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## World agricultural production and consumption

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### Abstract

The article deals with an analysis of the world agricultural and foodstuff production and consumption. It analyses production and consumption development during the last 45 years (1961-2006). The aim of our paper is to analyse the current growth of population and foodstuff consumption and production and on the basis of these analyses, the paper tries to analyse the past and current food production development. In general, the paper analyses which factors influenced the foodstuff demand and which factors influenced the foodstuff supply.

The study is part of a project which focuses on an analysis of the development of world agricultural production (supply) and consumption (demand) and which is undertaken by the authors within the VZ MSM 6046070906 ("Economics of resources of Czech agriculture and their efficient use in frame of multifunctional agri-food systems").

### Key words

Agriculture, production, consumption, development, analyses, World.

### Anotace

Článek analyzuje vývoj světové agrární produkce a spotřeby v období let 1961-2006. Cílem článku je analyzovat vývoj světové populace, produkce a spotřeby potravin v uplynulých 45 letech a na základě provedené analýzy poukázat na minulé a současné trendy v oblasti světové produkce a spotřeby agrárních produktů. V obecné rovině pak článek analyzuje obecné faktory, které ovlivňují vývoj nabídky a poptávky po agrárních produktech ve světě.

Článek je součástí projektu zaměřeného na analýzu vývoje světové nabídky a poptávky po potravinách na, kterém autoři dlouhodobě pracují v rámci VZ MSM 6046070906 („Ekonomika zdrojů českého zemědělství a jejich efektivní využívání v rámci multifunkčních zemědělskopotravinářských systémů“).

### Klíčová slova

Zemědělství, produkce, spotřeba, vývoj, analýza, svět.

### Introduction

The agricultural sector is one of the most important sectors of the world economy. Although the share of agricultural sector in the total world economy is about 6.3%, we have to emphasize that the agricultural sector has a very important influence on the world human society development. The ancient Greek philosopher Xenofon, speaking about agriculture, said that: "Agriculture is the mother of all sciences. When it works well, other sciences prosper. When it is marginalized, other sciences deteriorate". We have to agree with ancient Xenofon. He was completely right when he told

that the agricultural sector is one of the cornerstones of the human society.

The agricultural sector and its development supported a steady growth of the world economy. Other sectors of world economy take an advantage of a well working agrarian sector. The agrarian sector offered additional labour forces; its growing productivity enabled many people to move out of the agricultural sector and supports the development of some other sectors of world economy. In the past, the majority of the world population worked in the agricultural sector. Now, only 20% of the world population works in

agricultural business. There is a huge difference in a number of employees between developing and developed countries. In developed countries, only about 5% of the economically active population is working in the agricultural sector, while in developed countries, more than 20% of the total economically active population works in this sector.

The role of agriculture consists in a participation in a realization process of economic, political and social development which consists particularly in safeguarding the production function and rural regions.<sup>1</sup>

The influence of globalization processes, the New Economy and development tendencies in the world influence significantly development trends of agriculture in the world, integration groups or territories, the particular countries and regions.<sup>2</sup>

Nowadays, the agricultural sector plays a very important role because of a very intensive population growth. During the last 50 years, the world population increased by more than 200%. Its inter-annual growth rate reached the highest level in the history of human society development. In 1950, the world population was approximately 2.5 billion inhabitants, in 2006 it increased to more than 6.6 billion people. The average inter annual growth rate of population was about 1.7%. The following graph No.1 (together with the table No. 1) illustrates the world population development in the period 1960-2006.

## **Data and methods**

The paper analyzes the world agricultural production and consumption development in the years 1961-2006. It must be mentioned that this paper is written as a part of more extensive research undertaken by the author and the co-authors, and also that paper is undertaken within the framework of research activities which are a part of VZ MSM 6046070906 ("Economics of resources of Czech

agriculture and their efficient use in frame of multifunctional agri-food systems").

