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The Human Resources - a Factor for a Sustainable Agricultural Sector

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***Abstract*— The topicality of the topic: *The agricultural sector is vital to the national economy. A key factor in maintaining the well-being of the population is the human resource to specific activities in the sector, in the context of the common European agricultural policy union*. The research *aims* to assess the human factor as a tool for achieving sustainability in the agricultural sector of the economy. In terms of *methods* – in the study are used statistical methods, including arithmetic mean (arithmetic average) value, median, fashion. The development focuses on finding new income opportunities in the agricultural sector and tracking the digital skills of the population - with an emphasis on the Human Development Index - The Digital Economy and Society Index (DESI). *The main results* of the study of the achievements of human capital development are reduced to the identified need for new knowledge, respectively the growing need to acquire and maintain modern skills. This applies as a matter of priority to the managers of agricultural and livestock farms without completed education in the field of agriculture. This requires permanent qualification and retraining of employees in the agricultural sector. In conclusion, there is an opinion that the development of human potential requires training adequate to current technologies. The limited land as a resource for production requires the search for new opportunities for income in the agricultural sector. Regarding the research novelty on the developed issues - digital skills are perceived as a major factor in determining human capital, from this position the achievements in the individual member states of the European Union are followed. Study limitation - access to current public data. The development of a sustainable national agricultural sector is a guarantee of food security and independence, vibrant rural areas and employment of the local population.**

Keywords*— *Agricultural Sector, Human Development Index, Digital Skills.

I. Introduction

The agricultural sector is vital to the national economy. A key factor in maintaining the well-being of the population is the human resource to specific activities in the sector, in the context of the common European agricultural policy union.

The purpose of the study sets the stages of the study, ie. action plan. The research aims to objectively evaluate the human factor as a tool for achieving sustainability in the agricultural sector. The current study aims to reveal the state of the agricultural sector in terms of its ability to achieve sustainability for the development of individual and human capital as a whole. The agricultural sector is the primary sector of production. This proves its resilience in an indisputable way, on the one hand. On the other hand, the scarcity of land as a resource, the consolidation of farms and their specialization [1] justify the search for new opportunities for income in the agricultural sector.

In this regard, the research focuses on solving several conceptual problems, namely:

- Conduct a relevant review of the current state of the agro-industrial sector;
- Reflect trends in the development of human capital in crop production and animal husbandry;
- Identify employment priorities and the age structure of farm managers, including gender composition;
- Characterize the existing digital skills of the population of rural settlements, focusing on the Human Development Index (DESI).

The main results of the study of the achievements of human capital development are reduced to the identified need for new knowledge, respectively the growing need to acquire and maintain modern skills.

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Sustainable development characterized as a long-term development approach, including sustainability of results, «protection of the environment and natural resources, social and economic balance» [2].

The presented study reveals the state of the agricultural sector and proves its ability to achieve sustainability for the development of individual and human capital as a whole. The labor market feels the need to continuously improve the skills and retraining of workers in the industry. M. Petrova [3] points out that 98% of Bulgarian farmers do not have the necessary education; therefore, it is necessary to optimize the indicators of qualification and competence of the human capital of agricultural enterprises. Nevertheless, the intercalation of the competence approach into the human capital of agro-industrial enterprises is quite controversial [4]. Several researchers, scientists, and practitioners associate the development of the agricultural market and, accordingly, human capital with the introduction of environmental standards [5].

The concept of carbon farming was first mentioned in the strategy «From farm to fork», which aims to reduce the use of chemical pesticides by 50% and fertilizers by 20% by 2030. Carbon farming will in fact build on the Common Agricultural Program, which will enter effective from 2023. It is expected to contribute to the storage of 42 million tons of CO_2 in natural carbon sinks (Kodzhaivanova A (2022) [6].

The idea has both supporters and opponents. Critics say carbon offsets are basically a way for corporations and big business to shirk responsibility for the pollution they pay for by paying for it instead of actually reducing their emissions. There is also no mechanism to ensure that carbon storage in the soil is long-term.

An increasing number of studies highlight the potential of agrovoltaics (APVs) as an alternative in the fight against climate change. The idea of producing solar energy and growing crops on the same area originated in Germany in the early 1980s [7].

We are of the opinion, that the energy and transport, as pollutants, followed by agriculture (24-28%), are the reason for looking for ways to reduce damage to nature and climate change [6]. We consider it right, at European level, to seek new opportunities for a green business model - for example, carbon farming, in which the earth absorbs carbon dioxide from the atmosphere and stores it in the soil. The European Commission (European Union, 2021) [2] is about to regulate trade in emissions (so-called low- carbon agriculture) caught and stored in soils through Agri-environmental practices. The idea, presented as an opportunity for a new source of income for certified farmers, is still in its infancy. Legislation for reporting and certification is pending by the end of the year.

