

**PRODUCTIVITY AND THE PRODUCTIVITY  
FACTORS OF THE AGRICULTURAL SECTOR IN  
THE REPUBLIC OF MACEDONIA<sup>1</sup>**

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**Abstract**

The agrarian sector is the foundation for growth of the entire economy, especially for developing countries, but also is given special attention in the highly industrialized countries. The effects on agriculture resulting from its direct impact on the economic development of a country, with his relative share in the GDP, the deployment of labour and reducing unemployment, it is a special source of raw materials for industry development, especially for food but also for the development of industry for production of machines, production of various preparations for plant protection, trade in agricultural products, agro-tourism and handicrafts. What will be the contribution of agriculture to the economic development of a country apart from the other determinants is influenced by the level of productivity of the overall agricultural production and productivity of special factors involved. The productivity of agriculture is important for many reasons, such as: providing more food, increase market competitiveness, improve the distribution of

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<sup>1</sup> review scientific paper

agricultural income and increase savings, reduce labor migration, etc. Agricultural productivity is directly dependent on technological progress. For these reasons, investment in research and development in all sectors, and also in agriculture, have a major impact on economic growth and development of a country. The agrarian sector is vital for the economic development of the country. Bearing all this in mind the main purpose of this paper will be analyzing the importance of agricultural sector development in the country especially to assess its productivity, by considering how much attention has been given to research and development in this sector. Also through comparative analysis of the productivity of agriculture in the European Union we aim to point out the necessity of the measures necessary to improve the productivity of factors involved as a precondition of its faster growth and higher contribution to the economic development of the country.

**Keywords:** agrarian sector, economic growth, productivity

## INTRODUCTION

Until the mid-20th century it was believed that agriculture is unproductive and therefore all investments and policies are guided towards the industry as highly productive activity. Industry and agriculture are interdependent and development of one activity inevitably leads to the development of other activity, agriculture is a source of raw materials for industry, and industry turn to the production of modern machinery and equipment, as well as production of quality fertilizers and plant protection products, has a direct impact on increasing yields from agriculture.

Farmers who apply new techniques and technologies increase their productivity and generally enhance their well-being, while farmers who are not sufficiently productive are forced to leave the market and look for another source of livelihoods.

The comparative advantage of farms who are more productive increases, which means it can produce products with lower costs and therefore lower prices apart from the rest. And thus become competitive on regional and world markets. Increasing the productivity of agriculture can contribute to poverty alleviation in less developed countries where agriculture often employs the majority of the population.<sup>2</sup>Productivity in agriculture is becoming more important with the growth of world population. India, which

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<sup>2</sup>*Promoting Pro-Poor Growth: Agriculture, DAC Guidelines and Reference Series, Paris: OECD, 2006*

is one of the most populous countries in the world, has taken steps in the past decades to increase land productivity. Forty years ago, North India produced only wheat, but with the increase in yields of cereals and rice after wheat collected from the field, are planted rice. This combination of production of wheat and rice are used to increase the production of pulses. Wheat yield of three tons and rice yield of two tons are combined to produce five tons of grain products per hectare to feed the 1.1 billion people in India<sup>3</sup>. Productivity in agriculture is dependent on many factors, the significant are listed: machinery used, using varieties seeds with high yield, fertilizers used with primary and secondary nutrients, limiting use of limestone to prevent the occurrence of acid soils and raising the pH and providing the necessary amounts of calcium and magnesium, irrigation, using herbicides and pesticides, increased density of plants, processing of feed to be more digestible, keeping animals indoors when cold weather.