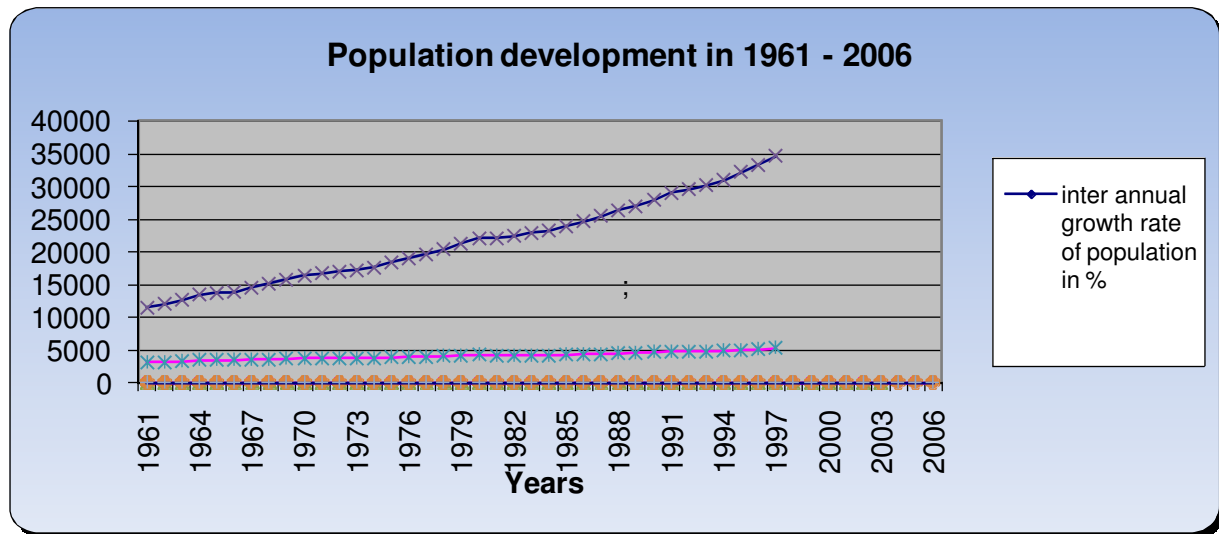
The aim of our paper is to analyze the current growth of agricultural consumption and production and on the basis of these analyses, this paper attempts to analyze past and current food production and consumption development. In general, it can be stated that this paper analyses which factors influenced the foodstuff demand and which factors influenced the foodstuff supply. For the purpose of our analyses we decided to analyze an influence of the following factors on the total world agricultural production and consumption: the population growth, the available agricultural and arable land, GDP, GDP/cap, the consumption of fertilizers, and the level of technological development (number of machines and vehicles used in the agricultural sector).

The fundamental data source for needs of this paper is the Food and Agricultural Organization's database. This database includes the main data about agricultural production and its utilization (<http://faostat.fao.org/site/502/default.aspx>). For the purpose of data analyses we used the following methods: time series analysis, linear and non-linear regression analysis, basic and chain indices. The analyses of consumption and production are performed in metric tons. Data for an analysis of GDP development are taken from the UN Statistics Division's database. All the data about the world GDP are calculated in USD (constant prices of 1990). Data about available agricultural and arable land are taken from FAOSTAT database. Data about the world population development are taken from UN Population Division's database. The world agricultural production and consumption are analysed in the following two basic categories: plant production and consumption (cereals, fibres, fruits, nuts, oil crops, pulses, roots and tubers, rubber, fodder crops, spices, stimulants, sugar crops, tobacco and vegetables), and animal production and consumption (meat, milk, eggs and honey). For the purpose of the structural analysis of agricultural products consumption, the agricultural consumption is analysed in the following six sub-categories: feeds consumption, seeds consumption, waste, primary production consumption, processed products consumption, nonfood utilization of agricultural production..

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1 SVATOŠ, M., *Economics of Czech and Slovak Agriculture Integration with the EU*, Prague 1999, ISBN 80-213-0497-9

2 SVATOŠ, M.: *Selected trends forming European agriculture*, *Agric. Econ. – Czech*, 54 (2008), No. 3, 93 – 101



Graph 1.

