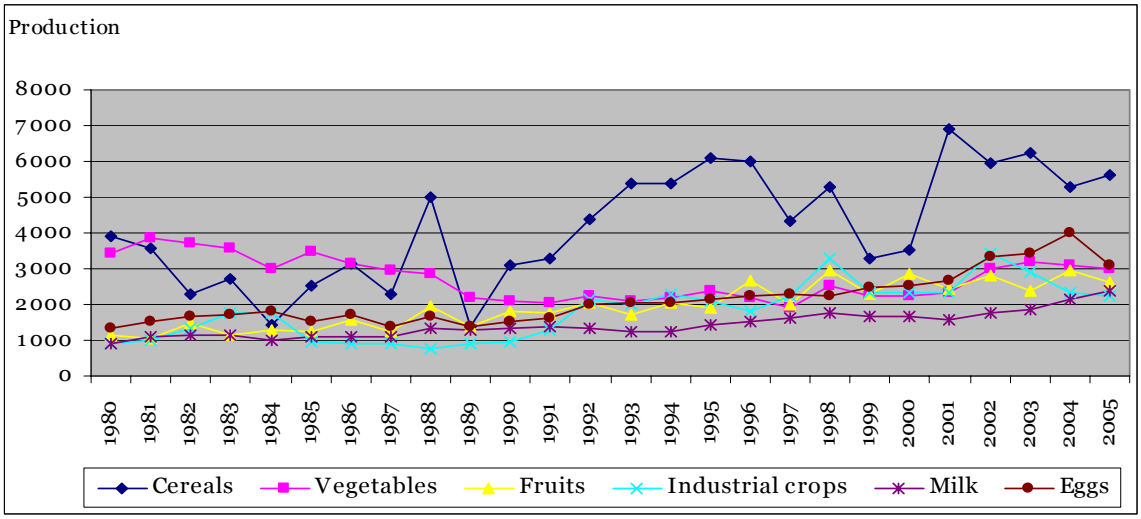
Figure 12 traces the evolution of the production for selected groups of agricultural production comprising cereals, vegetables, fruits, industrial crops, milk and eggs over the period 1980-2005 indicating upward sloping trends except for vegetables and high fluctuations for cereals and industrial crops because of the variations in climatic conditions and area & yield improvements. Figure 13 illustrates the evolution of the production for legumes, red meat and white meat pointing out to upward sloping trends and high fluctuations for legumes.

Figure 14 illustrates the annual changes in production for the major groups of crop production from 1980 to 2005 indicating the highest annual changes for cereals and legumes. Figure 15 traces the changes in production for the major groups of livestock pointing out to high fluctuations but well below those of crop production.

Table 12 shows the evolution of the production of the major food groups over the period 2000-2005 considering the original observations. The changes were positively high for cereals, legumes and white meat, positively moderate for milk, vegetables and eggs,

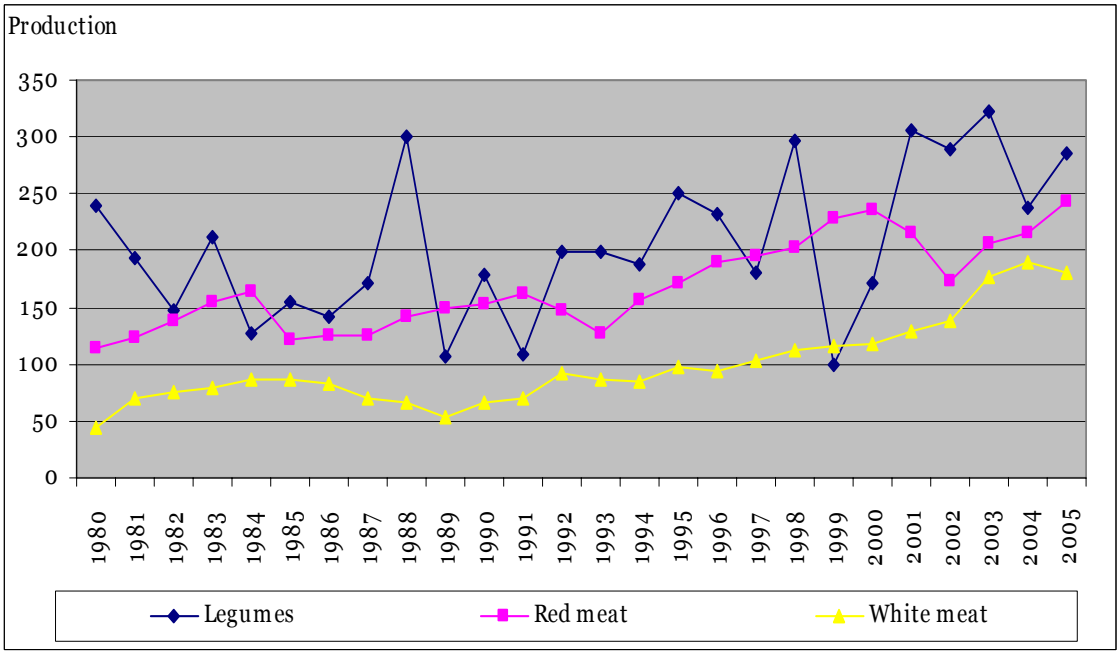
positively small for red meat and negatively small for fruits and industrial crops. The AGR followed the same patterns of changes.

Figure 12. Evolution of the production for the major groups of crop production and eggs, 1980-2005 (000 tons and million eggs)



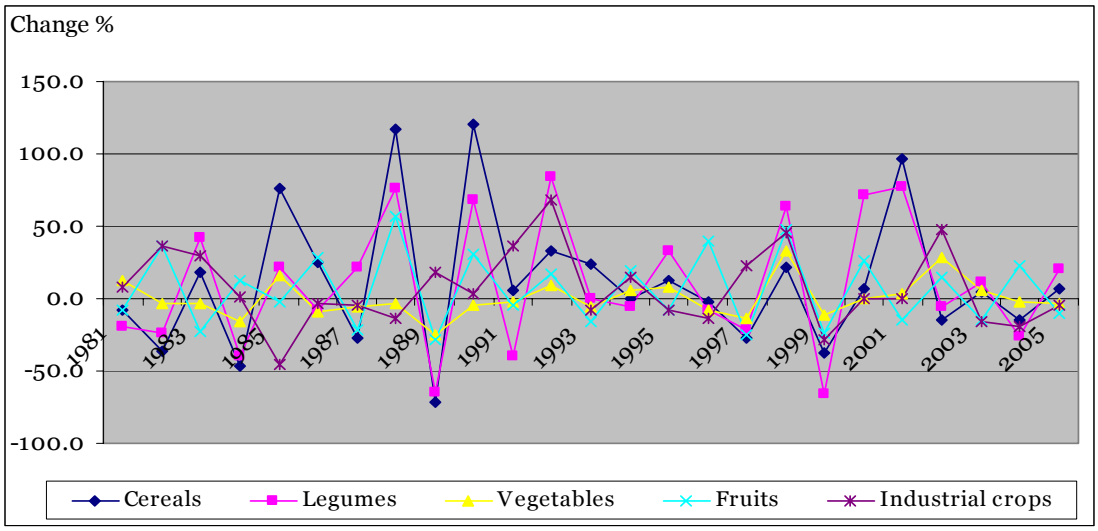
Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 13. Evolution of the production for legumes, red meat and white meat, 1980-2005 (000 tons)



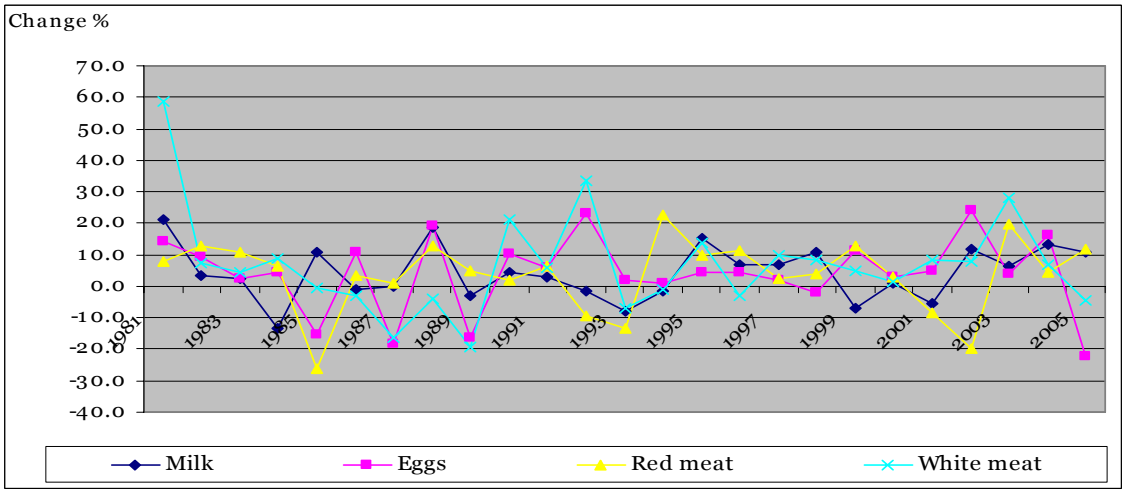
Source: Elaborated from: CBS. *Time series of the agricultural sector*. 1970, 1975-2003; MAAR. *The AASA 2005*.

Figure 14. Evolution of the annual changes in production for major food groups, 1980-2005 (%)



Source: Elaborated from: CBS. *Time series of the agricultural sector.* 1970, 1975-2003; MAAR. *The AASA 2005.*

Figure 15. Evolution of the annual changes in production of livestock, 1980-2005 (%)



Source: Elaborated from: CBS. *Time series of the agricultural sector.* 1970, 1975-2003; MAAR. *The AASA 2005.*

Table 12. Evolution of the production for major food groups, 2000-2005 (000 tons)

Item	2000	2001	2002	2003	2004	2005	Change %	AGR %
Cereals	3,510	6,919	5,930	6,223	5,278	5,627	60.3	9.9
Legumes	172	305	289	322	238	286	66.3	10.7
Vegetables	2,245	2,331	3,002	3,172	3,086	2,987	33.1	5.9
Fruits	2,867	2,440	2,803	2,393	2,931	2,641	-7.9	-1.6
Industrial crops	2,347	2,336	3,443	2,911	2,339	2,236	-4.7	-1.0
Milk	1,673	1,578	1,767	1,878	2,129	2,358	40.9	7.1
Eggs (million)	2,546	2,671	3,321	3,449	4,002	3,104	21.9	4.0
Red meat	236	316	173	207	216	242	2.5	0.5
White meat	118	128	138	177	189	180	52.5	8.8

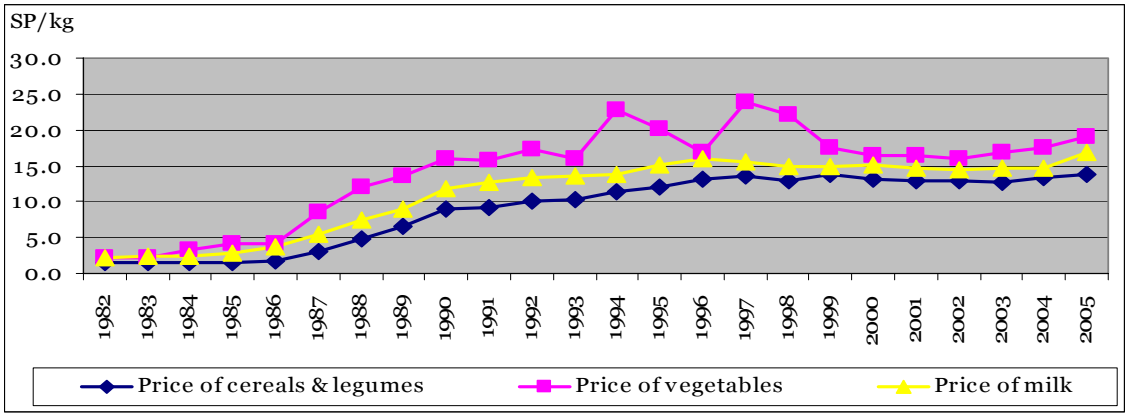
Source: Elaborated from: CBS. *Time series of the agricultural sector.* 1970, 1975-2003; MAAR. *The AASA 2005.*

3.5. Development of prices

Prices are considered one of the main determinants of food supply. Therefore, this section traces the evolution of prices in current and real terms from 1982 to 2005.