### **IMPORTANCE OF THE AGRICULTURE AND MORE IMPORTANT FEATURES OF THE AGRICULTURAL SECTOR IN THE ECONOMIC DEVELOPMENT**

The most accepted definition of agriculture is that it is an economic activity which involves the production of plant and animal origin and domestic processing of agricultural products. Often agriculture is accepted as a business activity that is based on systematic knowledge, science and skills.. The analysis of agriculture in many studies<sup>4</sup>, usually start with primary agricultural production, starting from the statistical methodologies and data without taking into account the processing of products, which is very important and has its part in the creation of macroeconomic aggregates, such as gross - domestic product, income, employment etc. Agriculture has a direct impact on the economic development of a country with his relative share in GDP and employment. It is a source of raw materials for industry development, especially for food industry but also for the development of the industry for producing machines, various

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<sup>3</sup>Brown, Lester R. *Plan B 2.0: Rescuing a Planet Under Stress and a Civilization in Trouble*. New York City: Earth Policy Institute, 2006

<sup>4</sup>Rimando T.J. 2004, *Crop Science 1: Fundamentals of Crop Science*. U.P. Los Baños: University Publications Office.,

Abellanosa A.L. u H.M. Pava 1987, *Introduction to Crop Science*. Central Mindanao University, Musuan, Bukidnon: Publications Office.

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preparations for plant protection, the development of trade in agricultural products, development of agro-tourism and handicrafts. In general it can be taken that agriculture is very important for the development and prosperity of a country in many ways. The survival of humanity depends mainly on the delivery and availability of healthy food, that it is not only the quantity of food security, on the contrary, in recent decades more and more attention is paid to food safety. This question has been emphasized in underdeveloped countries that have deteriorated the living conditions in which there is a lack of food. Common Agricultural Policy of the European Union aims to provide healthy and quality food especially for people living in the Member States of the European Union, as well as for the candidate countries and for developing countries.

The agrarian sector is vital for economic development of the Republic of Macedonia. As we see in general, the agrarian sector in the Republic of Macedonia has realistic prospects for further growth and development and its importance to the economy could actually increase by increasing cultivated areas and increasing livestock production, consolidation of land plots, horizontal and vertical integration of holdings in agricultural and food industry, improving the conditions for doing business in rural areas, increase productivity of available factors of production, increase food security, increasingly introducing agro-ecological approach to agricultural production, increase exports and increase foreign direct investment in this sector.

The main functions of agriculture can be grouped into three categories: environmental, economic and social group of functions.<sup>5</sup>

The function of protecting the environment means that agriculture can have a positive or negative (adverse) effects on the environment. Agriculture can mitigate the effects of climate change, maintain biodiversity, can contribute to the preservation of water quality and its availability and to reduce pollution through optimization of the relations with the biological and physical properties of the natural environment,.

Economic function means that agriculture is the foundation for growth of the entire economy. Valuation of different economic functions requires an assessment of short-, medium- and long-term benefit of agriculture. Important determinants of achieving economic function are the complexity and maturity of market development and institutional development, too.

Third, social function, means the maintenance of rural communities as the basis for maintaining agro-ecology and to improve the quality of life (and ensuring survival) of rural population. In rural areas there are not enough opportunities for new revenue, an inadequate crop cultivation is practicable,

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<sup>5</sup>*Food and Agriculture Organization of the United Nations, Netherlands Conference on the Multifunctional character of Agriculture and land*

inadequate maintenance of production systems, inadequate distribution networks, limited access to public services and poor quality of such services. The three functions of agriculture also highly interconnected. The relative importance of the three functions of agriculture depends on strategic choices, both at local and at national level, in accordance with needs, their impact should be evaluated over an extended period of time.

### **PRODUCTIVITY FACTORS IN THE AGRICULTURAL SECTOR**

Scientific research in the agricultural sector is of great importance for raising labour productivity, achieve higher earnings producing products with competitive advantages that can be placed besides the domestic and foreign markets. For these reasons, investment in research and development in all sectors, and in agriculture, have a major impact on economic growth and development of a country. The function of technical progress, which has been developed by Nicholas Kaldor, measure the technical progress as the rate of growth of labour productivity.<sup>6</sup> According to Nicholas, the higher the rate of capital growth - input per worker, the greater the rate of growth of output per worker or labour productivity. The rate of growth of labour productivity can be explained by the rate of growth of capital intensity. Technological progress is closely linked to human capital. Hence, the workforce should be appropriate to the available technology. Education directly affects the quality of available human capital that can use higher technology. Education helps people more effectively and more quickly adapt to new technology in terms of rapid technological development.<sup>7</sup>

The constant increase in gross expenditure on research and development is set by European Union as a priority objective and the process of integration of Macedonia into the European Union requires this priority order to be applied in Macedonia. Gross expenditure on research and development in the Republic of Macedonia in the last 5 years are about 0.2% of GDP.<sup>8</sup>

Total investment in research and development are around 0.22% of the gross domestic product of the Republic of Macedonia, which is a very small share in terms of participation in the European countries. Innovative businesses from the Department of Agriculture, Forestry and Fisheries participated with 2% of the total number of innovative entities.