	Population (in billion inhabitants)		inter annual growth rate 1960-2006	inter annual and total growth of population 1960-2006 (in million)	Population development in 1960-2006	Share of population in total population	
	1960	2006				1960	2006
<b>World</b>	3.03	6.59	1.70%	77.41 / 3 561	117.45%	xxx	Xxx
<b>Developed Countries</b>	0.92	1.22	0.62%	6.59 / 303	33.11%	30.22%	18.50%
<b>Developing Countries</b>	2.12	5.37	2.05%	70.82 / 3 258	153.97%	69.78%	81.50%

Source: FAO, own processing

Table 1: World population development in 1961 – 2006.

## Results and discussions

The globalization as a multidimensional process is not only a driving power but at the same time it is a resultant force of many development trends. In this sense, the formation of sustainable dimension of globalization is fundamental from the view-point of world society, economy and ecology. This aim is very considerably connected with global trends. In characterization of the global structures and definition of requirements for the needs of global coordination, it is necessary to stem from multidimensionality and mutual connection of the globalization processes and trends. Besides other decisive spheres of the global trends and the connected requirements of sustainable development

there is the area of world society, the world economy and the world ecology.<sup>3</sup>

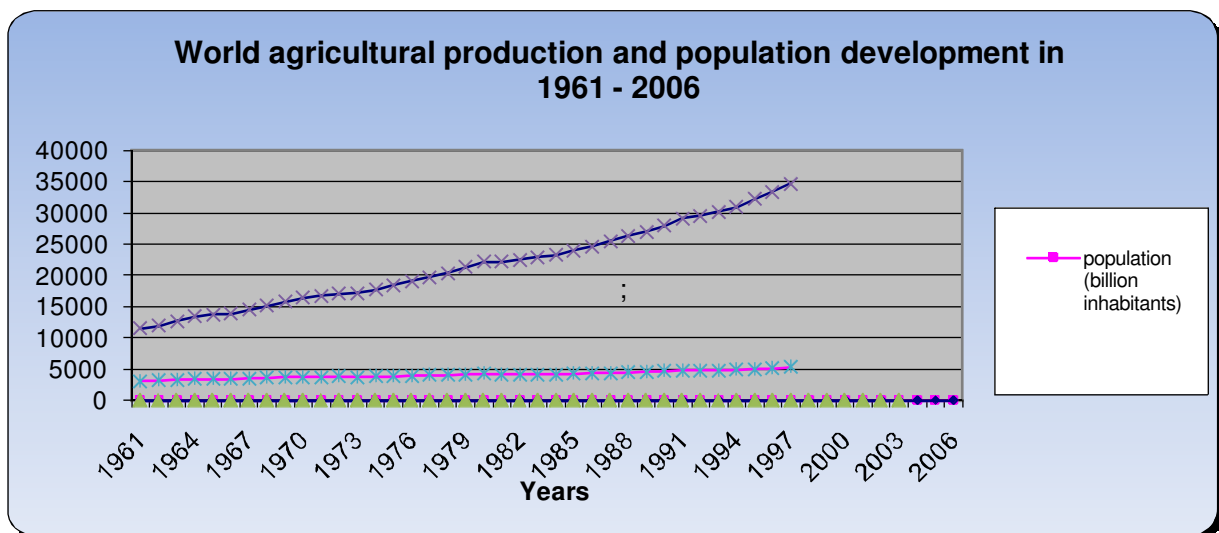
The population growth rate during the last 50 years was enabled by an intensive growth of agricultural production. The agricultural sector increased its production during the period 1960 – 2006 by 145% (which means that the average inter-annual growth rate of production reached the value 2.05%). It means that the growth rate of agricultural production was higher than the growth rate of world population. The following graph No. 2 illustrates the population and agricultural production growth during 1961-2006.