Figure 16 illustrates the evolution of the current retail prices for cereals & legumes, vegetables and milk over the period 1982-2005 indicating an increasing trend of the prices.

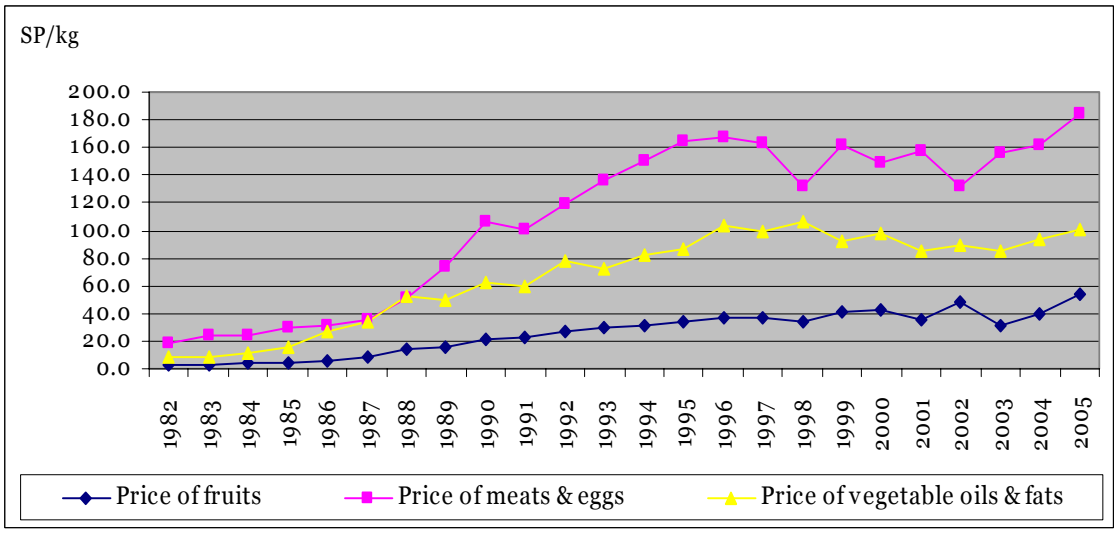
Figure 16. Evolution of the current prices of selected food groups, 1982-2005 (SP/kg)



Source: Elaborated from MAAR. *The Agricultural Annual Statistical Abstract*. Various issues; CBS. *ASA*. Various issues.

Figure 17 depicts the evolution of the current retail prices for fruits, meats & eggs and vegetable oils & fats indicating also an up warding trend.

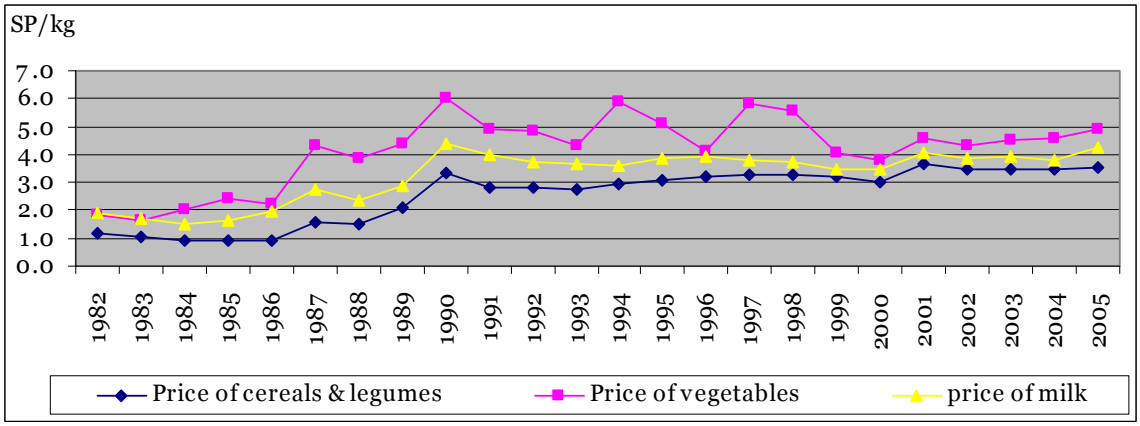
Figure 17. Evolution of the current prices of other selected food groups, 1982-2005 (SP/kg)



Source: Elaborated from MAAR. *The Agricultural Annual Statistical Abstract*. Various issues; CBS. *ASA*. Various issues.

Figure 18 traces the evolution of the deflated retail prices by the General Consumer Price Index (GCPI) considering 1980 as base year for cereals & legumes, vegetables and milk over the period 1982-2005 indicating an increasing trend. The trend line is highly significant at the 5% level of significance.

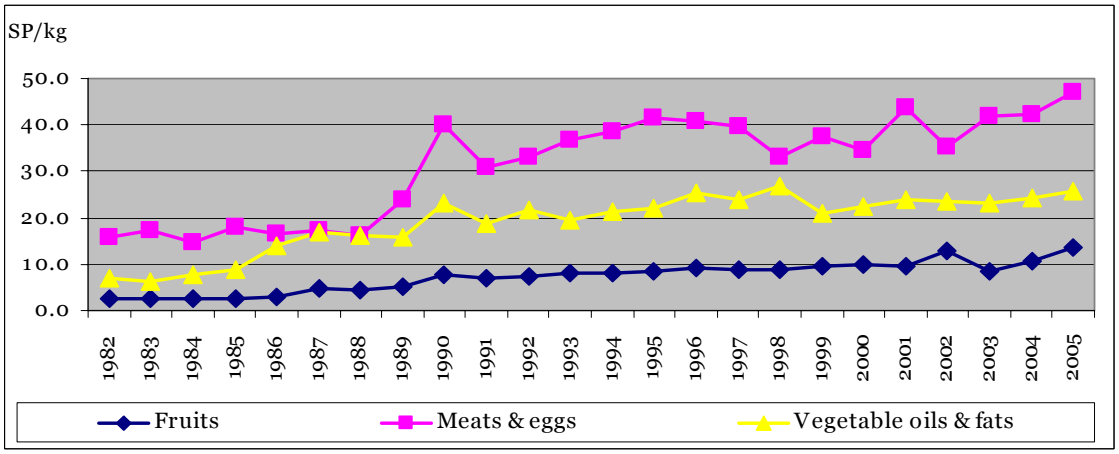
Figure 18. Evolution of the deflated prices of selected food groups, 1982-2005 (SP/kg)



Source: Elaborated from MAAR. *The Agricultural Annual Statistical Abstract*. Various issues; CBS. *ASA*. Various issues.

Figure 19 shows the evolution of the deflated retail prices by the GCPI (base 1980) for fruits, meats & eggs and vegetable oils & fats over the period 1982-2005 indicating an upward sloping trend. The trend line is highly significant at the 5% level of significance.

Figure 19. Evolution of the deflated prices of other selected food groups, 1982-2005 (SP/kg)



Source: Elaborated from MAAR. *The Agricultural Annual Statistical Abstract*. Various issues; CBS. *ASA*. Various issues.

Table 13 illustrates the descriptive statistics of the current and deflated retail prices of the individual food groups over the period 1982-2005 indicating moderate variations around the trend line.

Table 13. Summary statistics of the current and deflated retail prices, 1982-2005 (SP/kg)

Item	Current prices			Deflated prices			
	Mean	Min	Max	Mean	Min	Max	CV %
Cereals & legumes	9.0	1.4	13.9	2.6	0.9	3.6	21.5
Vegetables	14.2	2.2	23.9	4.2	1.7	6.0	26.8
Fruits	26.2	3.2	53.8	7.3	2.5	13.7	14.9
Meats & eggs	109.5	19.1	185.0	31.5	14.8	47.1	18.7
Milk & its products	11.1	2.3	16.8	3.3	1.5	4.4	19.1
Vegetable oils & fats	66.6	8.2	106.5	19.1	6.2	26.8	20.3

Source: Elaborated from: NAPC database; CBS. *The ASA*. Various issues.
Min: Minimum. Max: Maximum. CV: Coefficient of variation.

3.6. Evolution of the production cost

The level of supply of agricultural products relies to a great extent on the level of production costs. The main determinants of the cost of agricultural production are the costs of agricultural operations including manual and mechanical activities as well as the costs of production requirements comprising fertilizer, seeds, control materials and water. Increasing the production costs in the sense to improve the quality of operations and productivity will affect positively the supply of agricultural products. In contrast, increasing the costs without focusing on the improvement of production will cause a reduction in the level of supply. Credits are considered also important elements of supply boost. Table 14 traces the evolution of the production costs of representative products for cereals & legumes, vegetables and fruits as well as the average price of both barley and maize for the period 1982-2005. The table shows considerable changes in production costs during the studied period, but the changes in deflated values (real term) are substantially lower than those at current values. The variations around the trend line are considered moderate.

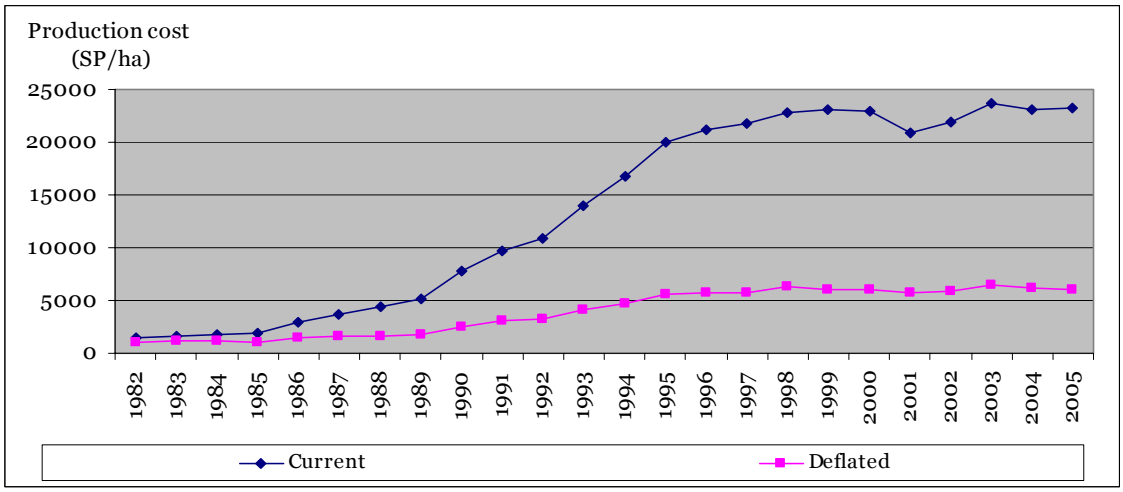
Table 14. Descriptive statistics of production costs and feed costs, 1982-2005

Item	Unit	Mean	Min	Max	Change %		AGR %		CV %
					OROB	Trend	OROB	Trend	
Current									
Cost of cl	SP/ha	13,601	1,445	23,617	1,511	2,856	12.8	16.6	27.8
Cost of veg.	SP/ha	88,748	18,320	149,288	715	1,454	9.6	12.7	22.1
Price of feed	SP/kg	5.4	0.8	8.3	869	783	10.4	9.9	30.1
Deflated									
Cost of cl	SP/ha	3,923	1,069	6,478	446	1,025	7.7	11.1	23.4
Cost of veg.	SP/ha	26,489	10,876	41,617	176	314	4.5	6.4	15.2
Price of feed	SP/kg	1.6	0.5	2.3	228	280	5.3	6.0	23.8

Source: Elaborated from MAAR. *The AASA*. Various issues.
OROB: Original observations. Cl: Cereals & legumes. Veg.: Vegetables.

Figure 20 depicts the evolution of the production cost for cereals & legumes at current and deflated prices from 1982 to 2005. Accordingly, a large increase at current prices is to observe, whereas in real term the increase is greatly smoother.