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<sup>6</sup>Kaldor, Nicholas (1957). "A Model of Economic Growth". *The Economic Journal* 67 (268): 591–624. JSTOR 2227704

<sup>7</sup>Koh, Winston T. H.; Leung, Hing Man (2003). "Education, Technological Progress and Economic Growth". Working Paper. SSRN 637462

<sup>8</sup>State Statistical Office of the Republic of Macedonia

Productivity of the agricultural sector is directly dependent on technological progress. It is commonly measured as the ratio of agricultural production toward agricultural inputs. Agricultural productivity can also be measured by what is called total productivity of the factors of production (TFP). This method of calculating agricultural productivity compares the index of agricultural inputs with the index of agricultural production. This measure of agricultural productivity has been introduced to remedy the shortcomings of partial measurements of productivity. Changes in the overall productivity of the factors of production is usually attributed to technological progress.

Technological progress in agriculture by type of innovation and their effects is divided into three types, namely<sup>9</sup>:

Technological progress that is connected with the appearance of the tractor, in the late 19th century. There were more benefits to its discovery, for example, has significantly reduced the required labour, thus saving time and money, but the need for use the animals as traction is reduced too.

The second technological progress in agriculture was achieved in the 20th century, when started the greater use of different types of chemicals, and the means of protection of animals and plants.

Third technological progress in agriculture is associated with the genetic development of the creation of new and improved plant and animal species.

The fourth technological progress in agriculture relates to the improvement of all previous achievements, in order to get bigger and better production with reduced inputs. With all this agriculture becomes more competitive on the market.

### **ANALYSIS OF PRODUCTIVITY OF THE AGRICULTURAL SECTOR IN MACEDONIA**

Improving the productivity of agriculture is vital to ensuring the food needs of a growing human population. Over the past 50 years, productivity growth in agriculture make food more accessible and cheaper. A broader conception of agriculture productivity is the productivity of the factors of agricultural production (TFP). "TFP" takes into account land, labour, capital, and material resources engaged in agricultural production and compares them with the total amount of crop and livestock production. "TFP" is different from the measures, for example, the yield per hectare or value added per agricultural worker as takes into account the sum of the inputs used in

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<sup>9</sup>*Feeding the World-An Economic History of Agriculture 1800-2000, Giovanni Federico, Princeton University press, 2005*

production. "TFP" includes the average productivity of all inputs involved in production.

"The calculation of the growth" provides a practical way to measure changes in agricultural "TFP" in a wide range of countries and regions, and in the world at large, having in mind the limited international data on production and inputs.

"TFP" is ratio of the total production and total input in the production process.

$$TFP = Y/X$$

Y= total production and

X= total input.

**Table 1. Economic Accounts for Agriculture at constant prices (previous year = 100), production, in million denars, from 2006 to 2013 year**

	2006	2007	2008	2009	2010	2011	2012	2013	2006
Y. Output of the agricultural 'industry'	66442	64577	69072	76263	75217	76107	72849	82718	1,24
X. Total intermediate consumption	34372	31831	34936	34926	33719	32213	33506	35151	1,02
TFP=Y/X	1,93	2,03	1,98	2,18	2,23	2,36	2,17	2,35	

Source: State Statistical Office database, Economic Accounts for Agriculture and author's calculations

According to the data presented in Table 1, the rate of productivity of the factors of agricultural production in 2006 was 1.93%, in 2007 2.03%, in

2008 was 1.98%, in 2009 was 2.18%, in 2010 was 2.23%, in 2011 was 2.36%, in 2012 was 2.17% and in 2013 the rate of productivity was 2.35%.