3 SVATOŠ, M.: Selected trends forming European agriculture, Agric. Econ. – Czech, 54 (2008), No. 3, 93 – 101

The current world agricultural production (in 2006, the volume of total agricultural production reached 8.9 billion tonnes) is represented by 88.8% crops production (7.9 billion tonnes). The share of animal production is only about 11% (approximately 1 billion tonnes). Even though, the volumes of crops and animal production constantly increase, the ratio between crops and animal production did not significantly change during the last 45 years. The world crops production increased during the analyzed period by 148% - i.e. 4.7 billion tonnes (average inter annual growth rate reached the value of 2.07%), animal production increased by 131% - i.e. 0.564 billion tonnes (average inter annual growth rate reached the value of 1.88%). The total world agricultural production increased during the analysed time period by 146% - i.e. 5.3 billion tonnes (average inter annual growth rate reached the volume of 2.05%). If we analyze the production development, we have to also analyze its structure. The main components of agricultural production are crops and the animal production. The following table No. 2 illustrates the structure of world production and its development during the last 45 years.

The world crops production consists particularly of the following commodity groups production: cereals, sugar crops, fodder crops, vegetables, oil crops, roots and tubers, fruits, pulses, fibres,

stimulants, nuts, spices and so on. The animal production is represented particularly by the following commodities: milk, meat and eggs. The following commodities have the main share in the total volume of world agricultural production. The main pillars of the world agricultural production are cereals (25%), sugar crops (18.5%), fodder crops (11%), vegetables (10.2%), oil crops (8.4%), roots and tubers (8.3%), milk (7.4%), fruits (5.9%), meat (3.1%) and the share of others is about 2.35%. During the last 45 years (1961 – 2006), the world agricultural production increased significantly. The most progressive growth (about more than 200%) of production can be seen in the following commodity groups: oil crops (381%), rubber (367%), (eggs (339%), spices (315%), meat (287%), nuts (267%), and fruits (200%). It is obvious that the high growth rates are usually connected with commodities with a low share in the total production and a relatively higher price per kilogram. Conversely, commodities with a significant share in the total world production are connected with a relatively lower production growth (sugar crops - 170%, cereals - 153%, stimulants – 137%, fibres – 104%, honey -100%, milk - 90%, tobacco - 88%, roots and tubers - 62%, fodder crops – 57% and pulses – 48%).



Graph 2.

	World production (in million tonnes)		Average inter annual growth rate	Inter annual growth (in million tonnes)	Production growth 1961-2006	Production growth 1961-2006 (in million tonnes)	Share of production in total production	
	1961	2006					1961	2006
<b>Cereals</b>	877.8	2 221.1	2.17%	29.9	153.04%	1 343.3	24.25%	24.99%
<b>Fibres</b>	14.4	29.3	1.87%	0.3	104.00%	15.0	0.40%	0.33%
<b>Fruits</b>	176.0	526.5	2.50%	7.8	199.14%	350.5	4.86%	5.92%
<b>Nuts</b>	3.0	11.1	3.09%	0.2	267.54%	8.1	0.08%	0.12%
<b>Oilcrops</b>	154.5	743.5	3.63%	13.1	381.14%	588.9	4.27%	8.36%
<b>Pulses</b>	40.8	60.2	0.98%	0.4	47.48%	19.4	1.13%	0.68%
<b>Roots, Tubers</b>	455.4	736.7	1.15%	6.3	61.78%	281.3	12.58%	8.29%
<b>Rubber, gums</b>	2.1	9.9	3.54%	0.2	367.85%	7.8	0.06%	0.11%
<b>Fodder crops</b>	620.6	972.6	1.36%	7.8	56.72%	352.0	17.15%	10.94%
<b>Spices</b>	1.8	7.3	3.35%	0.1	315.40%	5.6	0.05%	0.08%
<b>Stimulants</b>	7.0	16.6	2.18%	0.2	137.78%	9.6	0.19%	0.19%
<b>Sugarcrops</b>	609.1	1 649.7	2.32%	23.1	170.83%	1 040.5	16.83%	18.56%
<b>Tobacco</b>	3.6	6.7	1.85%	0.1	87.85%	3.1	0.10%	0.08%
<b>Vegetables</b>	222.2	903.4	3.19%	15.1	306.55%	681.2	6.14%	10.16%
<b>Eggs</b>	15.1	66.5	3.36%	1.1	339.53%	51.4	0.42%	0.75%
<b>Honey</b>	0.7	1.4	1.67%	0.0	100.03%	0.7	0.02%	0.02%
<b>Meat</b>	70.5	272.9	3.06%	4.5	287.03%	202.4	1.95%	3.07%
<b>Milk</b>	344.4	653.8	1.44%	6.9	89.81%	309.4	9.52%	7.35%
<b>Crops</b>	3 188	7 895	2.07%	104.6	147.61%	4 706.4	88.1%	88.8%
<b>Animal</b>	430.8	994.6	1.88%	12.5	130.89%	563.8	11.9%	11.2%
<b>Total</b>	3 619	8 889	2.05%	117.1	145.62%	5 270.2	xxx	xxx