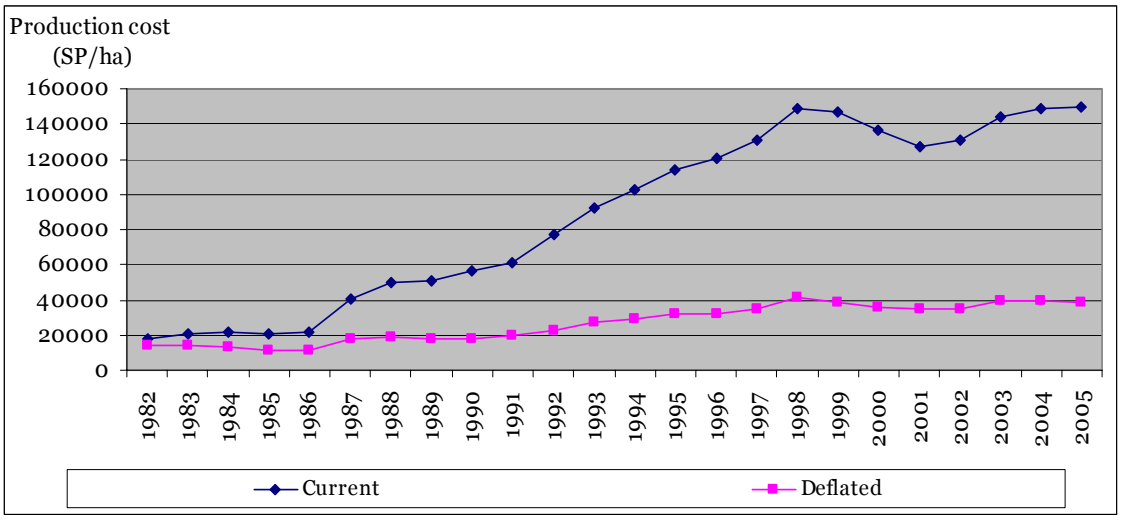
Figure 20. Evolution of the production cost for cereals & legumes, 1982-2005 (SP/ha)



Source: Elaborated from MAAR. *The AASA*. Various issues.

Figure 21 depicts the evolution of the production cost for vegetables at current and deflated prices from 1982 to 2005. The figure shows a large increase at current prices, whereas in real term the increase is greatly flatter.

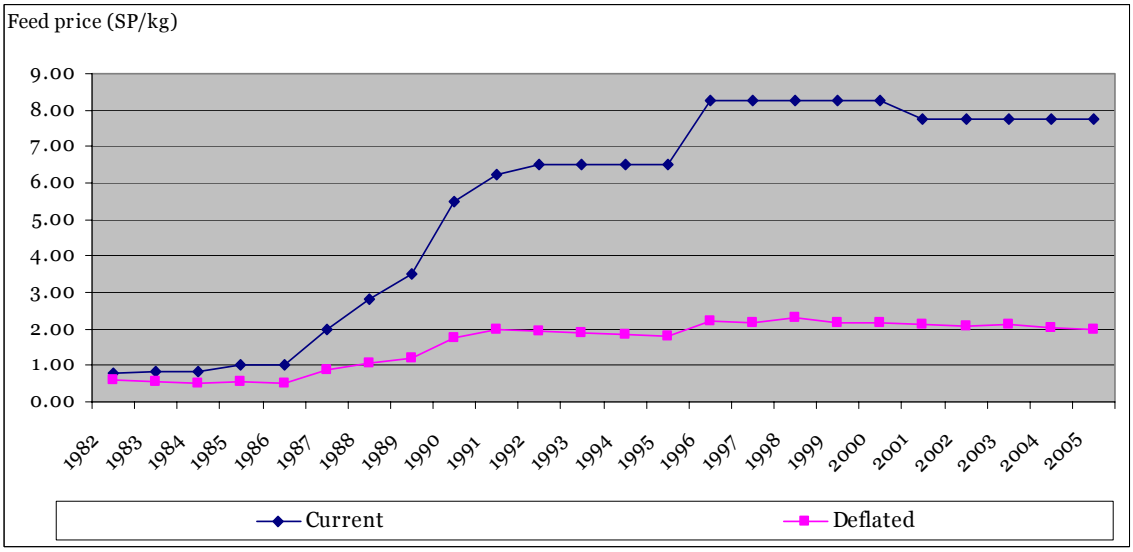
Figure 21. Evolution of the production cost for vegetables, 1982-2005 (SP/ha)



Source: Elaborated from MAAR. *The AASA*. Various issues.

Figure 22 illustrates the evolution of the feed price at current and deflated prices from 1982 to 2005. The figure shows a large increase at current prices, whereas in real term the increase is considerably lower.

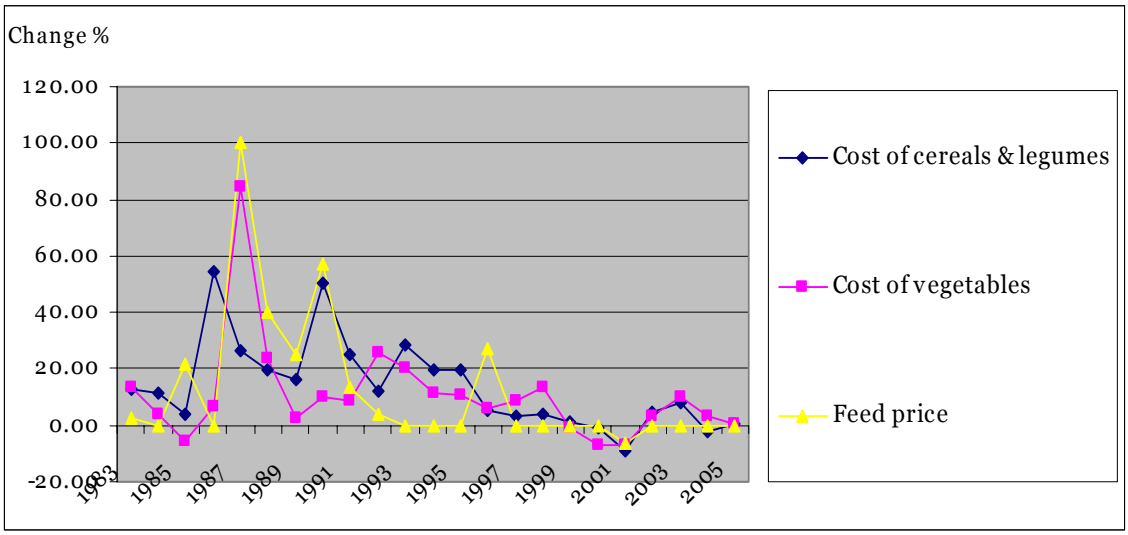
Figure 20. Evolution of the feed price, 1982-2005 (SP/kg)



Source: Elaborated from MAAR. *The AASA*. Various issues.

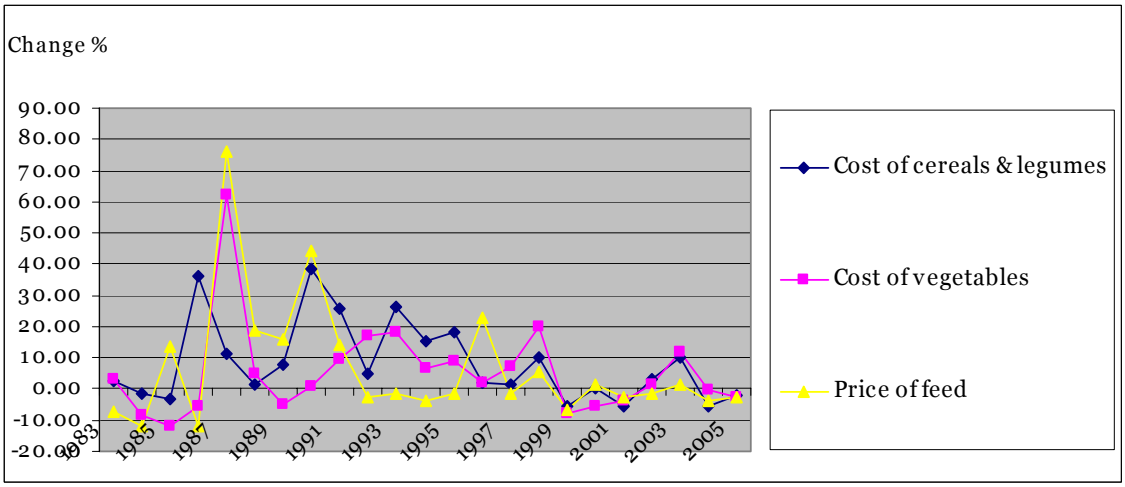
Figure 23 traces the evolution of the annual variations of the aforementioned measures at current prices from 1982 to 2005. Figure 24 portrays these fluctuations at deflated prices. The figures indicate an increasing trend at the beginning of the period and a declining one thereafter as well as lower fluctuations for deflated values.

Figure 23. Evolution of the annual variations of the production costs for selected groups and feed price at current prices, 1982-2005



Source: Elaborated from MAAR. *The AASA*. Various issues.

Figure 24. Evolution of the annual variations of the production costs for selected groups and feed price at deflated prices, 1982-2005



Source: Elaborated from MAAR. *The AASA*. Various issues.

4. Methodological notes

The graphic presentation of a supply schedule is a supply curve. A supply schedule specifies the units of a good or service that a producer is willing to supply at alternative prices over a given period of time. Accordingly, a market supply curve is derived from each producer's supply curve by summing the units each producer is willing to supply at alternative prices. Consequently, the quantity supplied of a commodity depends on its price and several other factors. These other factors are called supply shifters. Supply shifters are: prices of competing commodities (Po), prices of inputs (Pw), prices of joint products (Pj) (e.g. wheat and straw, leather and meat etc.), technology (tech), institutions (inst) [extension services, transport facilities, market places for inputs and outputs, regulations, etc.], and conditions of the natural environment (env). Thus, the supply function can be written as follows:

$$Qs = f (P (+), Po (-), Pw (-), P_j (+), tech (+), inst (+), env (+))$$

Hence, applying the ceteris paribus principle, where *ceteris paribus* indicates that variables other than the price of the commodity are unchanged, the supply function can be written Qs = f (P). Therefore, the change in the quantity supplied represents a movement along the supply curve due to a change in the commodity price; see, Salvatore and Diulio (1996), Heady et al. (1961), and Giovanni (1999). The change in supply, however, means that there is a shift in the supply curve.

According to Perali (2003) and Sadoulet and de Janvry (1995) there are several approaches to assess the supply response. The following approaches can be helpful for the estimation of supply in this paper:

Single equation approach

The following models are important for the analysis of supply of agricultural products:

Nerlovian models of supply response

Based on Perali (2003), Sadoulet and de Janvry (1995) and Nerlove (1958), it can be distinguished among the following models:

The general Nerlovian supply response model

$$q_{dt} = a_0 + a_1 * P_{et} + a_3 * Z_t + U_t$$

Where:

q_{dt} – The desired output (milk productivity or meat gain) in period t.

P_{et} – A vector of relative prices including the price of the commodity itself, prices of competing products, and factor prices (with one of these prices chosen as numeraire).

Z_t – A set of other exogenous shifters such as weather, U_t – Error term

The reduced form Nerlovian supply response model

$$q_t = b_0 + b_1 * P_{t-1} + b_2 * q_{t-1} + b_3 * q_{t-2} + b_4 * Z_t + b_5 * Z_{t-1} + e_t$$

The restricted Nerlovian supply response model

$$q_t = c_0 + c_1 * P_{t-1} + c_2 * q_{t-1} + c_3 * q_{t-2} + et$$

Where:

q_t – Output or productivity in period t, P_{t-1} – Lagged price, q_{t-1}, q_{t-1} – Lagged quantities

Z_{t-1} – Lagged supply shifters, e_t – Error term

In this regard, in a later study, Nerlove related milk production to a deflated lagged milk price and time, and successively added the variables milk production the previous year, total hay supply, supply of total concentrates, beef price, and hog price. Moreover, by estimating the supply, it has to be distinguished between short run (fixed factors) and long run (variable factors) elasticity (Heady et al., 1961, Perali, 2003, Nerlove, 1958, and Giovanni, 1999).

The relationship between the long-run and short-run elasticity is written as follows (Sadoulet and de Janvry, 1995):

$E_i^{lr} = E_i^{sr}/(1-b_i)$

Where:

E_i^{lr} – Elasticity in the long-run.
E_i^{sr} – Elasticity in the short-run.
b_i – Regression coefficient.

System of equations and simultaneous equations approach

Brown and Brandt (1989) illustrated a structural model of the beef industry in the United States, which consists of five behavioral equations and an identity. Another structural model was included in a study about the dynamics of supply and demand for New Zealand deer (Pearse, Ramaratnam, and Dake, 2002).