Changes in the "TFP" over time are calculated by comparing the rate of change in the total production with rate of change of the total input. Expressed as logarithms, equation changes over time can be write down as:

$$\frac{d \ln(TFP)}{dt} = \frac{d \ln(Y)}{dt} - \frac{d \ln(X)}{dt}$$

This simply indicates that the rate of change "TFP" is the difference in the rate of change in aggregate output and input.

Agriculture is the production process with multiple inputs and outputs, which means that Y and X are vectors. When technology is present constantly, manufacturers increase profits so that the elasticity of output with respect to the input is equal to the share in the cost of that input, and the markets are in long-term competitive balance, so the total revenue is equals to total costs, then the equation can be written as:

$$\ln \left( \frac{TFP_t}{TFP_{t-1}} \right) = \sum_i R_i \ln \left( \frac{Y_{i,t}}{Y_{i,t-1}} \right) - \sum_j S_j \ln \left( \frac{X_{j,t}}{X_{j,t-1}} \right)$$

R<sub>i</sub>= share of the value of certain products in the total production

S<sub>j</sub>= participation of the different costs in the total input

Output growth is estimated by summing the growth rates for each product weighted by its share in total production. Input growth is estimated by summing the growth rate of each cost, weighted by their shares in total. The growth of "TFP" is only the difference between the growth of total output and total input.

According to the data of Table 1, 2 and 3, the rate of growth of productivity of factors of production in agriculture calculated for 2013 in respect of the entire period up to 2006 was 0.20.<sup>10</sup>

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<sup>10</sup>State Statistical Office, *Economic Accounts for Agriculture at constant prices and author's calculations*



**Table 2. Economic Accounts for Agriculture at constant prices (previous year = 100), production, in million denars, from 2006 to 2013**

	2006	2007	2008	2009	2010	2011	2012	2013	$R_i \ln \left( \frac{Y_{i,t}}{Y_{i,t-1}} \right)$						
									2007	2008	2009	2010	2011	2012	2013
01 Cereals	5807	4621	6863	7895	5200	5876	6500	7659	-0,02	0,04	0,01	-0,03	0,01	0,01	0,02
02 Industrial plants	4398	4138	3170	4661	5598	5076	4850	5199	0,00	-0,01	0,02	0,01	-0,01	0,00	0,00
03 Forage plants	6270	4283	4096	4507	4591	5258	3835	4875	-0,03	0,00	0,01	0,00	0,01	-0,02	0,01
04 Vegetables	19632	19043	17628	21418	24062	26148	22786	25525	-0,01	-0,02	0,05	0,04	0,03	-0,04	0,04
05 Potatoes	2300	1562	1770	1840	2021	2007	2600	2184	-0,01		0,00		0,00		0,00
06 Fruits	7530	7927	9209	7038	7671	7014	7731	8706	0,01	0,02	-0,02	0,01	-0,01	0,01	0,01

15 Agricultural services output	171	8337	491	1572	0	1980	1975	6019	3522
	259	9193	107	1293	0	3150	1979	6528	4659
	248	10580	491	1441	0	3250	2685	7868	4877
	201	14182	652	1340	7	2732	2806	7537	2719
	361	9781	616	1262	6	3139	3255	8277	2115
	345	8145	469	1451	6	3056	3234	8217	2238
	330	8690	402	1389	5	3019	3148	7963	2016
	368	10217	691	1540	5	2427	3237	7901	2952
	0,00	0,01	0,00	0,00	0,00	0,02	0,00	0,01	0,02
	0,00	0,02	0,01	0,00	0,00	0,00	0,01	0,02	
	0,00	0,05	0,00	0,00	0,00	-0,01	0,00	0,00	-0,02
	0,00	-0,05	0,00	0,00	0,00	0,01		0,01	
	0,00	-0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	0,00	0,01	0,00	0,00	0,00	0,00			
	0,00	0,02	0,00	0,00	0,00	-0,01	0,00	0,00	0,01





To reduce potential index number bias in TFP growth estimates, cost shares are varied whenever such information is available. For outputs, fixed base year prices are used.