Source: FAO, own processing

Table 2: World agricultural production development.

## Agricultural products consumption development

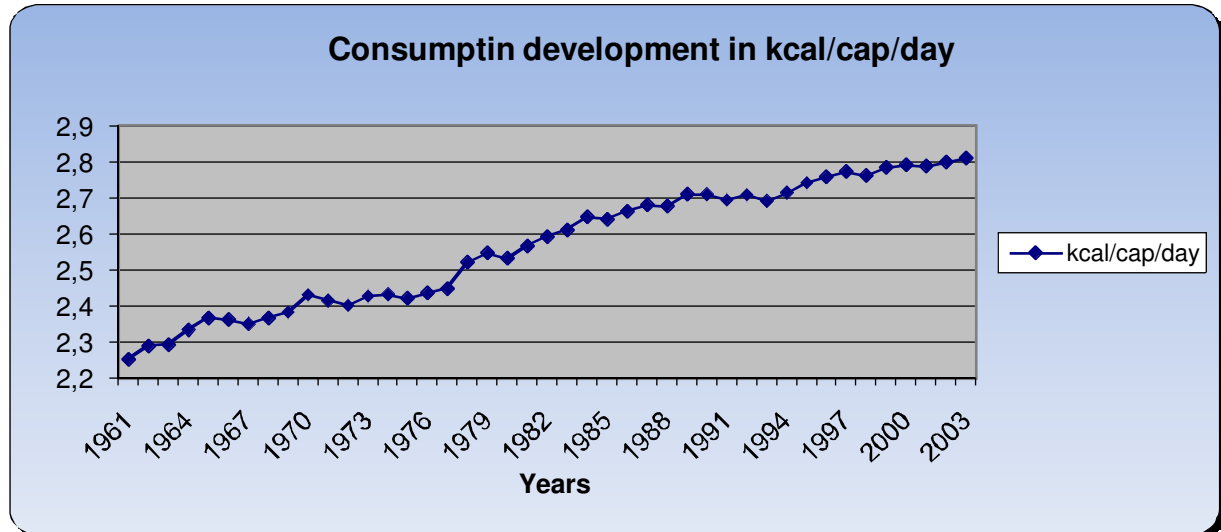
The world agricultural production is closely related to the level of agricultural consumption. During the analyzed period, the world agricultural products increased by 171%. If we analyze the world population growth – one of the main agricultural production stimuli – we can see that the population growth is the main source of agricultural products consumption growth. During the analysed period, the share of food products consumption in the total agricultural products consumption increased from 73% in 1961 to 78% at present. It is necessary to emphasize that the share of production used as a foodstuff constantly grows – and because the world agricultural production grows faster than the world population, the world food consumption per capita is slowly increases. The growth of consumption can be observed in the following graph No. 3 – which illustrates the growth of foodstuff consumption in

kcal/cap/day. The graph illustrates that the world average consumption/capita/day increased its caloric value by 24%. The growth of consumption caloric value is stimulated by the following two factors: the growth of consumption volume and improvements to the quality of the consumed products (higher nutrition value in one unit of consumed products). Thanks to these developments, it is possible to see changes in the structure of world production. It is possible to see that although the world production of all analyzed commodity groups grew, the growth rate of production is higher in the case of products with high nutrition values. Nevertheless, the ratio between the shares of crops and animal production in the total world agricultural production is the same from 1961 to the present. While the share of crops production in the total consumed nutrition value is 86%, the share of animal production is only 14%.