The following models of supply response are form interest for this research (Sadoulet and de Janvry, 1995):

Supply response of maize in Thailand under risk

Behrman's (1968) made an interesting extension of the Nerlovian supply model using four-equation structural model under risk to assess the area response as follows:

$A_t^d = a_o + a_1 p_t^e + a_2 y_t^e + a_3 \sigma_{pt} + a_4 y_t + a_5 M_t + u_{1t,}$

$A_t = b_o + A_{t-1} + \delta (A_t^d - A_{t-1}) + u_{2t,}$

$P_t^e = c_o + p_{t-1}^e + \gamma (p_{t-1} - p_{t-1}^e) + u_{3t,}$

$y_t^e = \hat{y}_t, y_t = d_o + d_1 (R_t - \check{R}) + d_2 t + d_3 t^2 + u_{4t,}$

where:

A^d, p^e, y^e = desired area, expected price (deflated by price index of competing crops), and expected yield,
A_t, y_t = area and yield respectively,
$\hat{y}$ = Predicted yield,
σ_{pt} and σ_{yt} =standard deviations of price and yield in last three periods,
M_t = malaria death rate,
R_t, $\check{R}$ = rainfall in t and average rainfall,
t = time trend,
t-1 = indication of past variables,
a_o, a_1, a_2, a_3, a_4, a_5, b_o, δ, c_o, γ, d_o, d_1, d_2, d_3 = Parameters to be estimated.

Supply response under controlled prices in Egypt

Cuddihy (1980) assessed a model of area response for the four major crops of Egyptian agriculture namely: cotton, wheat, maize and rice as follows:

$$A_t^d = a_1 + \sum_{i}^{5} a_{2i} p_{it}^e + \sum_{i}^{5} a_{3i} y_{it}^e + u_t,$$

$$A_t - A_{t-1} = \delta (A_t^d - A_t) + v_t,$$

where:

$p_{it}^e = p_{it-1}$ (administered prices),
$y_{it}^e = y_{it-1}$ (naive expectations).

The reduced form of the model is written as:

$$A_t = \Pi_1 + \sum_{i}^{5} \Pi_{2i} p_{it-1} + \Pi_3 A_{t-1} + \sum_{i}^{5} \Pi_{4i} y_{it-1} + (\delta u_t + v_t),$$

where:

$\Pi_1 = a_1 \delta$,
$\Pi_2 = a_2 \delta$, short-run elasticity of supply response,
$\Pi_3 = 1 - \delta$,

$\Pi_4 = a_3\ \delta$,
$a_2 = \Pi_2/(1 - \Pi_3)$, long-run elasticity of supply response.

Consequently, the reduced form approach with structural equations is adopted in this research using 7 food groups namely: cereals & legumes, vegetables, fruits, Red meat, poultry meat, eggs and milk. The proposed model assumes that the production response is a combination of both area and yield response for crop production. It is assumed also that the groups of crop production interact with each others and the groups of animal production affect each others. The interaction between crop production and animal production is considered through the feed price and solving the equations simultaneously using the procedure of Seemingly Unrelated Regression (SUR).

Equations of cereals & legumes

$Qcl_i = Acl_i^e * Ycl_i^e + ecl_i$;

$Acl_i^e = acl_0 + acl_1\ Acl_{i-1} + acl_2\ Pcl_i + acl_3\ Pv_{i-1} + acl_4\ Pf_{i-1}$;

$Ycl_i^e = bcl_0 + bcl_1\ Ycl_{i-1} + bcl_2\ DR_i + bcl_3\ DCcl_i + t$;

where:

Qcl_i – Quantity supplied of cereals & legumes;
Acl_i^e – Expected area of cereals & legumes;
Ycl_i^e - Expected yield of cereals & legumes;
ecl_i – Error term;
Acl_{i-1} – Lagged (past) area of cereals & legumes;
Pcl_i – Price of cereal & legumes;
Pv_{i-1} – Lagged price of vegetables;
Pf_{i-1} – Lagged price of fruits;
Ycl_{i-1} – Lagged yield of cereals & legumes;
DR_i – Difference in rainfall;
$DCcl_i$ – Difference in production costs;
$acl_0,\ acl_1,\ acl_2,\ acl_3,\ acl_4,\ bcl_0,\ bcl_1,\ bcl_2,\ bcl_3$ – Parameters (regression coefficients) to be estimated;
t – Time trend;
i – Observation in year i, where i = 1,..., n;
i-1 – Lagged variable (variable in past year);
n – Number of observations or years.

Equations of vegetables

$Qv_i = Av_i^e * Yv_i^e + ev_i$;

$Av_i^e = av_0 + av_1\ Av_{i-1} + av_2\ Pcl_{i-1} + av_3\ Pv_{i-1} + av_4\ Pf_{i-1}$;

$Yv_i^e = bv_0 + bv_1\ Yv_{i-1} + bv_2\ DR_i + bv_3\ DCv_i + t$;

where:

Qv_i – Quantity supplied of vegetables;
Av_i^e – Expected area of vegetables;
Yv_i^e - Expected yield of vegetables;
ev_i – Error term;
Av_{i-1} – Lagged (past) area of vegetables;
Pcl_{i-1} – lagged price of cereal & legumes;
Pv_{i-1} – Lagged price of vegetables;
Pf_{i-1} – Lagged price of fruits;
Yv_{i-1} – Lagged yield of vegetables;

DR_i – Difference in rainfall;
DCv_i – Difference in production costs;
av_0, av_1, av_2, av_3, av_4, bv_0, bv_1, bv_2, bv_3 – Parameters (regression coefficients) to be estimated;
t – Time trend;
i – Observation in year i, where i = 1,..., n;
i-1 – Lagged variable (variable in past year);
n – Number of observations or years.

Equations of fruits

$$Qf_i = Af_i^e * Yf_i^e + ef_i;$$

$$Af_i^e = af_0 + af_1 Af_{i-1} + af_2 Pcl_{i-1} + af_3 Pv_{i-1} + af_4 Pf_{i-1};$$

$$Yf_i^e = bf_0 + bf_1 Yf_{i-1} + bf_2 DR_i + bf_3 DCf_i + bf_4 PNT_i + t;$$

where:

Qf_i – Quantity supplied of fruits;
Af_i^e – Expected area of fruits;
Yf_i^e - Expected yield of fruits;
ef_i – Error term;
Af_{i-1} – Lagged (past) area of fruits;
Pcl_{i-1} – lagged price of cereal & legumes;
Pv_{i-1} – Lagged price of vegetables;
Pf_{i-1} – Lagged price of fruits;
Yf_{i-1} – Lagged yield of fruits;
DR_i – Difference in rainfall;
DCf_i – Difference in production costs;
PNT_i – Number of fruit bearing trees per ha;
af_0, af_1, af_2, af_3, af_4, bf_0, bf_1, bf_2, bf_3, bf_4 – Parameters (regression coefficients) to be estimated;
t – Time trend;
i – Observation in year i, where i = 1,..., n;
i-1 – Lagged variable (variable in past year);
n – Number of observations or years.

Equations of red meat

$$Q_{rmt} = Q_{rm}^e{}_t + e_{rmt};$$

$$Q_{rm}^e{}_t = a_0 + a_1 Q_{rmt-1} + a_2 NHR_t + a_3 P_{rmt-1} + a_4 P_{pmt-1} + a_5 P_{eggt-1} + a_6 P_{mt-1} + a_7 Pfd_{t-1};$$

where:

Q_{rmt} – Quantity supplied of red meat;
$Q_{rm}^e{}_t$ – Expected (fitted) quantity of red meat;
e_{rmt} – Error term;
Q_{rmt-1} – Lagged production of red meat;
NHR_t – Total number of herd (cattle, sheep and goats);
P_{rmt-1} – Lagged price of red meat;
P_{pmt-1} – Lagged price of poultry meat;
P_{eggt-1} – Lagged price of eggs;
P_{mt-1} – Lagged price of milk;
Pfd_{t-1} – Lagged price of feed;
t – Observation in year t, where t = 1, ..., n;
n – Number of observations or years;
t-1 – Lagged variable.

Equations of poultry meat

$Q_{pmt} = Q_{pm}{}^{e}{}_{t} + e_{pmt}$;

$Q_{pm}{}^{e}{}_{t} = a_0 + a_1 Q_{pmt-1} + a_2 NHP_t + a_3 P_{rmt-1} + a_4 P_{pmt-1} + a_5 P_{eggt-1} + a_6 P_{mt-1} + a_7 Pfd_{t-1}$;

where:

Q_{pmt} – Quantity supplied of poultry meat;
$Q_{pm}{}^{e}{}_{t}$ – Expected (fitted) quantity of poultry meat;
e_{pmt} – Error term;
Q_{pmt-1} – Lagged production of poultry meat;
NHP_t – Total number of poultry heads;
P_{rmt-1} – Lagged price of red meat;
P_{pmt-1} – Lagged price of poultry meat;
P_{eggt-1} – Lagged price of eggs;
P_{mt-1} – Lagged price of milk;
Pfd_{t-1} – Lagged price of feed;
t – Observation in year t, where t = 1, ..., n;
n – Number of observations or years;
t-1 – Lagged variable.

Equations of eggs

$Q_{eggt} = Q_{egg}{}^{e}{}_{t} + e_{eggt}$;

$Q_{egg}{}^{e}{}_{t} = a_0 + a_1 Q_{eggt-1} + a_2 NHL_t + a_3 P_{rmt-1} + a_4 P_{pmt-1} + a_5 P_{eggt-1} + a_6 P_{mt-1} + a_7 Pfd_{t-1}$;

where:

Q_{eggt} – Quantity supplied of eggs;
$Q_{egg}{}^{e}{}_{t}$ – Expected (fitted) quantity of eggs;
E_{eggt} – Error term;
Q_{eggt-1} – Lagged production of eggs;
NPH_t – Total number of layers;
P_{rmt-1} – Lagged price of red meat;
P_{pmt-1} – Lagged price of poultry meat;
P_{eggt-1} – Lagged price of eggs;
P_{mt-1} – Lagged price of milk;
Pfd_{t-1} – Lagged price of feed;
t – Observation in year t, where t = 1, ..., n;
n – Number of observations or years;
t-1 – Lagged variable.

Equations of milk

$Q_{mt} = Q_{m}{}^{e}{}_{t} + e_{m}$;

$Q_{m}{}^{e}{}_{t} = a_0 + a_1 Q_{mt-1} + a_2 NHC_t + a_3 P_{rmt-1} + a_4 P_{pmt-1} + a_5 P_{eggt-1} + a_6 P_{mt} + a_7 Pfd_{t-1}$;

where:

Q_{mt} – Quantity supplied of milk;
$Q_{m}{}^{e}{}_{t}$ – Expected (fitted) quantity of milk;
E_{mt} – Error term;
Q_{mt-1} – Lagged production of milk;
NHC_t – Total number of milked cows;
P_{rmt-1} – Lagged price of red meat;
P_{pmt-1} – Lagged price of poultry meat;
P_{eggt-1} – Lagged price of eggs;

P_{mt} – Price of milk;
Pfd_{t-1} – Lagged price of feed;
t – Observation in year t, where t = 1, …, n;
n – Number of observations or years;
t-1 – Lagged variable.

5. Empirical results

The assessment of supply was conducted relying on the guidelines mentioned in section 4 using Syrian data. The data used for the estimation is the official statistics of the Ministry of Agriculture and Agrarian Reform (MAAR) and the Central Bureau of Statistics (CBS).

5.1. Estimates of cereals & legumes

Table 15 illustrates the estimates of the area response for cereals & legumes using SUR, which gave more significant results than OLS, comprising the regression coefficients, testing results and short & long-run elasticities. The supply equation of the area explains 88% of the area variations. All regression coefficients are statistically significant at the 5% level of significance with the exception of the lagged price of fruits. The signs and magnitudes of the regression coefficients coincide with economic theory. The elasticities indicate a positive relationship between the area supplied, the price of cereals & legumes, the lagged area of cereals & legumes and the lagged price of fruits as well as a negative correlation between the area supplied and the lagged price of vegetables. The long-run elasticities are substantially higher than the short-run ones. The elasticities point out also to a rigid supply in the short-run. The rigidity of supply is also prevailing in the long-run with the exception of the lagged area of cereals & legumes, which implies an elastic supply.