The outlined above provides a simple means of decomposing the relative contribution of TFP and inputs to the growth in output. The growth in output is equal to the growth in TFP plus the growth rates of the inputs times their respective cost shares:

$$\dot{Y} = TFP + \sum_{j=1}^J S_j \dot{X}_j$$

Equation given above is a *cost decomposition* of output growth since each  $S_j \dot{X}_j$  term gives the growth in cost from using more of the input to increase output.

$$\dot{Y} = 0,20+0,17=0,37$$

According to FAO (Food and Agriculture Organization of the United Nations), agricultural production is measured as gross value of production using the sum of the average prices of the products, and is expressed in constant prices of 2005, in so called "International dollars".<sup>11</sup>

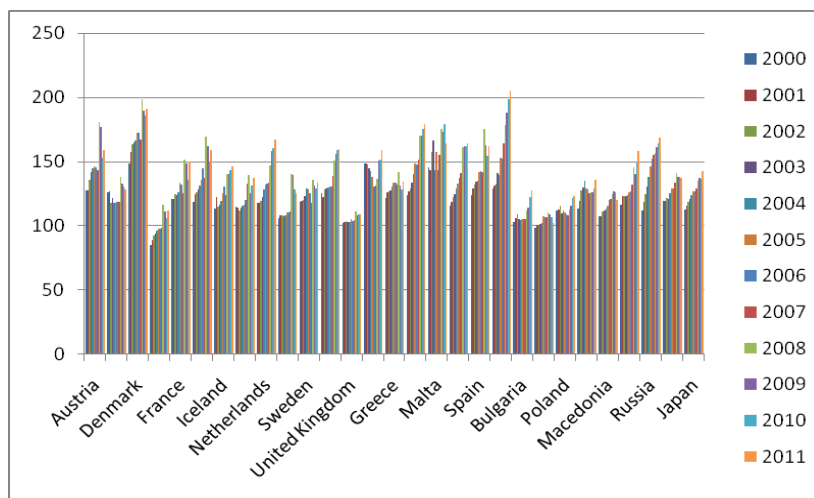
For the agricultural input data are used for crops (total and irrigated areas), permanent pastures, employees in agriculture, animal reserves, the number of agricultural machines in use and consumption of inorganic fertilizers.

**Figure 1. Growth of total factor productivity in agriculture (Agricultural Total Factor Productivity Growth) in the EU countries, in Macedonia and other selected countries, 2000-2011**

Indices (1992=100)

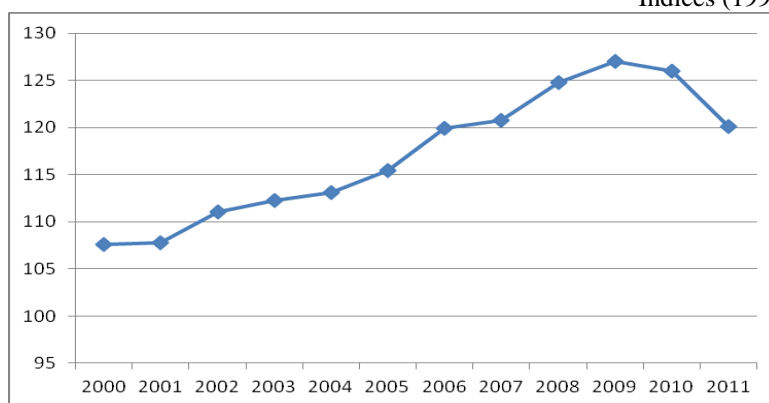
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<sup>11</sup> United States Department of Agriculture, Economic Research Service



Source: USDA, Economic Research Service

**Figure 2. Growth of total factor productivity in agriculture (Agricultural Total Factor Productivity Growth) in the Republic of Macedonia, 2000-2011**  
Indices (1992=100)



Source: USDA, Economic Research Service

Labour productivity (as one of the factors of agricultural production besides land, capital and material resources) is calculated when the value added created in agriculture will be put in relation to the number of employees. As shown in the table 4 in the Republic of Macedonia, during 2010 and 2011 there was a decline in productivity (up 1% and 2% respectively), and then

noticed an increase (in 2012 growth of 5% compared to 2011, and in 2013 growth of 0.4%).