The total world agricultural consumption is not represented only by the food and foodstuff industry consumption. A huge part of the world agricultural consumption is represented by the feeds and seeds consumption, the industrial non-food consumption (for example - bio-fuels and so on) and also a certain part of the world production is lost because of manipulation, poor storage conditions, and so on. The current share of non-food agricultural products consumption in the total agricultural products consumption is about 22% (i.e. 1.650 billion tonnes) and in spite of the fact that the quantity of consumption continuously grows, the share of non-food agricultural products consumption in total agricultural products consumption constantly decrease (in 1961 it was 27% - i.e. 0.812 billion tonnes). It is possible to see following development trends in the non-food consumption. The share of feeds and seeds consumption in the total world agricultural products consumption decreases. During the analyzed period, their share decreased from 21% to 15.5%. In spite of the fact that the share of feeds and seeds consumption in the total consumption decreases, the total quantity of agricultural products, which are produced as feeds

or seeds, constantly increases. In 1961, the seeds and feeds consumption represented by 127 and 512 million tonnes respectively, at present, the seeds consumption is represented by 153 million tonnes of agricultural products and the feeds consumption is represented by 1.026 billion tonnes of agricultural products. While the share of feeds (mainly: fodder crops, cereals, starchy and tubers crops, vegetable, oil crops and sugar crops) and seeds (mainly: cereals, starchy and tubers crops, pulses and oil crops) consumption decrease, the share of agricultural production, which is used by the non-food industry, slowly increases – at present, the share of the non-food industry consumption in the total agricultural products consumption is 2.1% - 160 million tonnes (i.e. during the analyzed period, the share of agricultural consumption, which is used by non-food industry, increased by 50% - in 1961; the total production used for non-agricultural and food purposes represented 45 million tonnes). The growth of production which is consumed by the non-food industry is especially stimulated by the increasing demand for alternative energies and bio fuels.



Graph 3.

World (in hectares)	1961	2006
available arable land per capita	0.41	0.22
available agricultural land per capita	1.44	0.75
total available area per capita	4.22	1.97

Source: FAO, own processing

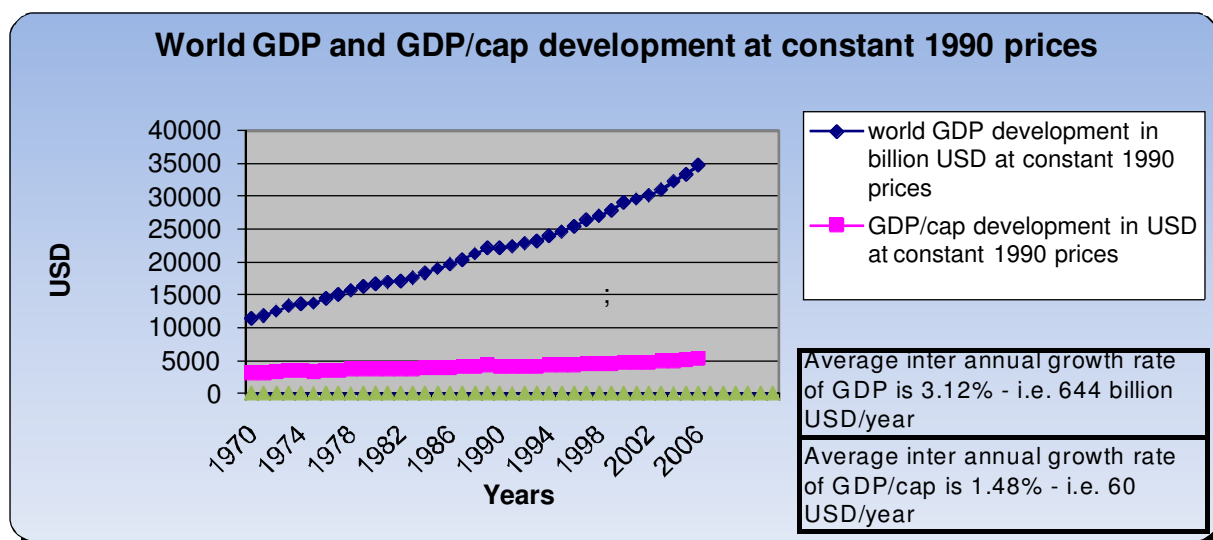
Table 3: Available land/cap development in the world.