Table 15. Estimates of the area response for cereals & legumes using SUR, 1982-2005

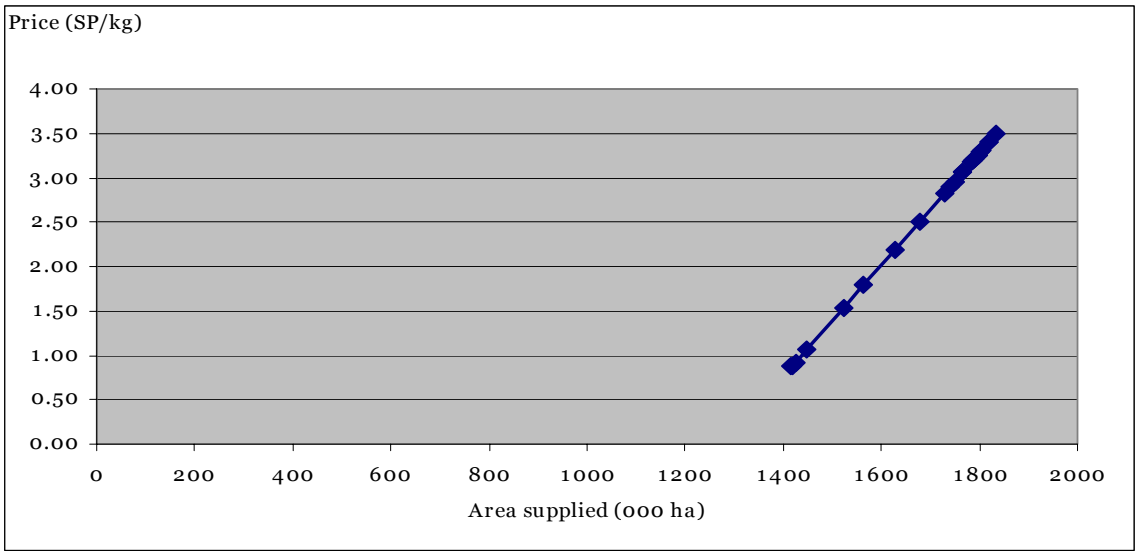
Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	547.55	157.18	0.0027		
Lagged area	0.51	0.13	0.0009	0.50	1.01
Price of cereals & legumes	159.46	74.82	0.0471	0.24	0.50
Lagged price of vegetables	-60.01	25.96	0.0328	-0.15	-0.31
Lagged price of fruits	19.60	18.50	0.3032	0.08	0.16

Source: Elaborated by the author.

Figure 25 traces the supply curve of the area response for cereals & legumes with respect to the price of cereals & legumes holding all other factors affecting the area constant from 1982 to 2005. The figure shows a positive relationship between the area supplied and the price.

Table 16 includes the estimates of the yield response with respect to the yield in previous year, the difference in rainfall, the difference in production cost of cereals & legumes and the time trend, comprising the regression coefficients, testing results and short & long-run elasticities. The yield equation explains 70% of the yield variations. All regression coefficients are statistically significant at the 10% level of significance with the exception of the lagged yield of cereals & legumes. The elasticities indicate a positive relationship between the yield of cereals & legumes and its affecting factors. The long-run elasticities are higher than the short-run ones. The elasticities point out also to a rigid yield response in both the short-run and the long-run.

Figure 25. Supply curve of the area for cereals & legumes with respect to the price, 1982-2005



Source: Elaborated by the author.

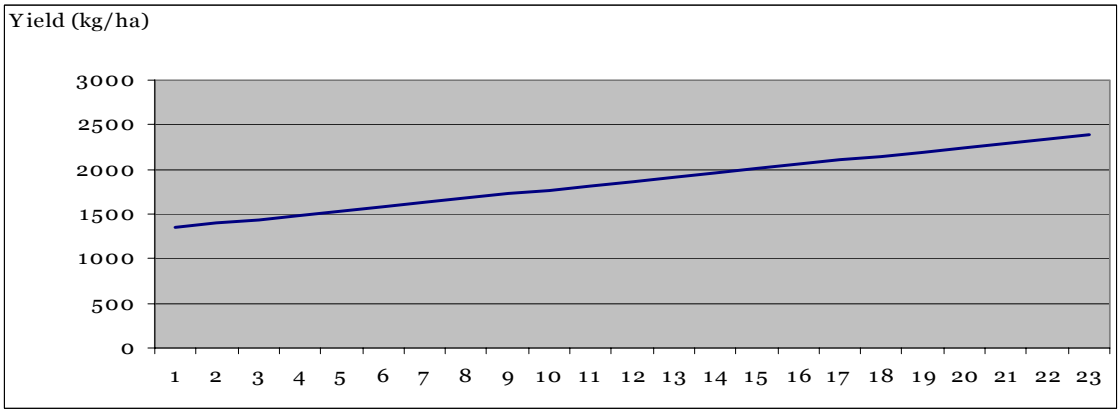
Table 16. Estimates of the yield response for cereals & legumes, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	758.61	234.35	0.0046		
Lagged yield	0.25	0.18	0.1775	0.25	0.33
Difference in rainfall	1.83	0.70	0.0177	0.0006	0.0007
Difference in prod. cost	0.36	0.18	0.0676	0.04	0.48
Time trend	47.34	14.88	0.0052	0.30	0.41

Source: Elaborated by the author.

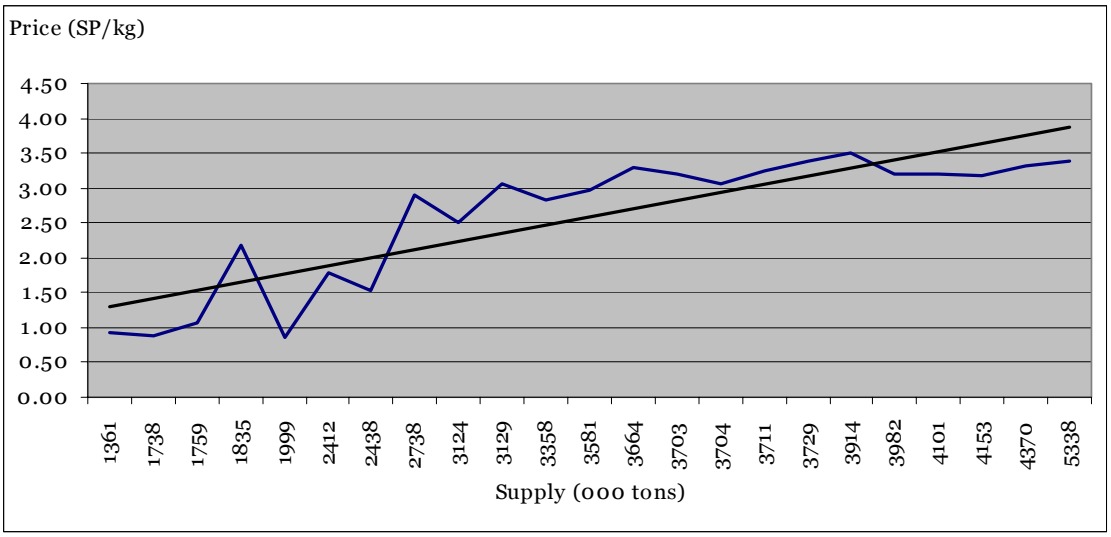
Figure 26 depicts the curve of the yield response for cereals & legumes with respect to the time trend holding all other factors impacting the yield constant, which shows an increasing trend. Figure 27 traces the combined effect of the area and yield response on the supply of cereals and legumes indicating also an upward sloping trend line.

Figure 26. Yield response for cereals & legumes with respect to the time trend, 1982-2005



Source: Elaborated by the author.

Figure 27. Production response for cereals & legumes with respect to the price, 1982-2005



Source: Elaborated by the author.

5.2. Estimates of vegetables

Table 17 illustrates the estimates of the area response for vegetables using SUR, which gave more significant results than OLS, comprising the regression coefficients, testing results and short and long-run elasticities. The supply equation of the area explains 89% of the area variations. All regression coefficients are statistically insignificant at the 5% level of significance with the exception of the lagged area of vegetables. The signs and magnitudes of the regression coefficients coincide with economic theory. The elasticities indicate a positive relationship between the area supplied, the lagged price of vegetables and the lagged area of vegetables as well as a negative correlation between the area supplied and the lagged prices of fruits and cereals & legumes. The long-run elasticities are considerably higher than the short-run ones. The elasticities point out also to a rigid supply in the short-run. The rigidity of supply is also prevailing in the long-run with the lagged prices of fruits and cereals & legumes.

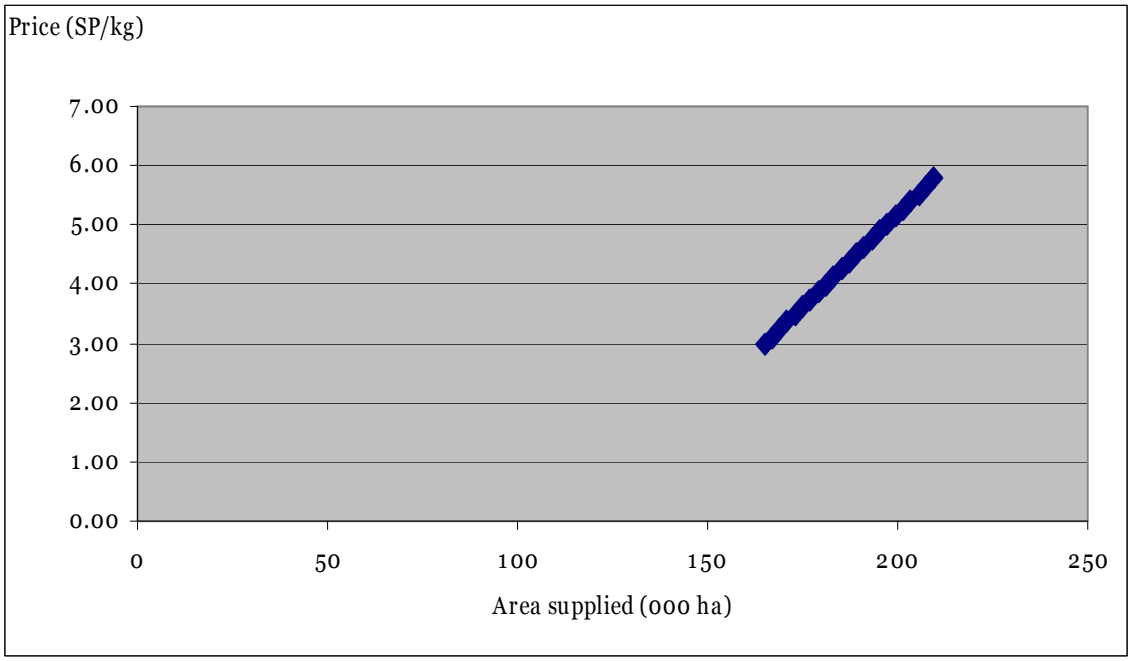
Table 17. Estimates of the area response for vegetables using SUR, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	55.27	81.40	0.5058		
Lagged area	0.67	0.22	0.0062	0.69	2.10
Lagged price of vegetables	15.96	12.92	0.2329	0.37	1.14
Lagged price of fruits	-6.62	4.33	0.1436	-0.26	-0.80
Lagged price of cl	-7.09	17.74	0.6942	-0.09	-0.29

Source: Elaborated by the author.
cl: Cereals & legumes.

Figure 28 traces the supply curve of the area response for vegetables with respect to the lagged price of vegetables holding all other factors affecting the area constant from 1982 to 2005. The figure shows a positive relationship between the area supplied and the price.

Figure 28. Supply curve of the area for vegetables with respect to the price, 1982-2005



Source: Elaborated by the author.

Table 18 incorporates the estimates of the yield response with respect to the yield in the previous year, the difference in rainfall, the difference in production cost of vegetables and the time trend comprising the regression coefficients, testing results and short & long-run elasticities. The yield equation explains 68% of the yield variations. All regression coefficients are statistically significant at the 10% level of significance excluding the one of the lagged yield. The elasticities indicate a positive relationship between the yield of vegetables and its affecting factors. The long-run elasticities are substantially higher than the short-run ones. The elasticities point out also to a rigid yield response in both the short-run and the long-run.