To protect the landscape and biodiversity is need further development and improvement of agro voltaic systems. This is an opportunity for sustainable policies in the energy, agriculture and rural development sectors.

II. Materials and methods

At national level, according to data from the Ministry of Agriculture [8], information on the number of agricultural holdings for the period 2003-2020 presented in Table 1. Their census was conducted in 2003, 2010 and 2020. Data for 2020 are preliminary. An intermediate review carried out in 2005, 2007, 2013 and 2016 respectively.

Table 1 Crop farms (number) in Bulgaria for the period 2003-2020

Year	Holdings (number)	Change (%) * compared to 2020 **
2003	665.500	-80
2005	534.600	-75
2007	493.100	-73
2010	370.200	-64
2013	254.100	-48
2016	201.000	-34
2020 *	132.400	-

Source: Compiled by the author.
Note: * Values are rounded.
** Presented data are preliminary.

Based on the presented information, the steady trend for the reduced number of plant farms is visible (Figure 1). In 2010 there were 371.100 farms. The decrease compared to the number of farms in 2003 was 44% and 64 % - 2020 compared to 2010. The decrease is maintained especially in recent years - by 2020 it is 80%.

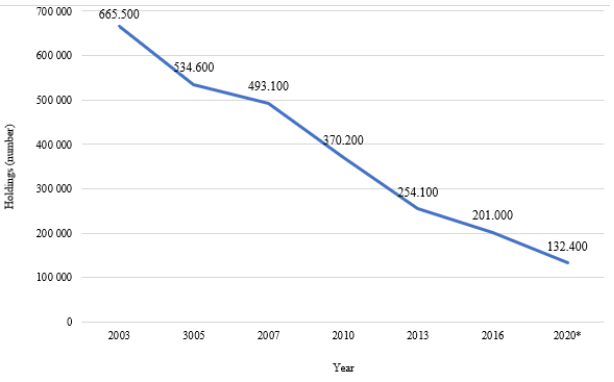

Fig. 1. Graphic presentation of the crop farms (number) in Bulgaria for the period 2003-2020.

Source: Compiled by the author.

The factors for the significant reduction are:

- The increased amount of utilized agricultural area - at average values cultivated by farms, amounting to 3.957 thousand ha. The positive trend is an increase of 9% compared to 2010 and 36% compared to 2003;

- Increased (average) number of holdings - Table 2, keeping animals, birds and bee colonies [9].

TABLE 2 BULGARIAN LIVESTOCK FARMS (NUMBER) FOR THE PERIOD 2003-2020 *

Year	Holdings (number)	Change (%) * compared to 2020 **
2003	600.815	-53%
2010	279.717	-74%
2020 *	71.693	-

Source: Compiled by the author.
Note: * Values are rounded.
** Presented data are preliminary.

The significant changes registered in the Livestock sector are presented in Figure 2.

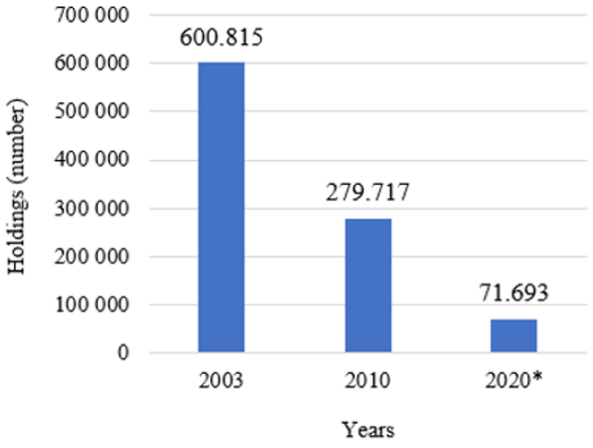

Fig. 2. Graphic presentation of livestock farms (number) in Bulgaria for the period 2003-2020.

Source: Compiled by the author.

As a structural determinant for the economy of our country, it is claimed that the agricultural sector provides employment to about 1,4 million people (permanently or seasonally employed). Data on the age structure of farm managers in the agricultural sector for the period 2003-2020 are presented in Table 3:

«The relative share of women farm managers in 2020 is 28% (compared to 5% as of 2010) [10].