The last part of the total agricultural products consumption is represented by a waste of agricultural production. The share of waste in the total consumption is stable in the long term. During the analyzed period, the share of waste in the total consumption oscillated between 3.9 – 4.4%. The current share of waste in the total consumption is more than 4% (i.e. 311 million tonnes of world production is lost somehow). The following commodity groups have the main shares in the total waste of agricultural production: cereals (26%), sugar crops (24%), starchy roots (22%) and eggs (14%). The share of other commodity groups in the total waste is about 15%.

### Factors which have been influencing world production and consumption development

The world agricultural production and consumption possibilities are influenced (limited) by the technological level of human society, an available agricultural area (which is suitable for agricultural production), yields respectively an available production per hectare development, climate conditions, the population growth, GDP and

GDP/cap development, and many other factors. If we analyze the technological level of agricultural production and the level of productivity, it has to be emphasized that the character of agricultural sector changed during the last more than 40 years. The number of machines and vehicles increased during the analyzed period by more than 122% (according to FAO - the current number of machines and vehicles used in the agrarian sector reached almost 34 million pieces). Another factor which influenced the world agricultural production is the consumption or the availability of fertilizers. The current consumption of basic fertilizers (N,P,K) reached almost 161.5 million tonnes, and it is possible to expect that the consumption will permanently increase because during the years 2002 – 2005 alone, the world consumption of fertilizers increased by 10% (the current available amount of fertilizers per hectare in the world reached 32.5 kilograms). New methods and technological development increased the total agricultural sector's production rate. We can see that the world agricultural production increased by 148% and the main reason for this development trend is increasing productivity (yields or number of animals per hectare development).



Graph 4.

	1961	2006
Animals (head)	0.66	0.95
Poultry (1000 head)	0.98	3.90
Crops production (tonnes)	0.72	1.59
Animal production (tonnes)	0.10	0.20

Source: FAO, own processing

Table 4: Agricultural production per one hectare of available agricultural land.



	1961	2006	inter annual growth rate (%)	relative change	absolute change
<b>World population (in billion inhabitants)</b>	3.03	6.59	1.70%	117.45%	3.56
<b>World agricultural production (in billion tonnes)</b>	3.62	8.89	2.05%	145.62%	5.27
<b>World agricultural consumption (cal/cap/year)</b>	2253.77	2808.87	0.53%	24.63%	555.10
<b>World available agricultural land (in billion hectares)</b>	4.46	4.97	xxx	11.49%	0.51
<b>Available agricultural land per capita in the world (hectares/cap)</b>	1.44	0.75	xxx	-47.75%	-0.69
<b>World GDP (in billion USD) 1970 - 2006</b>	11 501.0	34 694.0	3.12%	201.66%	23 193.0
<b>World GDP/cap (in USD) 1970 - 2006</b>	3 109.0	5 262.0	1.48%	69.25%	2 153.00
<b>Available number of machinery (in million pieces)</b>	15.23	33.96	xxx	122.94%	18.72
<b>Available amount of fertilizers (in million tonnes)</b>	150.26	163.14	xxx	8.57%	12.88
<b>World crops production (in billion tonnes)</b>	3.19	7.89	2.07%	147.61%	4.71
<b>World animal production (in billion tonnes)</b>	0.43	0.99	1.88%	130.89%	0.56
<b>Agricultural production per hectare - crops production (tonnes/hectare)</b>	0.72	1.59	xxx	122.10%	0.87
<b>Agricultural production per hectare - animal production (tonnes/hectare)</b>	0.10	0.20	xxx	107.10%	0.10

Source: FAO, own processing

Table 5: Main indicators of world agricultural production and consumption development.