Compared with the EU Member States (Table 5), the productivity of Macedonia is just higher than Latvia (3662 euros per employee), Poland (5270 euros per employee), Romania (3577 EUR) and Slovenia (6078 euros), while in the EU in 2013 they were created 17710 euros value added per employee in agriculture. Productivity in the Republic of Macedonia in 2013 is 65% lower than in the European Union.

**Table 4. Productivity of agriculture in the Republic of Macedonia, 2009-2013,**

	Gross value added in agriculture in million denars	Employed in agriculture	denars per employee	euros per employee
2009	42997	115581	372008	6032
2010	44258	120597	366991	5951
2011	43405	120893	359037	5822
2012	42493	112623	377303	6118
2013	48170	127186	378737	6142

*Source: State Statistical Office / database (estimated data for 2013)*

**Table 5. Gross value added and employment in the agriculture sector in the EU and Macedonia, 2013**

	Gross value added in agriculture in million euros	Employed in the agriculture sector (in thousands)	euros per employee
European Union	166.117	9.380	17710
Belgium	2.413	58	41603
Bulgaria	1.694	188	9011
Czech	1.442	145	9945
Denmark	2.715	61	44508
Germany	18.887	518	36461
Estonia	333	26	12808
Ireland	1.901	87	21851
Greece	5.215	459	11362
Spain	23.330	722	32313
France	25.511	767	33261
Croatia	1.126	143	7874
Italy	29.330	744	39422

Cyprus	337	9	37444
Latvia	249	68	3662
Lithuania	1.058	106	9981
Luxembourg	107	3	35667
Hungary	2.883	182	15841
Malta	63	2	31500
Netherlands	10.229	153	66856
Austria	2.775	163	17025
Poland	9.401	1.784	5270
Portugal	2.482	275	9025
Romania	7.658	2.141	3577
Slovenia	389	64	6078
Slovakia	598	77	7766
Finland	1.443	92	15685
Sweden	1.688	81	20840
Great Britain	10.860	266	40827
Macedonia	781	127	6142

Source: Eurostat and SSO / databases

Global agricultural growth (average annual growth in decades) slowed down in the 70s and 80s, but then increased in the period from the 90s. In the last ten years (2002-2011), world production of plant and livestock products is growing at an average rate of 2.53 percent per year. Over the last two decades, however, the growth rate of agricultural resources (land, labor, capital, etc.) is significantly delayed. In the last decade, improvements in "TFP" resulted in about two-thirds of the total growth of agricultural production worldwide. The global average growth rate of "TFP" in this period was 1.69 percent annually. This is due to the use of new technology and changes in management.

## CONCLUSION

The agrarian sector as separate part of the national economy correlates with economic development. So economic development can have a retroactive impact on the further growth and development of the agricultural sector through increased purchasing power of the population due to increased living standards, which means greater demand for agricultural products. Productivity in agricultural production in the Republic of Macedonia in comparison with EU countries is ten times lower. Multiple analyzes show that it is the highest correlation depending on the application of technical and technological solutions or the development research activities. We believe



that the productivity of the agricultural sector in the Republic of Macedonia can be increased through: the adoption of new techniques of crop production and livestock farming. To achieve this goal, it is needed to give adequate support by agriculture subsidies for growing crops and livestock, support for investment in the purchase of machinery and equipment, as well as with training and educating the farmers.

Outdated crop production and breeding technologies result in low yields and product quality. Investing in a new and modern machinery and equipment, including new modes of production, and even innovation, inevitably leads to an increased productivity of agriculture. The low level of education has a conservative attitude toward change and innovation and therefore it is necessary to improve the educational profile of the Macedonian farmer, as well as to invest in further education, in training and seminars including the so-called "lifelong learning and education."

Educational, scientific and research institutions should be encouraged to carry out research projects that aim to improve productivity with projects such as maintenance of a gene bank, the production of certified propagation materials, analyzes and testing of plants for diseases and pests protection, etc. It is necessary to develop the entrepreneurial capacity of managers towards increasing the competitiveness of products produced on farms, which need timely and accurate information, better resource management, introducing innovation, as well as market-oriented production of the holding.

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