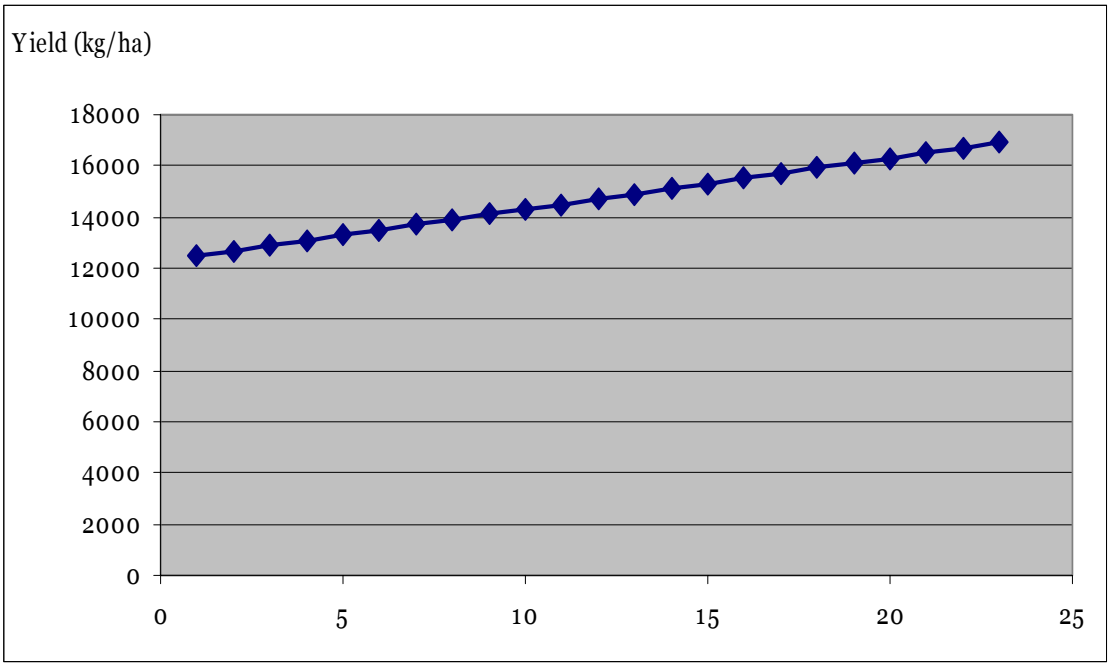
Table 18. Estimates of the yield response for vegetables, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	758.61	234.35	0.0046		
Lagged yield	0.25	0.18	0.1775	0.25	0.33
Difference in rainfall	1.83	0.70	0.0177	0.0006	0.0007
Difference in prod. cost	0.36	0.18	0.0676	0.04	0.48
Time trend	47.34	14.88	0.0052	0.30	0.41

Source: Elaborated by the author.

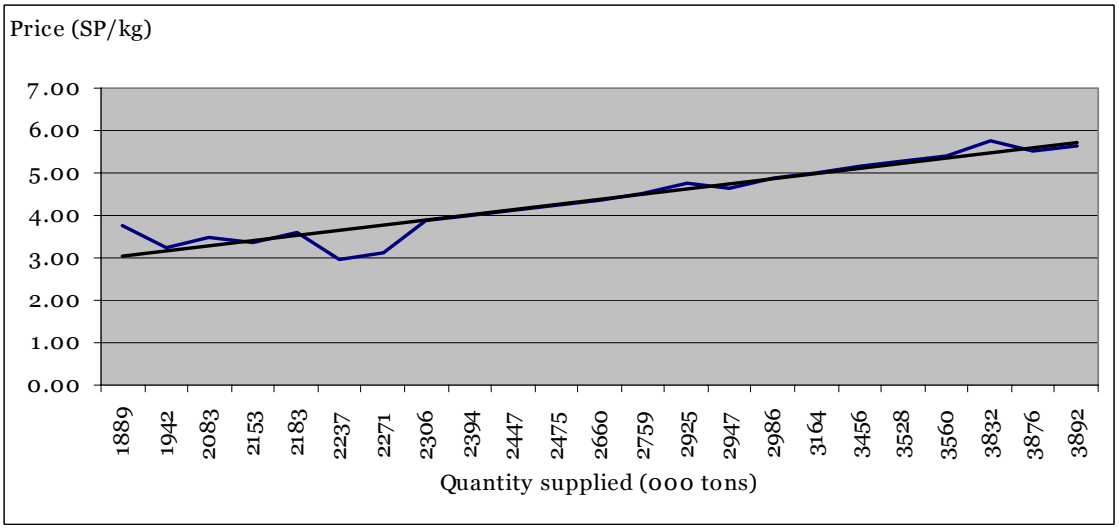
Figure 29 depicts the yield response of vegetables with respect to the time trend holding all other factors impacting the yield constant, which shows an increasing trend. Figure 30 traces the combined effect of the area and yield responses on the quantity supplied of vegetables indicating also an upward sloping trend line.

Figure 29. Yield response for vegetables with respect to the time trend, 1982-2005



Source: Elaborated by the author.

Figure 30. Production response for vegetables with respect to the price, 1982-2005



Source: Elaborated by the author.

5.3. Estimates of fruits

Table 19 illustrates the estimates of the area response of fruits using SUR comprising the regression coefficients, testing results and short and long-run elasticities. The supply equation of the area explains 85% of the area variations. The regression coefficients are statistically insignificant at the 5% level of significance with the exception of the lagged area of fruits. The signs and magnitudes of the regression coefficients coincide with economic theory. The elasticities indicate a positive relationship between the area supplied and the price of fruits, the lagged area of fruits and the lagged price of vegetables as well as a negative correlation between the area supplied and the lagged price of cereals & legumes. The long-run elasticities are considerably higher than the short-run ones especially that of lagged area

of fruit. The elasticities point out also to a rigid supply in the short-run. The rigidity of supply is also prevailing in the long-run with the price of fruits, price of cereals & legumes and lagged price of vegetables.

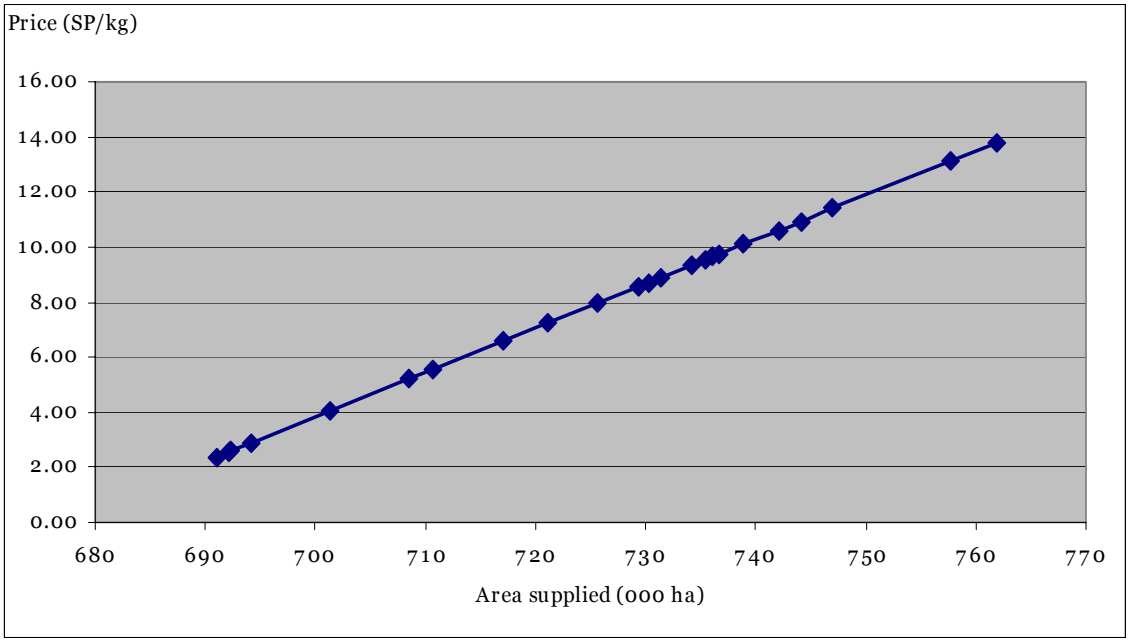
Table 19. Estimates of the area response for fruits using SUR, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	128.02	71.92	0.0919		
Lagged area	0.82	0.14	0.0000	0.810	4.71
Price of fruits	6.20	5.49	0.2733	0.063	0.37
Lagged price of vegetables	0.68	8.74	0.9386	0.002	0.010
Lagged price of cl	-13.35	23.06	0.5698	-0.045	-0.261

Source: Elaborated by the author.
cl: Cereals & legumes.

Figure 31 traces the supply curve of the area response for fruits with respect to the price of fruits holding all other factors affecting the area constant from 1982 to 2005. The figure shows a positive relationship between the area supplied and price.

Figure 31. Supply curve of the area for fruits with respect to the price, 1982-2005



Source: Elaborated by the author.

Table 20 incorporates the estimates of the yield response with respect to the yield in previous year and the time trend comprising the regression coefficients, testing results and short and long-run elasticities. The yield equation explains 58% of the yield variations. The regression coefficient of the lagged yield is statistically significant at the 11% level of significance, whereas the regression coefficient of the time trend is statistically significant at the 5% level. The elasticities indicate a negative relationship between the yield of fruits and its lagged yield and a positive relationship with the time trend. The long-run elasticities are lower than the short-run ones. The elasticities point out also to a rigid yield response in both the short-run and the long-run.

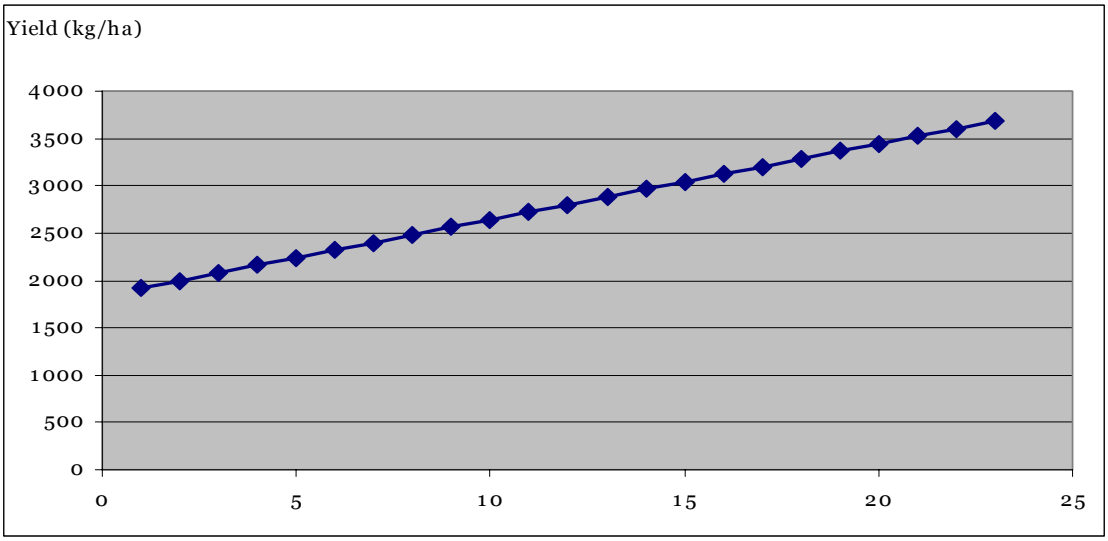
Table 20. Estimates of the yield response for fruits, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	2773.07	444.06	0.0006		
Lagged yield	-0.33	0.20	0.1072	-0.33	-0.25
Time trend	80.34	16.04	0.0000	0.34	0.26

Source: Elaborated by the author.

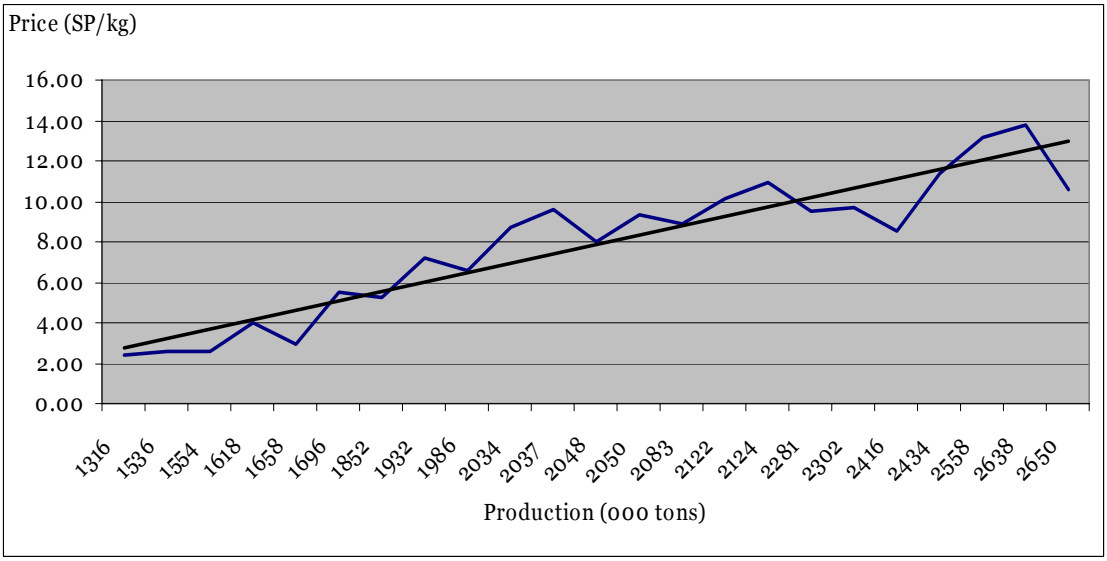
Figure 32 depicts the yield response of fruits with respect to the time trend holding all other factors impacting the yield constant, which shows an increasing trend. Figure 33 traces the combined effect of the area and yield response on the quantity supplied of fruits indicating an upward sloping trend line.