A very important factor is the available land area. During the analyzed period, the world agricultural area increased by 11.5%. The current agricultural area represents approximately 38% (almost 5 billion hectares) of the total land area in the world (about 13 billion hectares). The share of arable land in the total world land and agricultural area is about 10% and 28% respectively. The share of arable land has the same development trend as the share of agricultural area, both increased by approximately 10%. While the total area, which is used for agricultural activities, increases, it has to be emphasized that the total agricultural area per capita, and especially the arable land per capita, decrease significantly. During the analyzed period, the available area per capita decreased by more than 50% (in 1961, the available area per capita was about 4.22 hectares and in 2006 it was only 1.98 hectares). The same development trend can be observed in the case of arable and agricultural land development (the table No. 3).

The above mentioned development trend is connected with an intensive need to increase the effectiveness of the world agricultural production – because the population growth (the table No. 1 and the graph No.1) together with the growth of incomes and GDP growth (the graph No. 4) are

connected with the growth of demand for agricultural and foodstuff products. Because the surface of the Earth is constant, the growth of population is connected with the decrease of available area per capita. Owing to this development, the agricultural sector has to increase production and the only way to achieve it is to increase the production effectiveness. The following table No. 4 illustrates the development of agricultural production intensity (a number of animals per hectare and yields per hectare) during the last 45 years. It can be seen that the production growth is connected with the process of intensification.

While the total available agricultural and arable land in the world increased approximately only by 10%, the agricultural production per one hectare of agricultural land increased significantly. During the analyzed period, the crops production per hectare increased by 122%, the animal production increased by 107% and the number of animals and poultry per hectare increased by 42% respectively 300%. In general, it is possible to see that owing to the intensification process (the growth of yields per hectare), the total world agricultural production increased by almost 150% during the last 45 years

(the share of slowly increasing agricultural area in this production growth is only minimal).

Another stimulus for the growth of production respective to consumption is GDP growth. The graph No. 4 illustrates the total world GDP and GDP/cap development. It is possible to see that the average inter annual growth rate of world GDP's reached a value of about 3.12% (644 billion USD / year) and GDP/cap also increased by 1.48% every year.

The growth of GDP respective to GDP/cap is connected with the growth of demand for food, foodstuff product and raw materials. The economy and population growths are connected not only with the growth of food consumption, but also with growth of other sectors' demand. It is possible to see that through the permanent growth of income per capita, the individual agricultural products consumption also increased during the whole analyzed period. The food consumption/capita/year (the current value is 640.4 kg) increased during the analyzed period by 27% (i.e. 136.5 kg). The average inter-annual growth rate reached a value of about 0.58% (i.e. 3.25 kg). If we analyze the influence of population and GDP/cap growth on the total consumption (with respect to production) development, we have to highlight the following development trend. The growth of total food and foodstuff consumption (about 171% during the analyzed period) is especially stimulated by the population growth (about 113%), while the influence of growing GDP/cap (which is connected with the increasing level of individual demand for foodstuff products) was only about 58%. Nevertheless, both mentioned factors played a very important role in the development process of agricultural sector.

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## **Conclusion**

The following table No. 5 provides data describing the world agricultural production development and the development trends of those factors which influenced the world production in the most significant way.

During the last 45 years, the agricultural production and consumption significantly increased their volumes. The permanent growth of agricultural products consumption stimulated the growth of production by 150%. While the world demand (consumption) for food is especially stimulated through the population growth and the growth of individual incomes, the growth of world agricultural production (which is stimulated through the growth of demand for agricultural products) is especially achieved through the growth of production effectiveness (yields per hectare growth) and through the growth of available areas which are used for agricultural activities. Nevertheless, it is necessary to emphasize that the influence of new available areas is only minor; the main share in the total growth of production is the growth yields per hectare.

Nowadays, the world agriculture is standing at a crossroad – a very important crossroad. Agriculture is a very important part of the world economy and plays a key role in the development of human society. Agriculture is not only the source of food for a permanently growing population; it is also a very important part of sustainable development concept. It is connected with the following issues - for example: food security, market and price stability, environment protection, rural development, bio-fuel and so on.

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