Figure 32. Yield response of fruits with respect to the time trend, 1982-2005



Source: Elaborated by the author.

Figure 33. Production response of fruits with respect to the price, 1982-2005



Source: Elaborated by the author.

5.4. Estimates of red meat

Table 21 illustrates the estimates of the production response of red meat using SUR comprising the regression coefficients, testing results and short-run and long-run elasticities. The supply equation of red meat explains 81% of the production variations. The regression coefficients of lagged production of red meat, number of heads of sheep, cattle and goats and the lagged price of red meat are statistically significant at the 5% level of significance. The regression coefficient of the lagged price of poultry meat is statistically significant at the 10% level of significance. All other regression coefficients are statistically insignificant. The elasticities indicate a positive relationship between the supply of red meat and the lagged production of red meat, the number of heads, the lagged price of red meat and the lagged price of poultry meat. While there is an inverse relationship with the lagged price of eggs, the price of milk and the lagged price of feed. The long-run elasticities are considerably higher than the short-run ones. These elasticities point out to a rigid supply in both the short-run and the long-run.

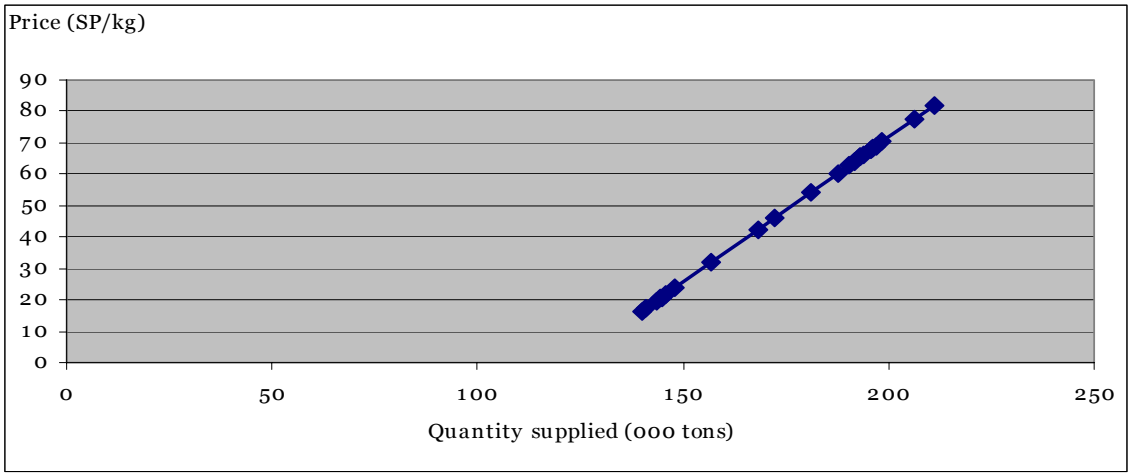
Table 21. Estimates of the production response of red meat using SUR, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	15.58	25.93	0.5570		
Lagged production	0.49	0.13	0.0018	0.47	0.92
Number of heads	0.004	0.00	0.0294	0.31	0.61
Lagged price of red meat	1.08	0.35	0.0076	0.30	0.59
Lagged price of poultry m.	3.78	1.94	0.0705	0.35	0.68
Lagged price of eggs	-18.58	18.48	0.3306	-0.07	-0.14
Price of milk	-13.97	10.04	0.1844	-0.27	-0.52
Lagged price of feed	-20.59	19.16	0.2997	-0.19	-0.36

Source: Elaborated by the author.
m.: Meat.

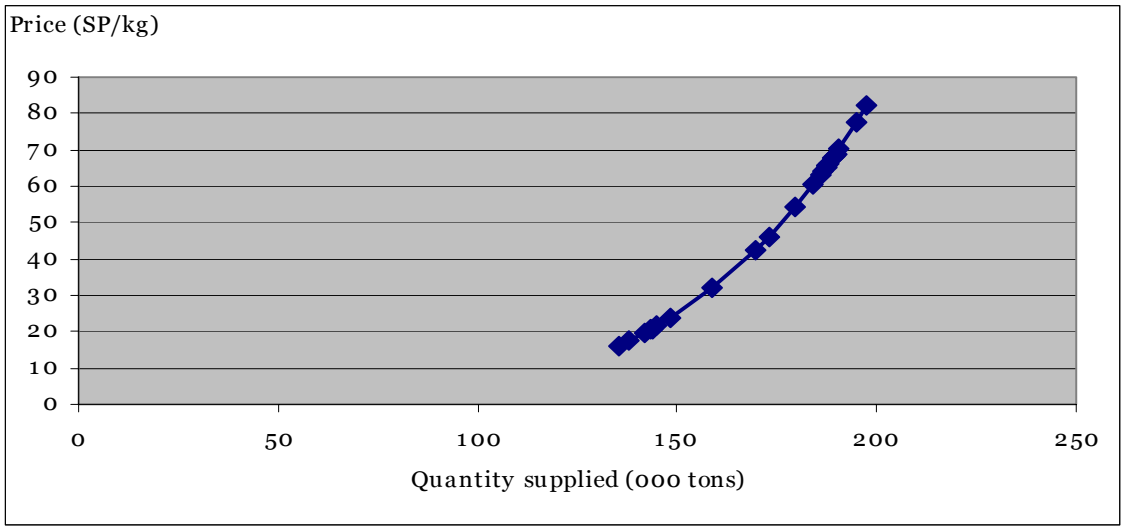
Figure 34 traces the supply curve of the production of red meat with respect to its price holding all other factors affecting red meat production constant from 1982 to 2005 taking into consideration the linear form. The figure shows a positive relationship between the quantity supplied and the price. Figure 35 illustrates the exponential supply response.

Figure 34. Linear supply curve of the production response of red meat with respect to its price, 1982-2005



Source: Elaborated by the author.

Figure 35. Exponential supply curve of the production response of red meat with respect to its price, 1982-2005



Source: Elaborated by the author.

5.5. Estimates of poultry meat

Table 22 illustrates the estimates of the production response of poultry meat using SUR comprising the regression coefficients, testing results and short-run and long-run elasticities. The supply equation of poultry meat explains 92% of the production variations. The regression coefficient of the lagged production of poultry meat is statistically significant at the 5% level of significance. The regression coefficient of the number of poultry heads however is statistically significant at the 10% level of significance. All other regression coefficients are statistically insignificant. The elasticities indicate a positive relationship between the supply of poultry meat and the lagged production of poultry meat, the number of heads, the lagged price of poultry meat and the lagged price of feed. On the other hand, there is an inverse relationship with the other regressors. The long-run elasticities are considerably higher than the short-run ones. These elasticities point out to a rigid supply in both the short-run and the long-run with the exception of the elasticities of lagged production and the number of heads, which indicate elastic supply in the long-run.

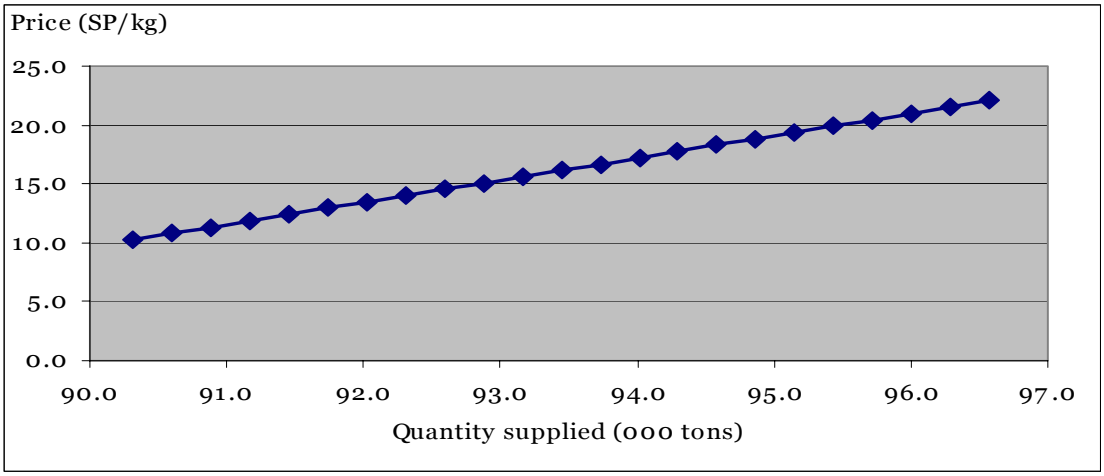
Table 22. Estimates of the production response of poultry meat using SUR, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	-14.01	14.25	0.3412		
Lagged production	0.79	0.18	0.0005	0.75	3.55
Number of heads	0.002	0.001	0.0525	0.47	2.22
Lagged price of poultry m.	0.53	2.77	0.8509	0.09	0.43
Lagged price of red meat	-0.31	0.30	0.3180	-0.16	-0.77
Lagged price of eggs	-9.92	11.63	0.4069	-0.07	-0.35
Price of milk	-2.94	6.88	0.67574	-0.10	-0.49
Lagged price of feed	10.41	10.75	0.3483	0.18	0.84

Source: Elaborated by the author.
m.: Meat.

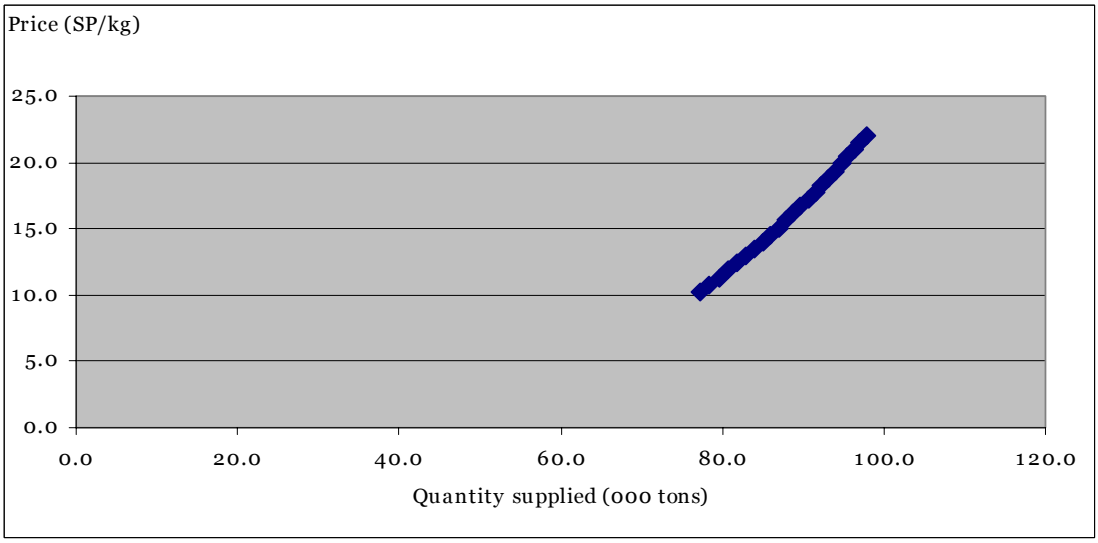
Figure 36 traces the linear supply curve of the production of poultry meat with respect to its price holding all other factors affecting poultry meat production constant from 1982 to 2005. The figure shows a positive relationship between the quantity supplied of poultry meat and the price. Figure 37 illustrates the exponential supply response of poultry meat.

Figure 36. Supply curve of the production response of poultry meat with respect to its price, 1982-2005



Source: Elaborated by the author.

Figure 37. Exponential supply curve of the production response of poultry meat with respect to its price, 1982-2005



Source: Elaborated by the author.

5.6. Estimates of eggs

Table 23 illustrates the estimates of the production response of eggs using SUR comprising the regression coefficients, testing results and short-run and long-run elasticities. The supply equation of eggs explains 99% of the production variations. The regression coefficients of the lagged production of eggs, number of productive chicks, price of milk and lagged price of feed are statistically significant at the 5% level of significance. The regression coefficient of the lagged price of poultry meat is statistically significant at the 10% level of significance. All other regression coefficients are statistically insignificant. The elasticities indicate a positive relationship between the quantity supplied of eggs and the lagged production of eggs, the number of layers, the lagged price of eggs, the lagged price of red meat and the lagged price of feed. On the other hand, there is an inverse relationship with the other regressors. The elasticities point out also to a rigid supply in both the short-run and the long-run with the exception of the elasticity with respect to layers, which implies an elastic supply in the long-run.

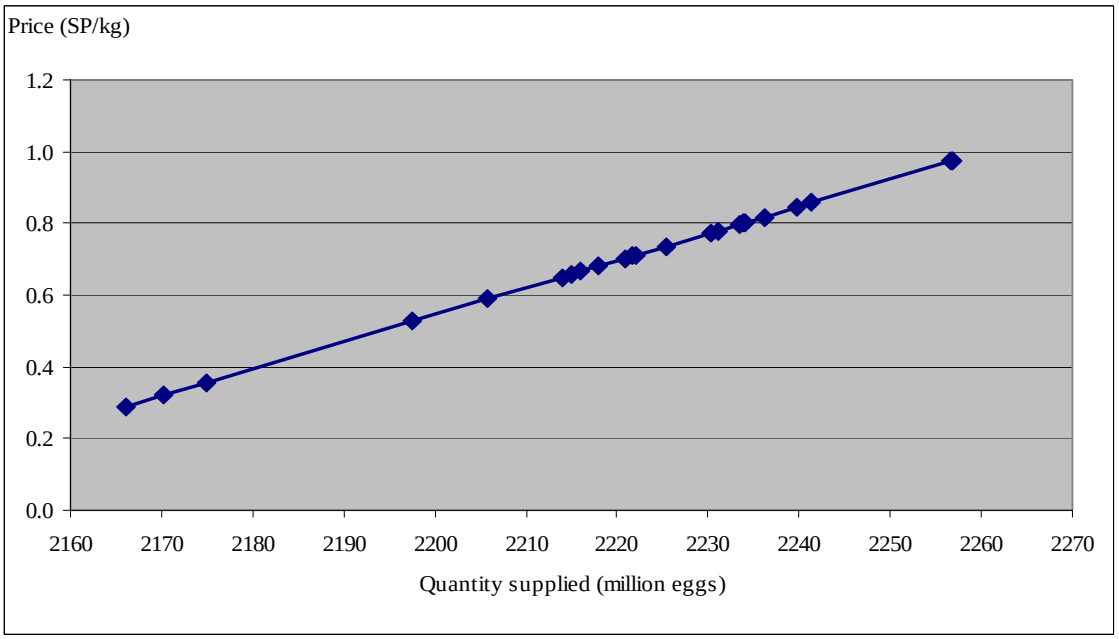
Table 23. Estimates of the production response of eggs using SUR, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	-97.49	100.95	0.3495		
Lagged production	0.15	0.05	0.0076	0.14	0.17
Number of heads (layers)	0.18	0.01	0.0000	0.99	1.16
Lagged price of eggs	132.04	88.85	0.1580	0.04	0.04
Lagged price of poultry m.	-17.79	9.10	0.0696	0.03	0.03
Lagged price of red meat	0.40	2.31	0.8652	-0.10	-0.11
Price of milk	-103.95	45.54	0.0375	-0.30	-0.32
Lagged price of feed	208.43	87.98	0.0317	0.22	0.24

Source: Elaborated by the author.
m.: Meat.

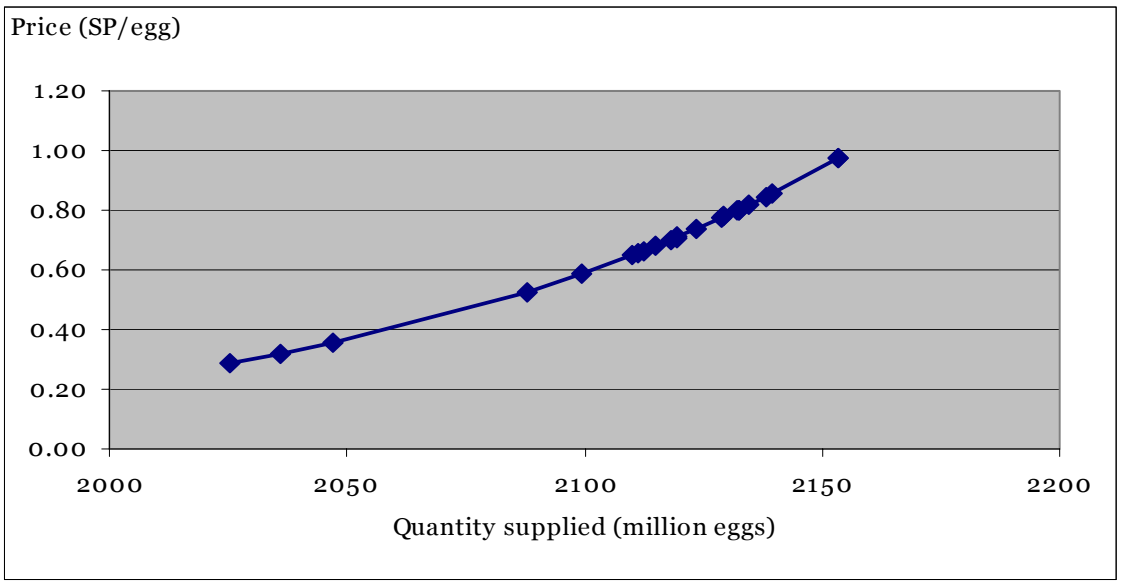
Figure 38 traces the linear supply curve of eggs with respect to own-price holding all other factors affecting egg production constant from 1982 to 2005. The figure shows a positive relationship between the quantity supplied of eggs and the price. Figure 39 illustrates the exponential supply response of eggs.

Figure 38. Linear supply curve of eggs response with respect to own-price, 1982-2005



Source: Elaborated by the author.

Figure 39. Exponential supply curve of eggs response with respect to own-price, 1982-2005



Source: Elaborated by the author.

5.7. Estimates of milk

Table 24 illustrates the estimates of the supply response of milk using SUR comprising the regression coefficients, testing results and short-run and long-run elasticities. The supply equation of milk explains 94% of the production variations of milk. The regression coefficients of the lagged production of milk, number of milked cows, lagged price of red meat and intercept are statistically significant at the 5% level of significance. All other regression coefficients are statistically insignificant. The elasticities indicate a positive relationship between the supply of milk and the lagged production of milk, the number of milked cows, the price of milk and the lagged price of red meat. On the other hand, there is an inverse relationship with the other regressors. The elasticities point out also to a rigid supply in both the short-run and the long-run with the exception of the elasticity with respect to lagged production of milk and number of milked cows, which indicate elastic supply in the long-run.

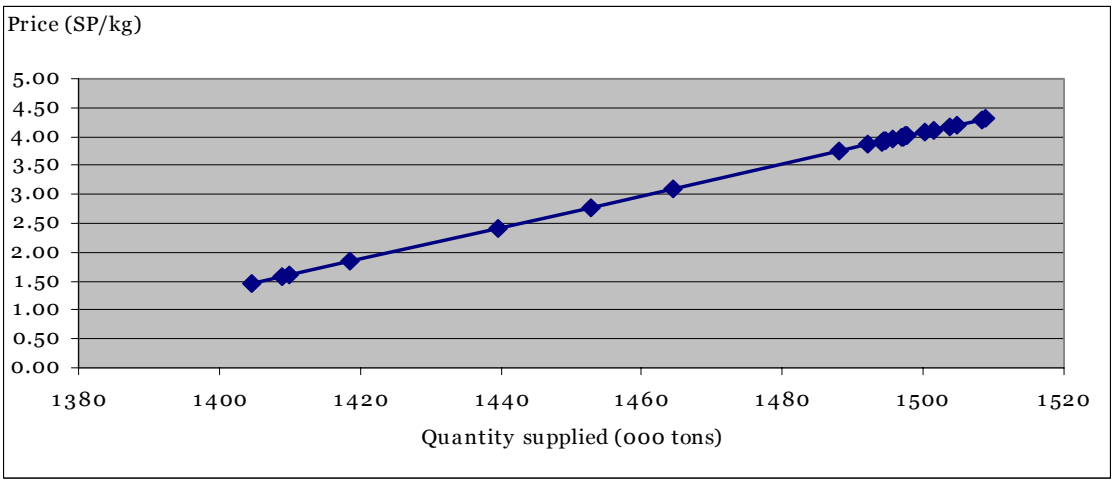
Table 24. Estimates of the supply response of milk using SUR, 1982-2005

Variable	Coefficient	Standard error	P-value	Sort-run elasticity	Long-run elasticity
Intercept	-250.80	112.31	0.0412		
Lagged production	0.62	0.14	0.0004	0.60	1.57
Number of milked cows	0.07	0.02	0.0011	0.47	1.23
Price of milk	36.55	52.95	0.5005	0.09	0.22
Lagged price of poultry m.	-0.98	10.11	0.9242	-0.01	-0.03
Lagged price of red meat	4.49	1.92	0.0338	0.15	0.39
Lagged price of eggs	-33.54	98.04	0.74	-0.02	-0.04
Lagged price of feed	-95.69	101.24	0.3595	-0.10	-0.27

Source: Elaborated by the author.
m.: Meat.

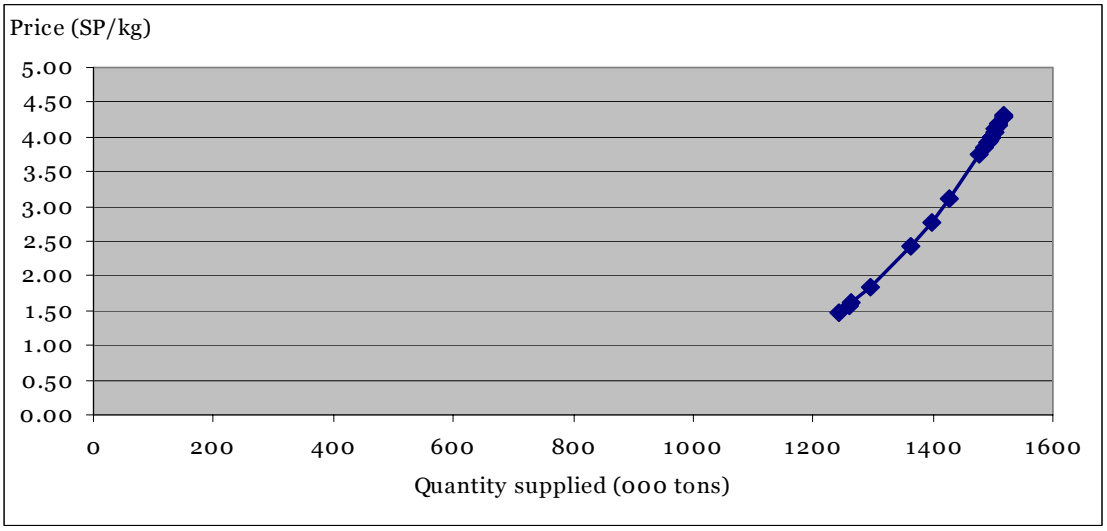
Figure 40 traces the linear supply curve of milk with respect to own-price holding all other factors affecting milk production constant from 1982 to 2005. The figure shows a positive relationship between the quantity supplied of milk and the price. Figure 41 illustrates the exponential supply response of milk.

Figure 40. Linear supply curve of milk response with respect to own-price, 1982-2005



Source: Elaborated by the author.

Figure 41. Exponential supply curve of milk response with respect to own-price, 1982-2005



Source: Elaborated by the author.

6. Concluding remarks

The estimates of this research are considered the base for conducting more detailed assessment taking into account single agricultural products and future expectations. They are also helpful by building an advanced database so that the figures are organized and processed in such a way to be used directly for multiple purposes. These estimates are acceptable when they compared with international ones.

The research has been organized in this way to comply with the estimates of the demand study[1] , to conduct partial equilibrium analysis in future, to assess the impact of various policies in place and to help by the decision making process.

[1] Grad Samir and Mouzad Karkout. Demand analysis for selected food groups in Syria. NAPC, Damascus, 2008.

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