Women in Europe make up 42% of the population labor in the agricultural sector**.** Three out of ten agricultural enterprises are run by women. With equal access to resources for women and men, it is claimed that agricultural production could increase by 30% (including 4% in developing countries), allowing another 150 million people to be fed» [10].

In recent years, there has been a change in the identified negative trend - Figure 3.

TABLE 3 AGE STRUCTURE OF BULGARIAN FARM MANAGERS FOR THE PERIOD 2003-2020

Years / Age	Relative share (%) by years		
	2003	***2010***	***2020****
Under 24	1	1	1
25-34	4	6	8
35-44	11	12	16
45-54	18	18	21
55-64	26	25	24
Over 65	40	37	31
Total:	100	99 **	101 **

Source: Compiled by the author.
Note: * Presented data are preliminary.
** Some inaccuracies in the published data have been found.

The development of a modern agricultural sector requires leadership to promote sustainability and diversity of the workforce.

The data presented in Table 4 are an opportunity for their deepening and further development.

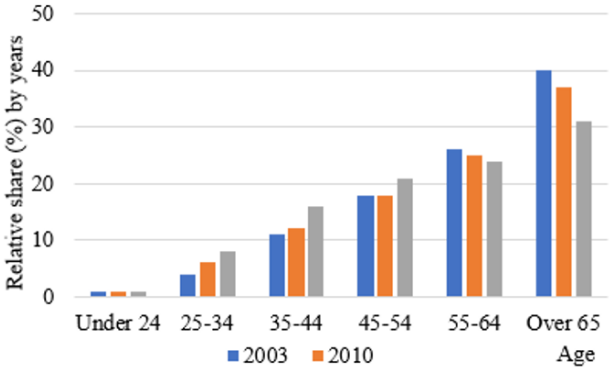

Fig. 3. Graphic presentation of the age structure of the managers of agricultural holdings for the period 2003-2020.

Source: Compiled by the author.

Attention is focused on the interest on publicly available ideas, respectively in niches for agribusiness [4].

- Cultivation of daffodils in mountainous areas - a special type of daffodils grown in adverse conditions above 300 m above sea level, containing *Narcissus pseudonarcissus*, used in drugs to treat dementia and Alzheimer's.
- Year-round food delivery - mediation for others companies to plan individual food supply products [11] one year earlier.

TABLE 4 IDEAS FOR OWN BUSINESS IN THE AGRICULTURAL SECTOR

Year	Holdings (number)	Change (%) * compared to 2020 **
Cultivated cultivation of daffodils in mountainous areas	over 10.000	7.241
Year-round food delivery - mediation for other companies to plan their food deliveries	501-1.000	8.338
Production of fruit wines	over 1.000	9.254
Construction of phytowalls	5.000-10.000	9.940
Paulownia cultivation plantation	1.001-5.000	20.217
Germination machine and ponies	1.001-5.000	25.882
Combined cultivation of hazelnuts and truffles	101-500	31.275

Source: Compiled by the author.

- Construction of phytowalls (plantwall, green wall) – Phytowalls are special walls planted with live plants, which are located in offices, hotels, public buildings, private homes, etc.
- Production of fruit wines from berry crops - raspberries, blackberries, blueberries, chokeberry, blackcurrants, tayberry.
- Combined cultivation of hazelnuts and truffles - The roots of hazelnut saplings are one of the best hosts of the expensive and highly sought-after truffle mushroom.
- Plantations for growing Paulownia - Fast-growing tree, grown for timber and biomass. The idea is to use the uncultivated areas, especially in the semi-mountainous and southern regions of Bulgaria.
- Machine for germination of seeds and ponies of sprouts at home. It is possible to make money by selling sprouts to a retailer.

Descriptive statistics methods were used for analysis of the collected data - arithmetic mean (arithmetic mean), median, mode). Thus, the research used (1) a set of methods based on the analysis of numerical indicators statistics of human capital in rural settlements; (2) multidimensional statistical analysis of human capital to substantiate the objectivity of the data; and (3) analysis of functions (processes) and time series of the human capital of the agro-industrial sector in recent years. Besides, we used statistical methods for agro-industrial objects with non-numerical characteristics to prove the priority of human capital development. To measure the result of the presented ideas for obtaining a typical, pronounced main trend, we will calculate the average point in the distribution of participants' assessments, namely:

- We will use the arithmetic mean (arithmetic average) value to present participants' interest. In the specific case 16.021. There is considerable interest in the ideas for: Paulownia plantation, germination machine and ponies, combined cultivation of hazelnuts and truffles.
- Median - gives an idea of the center of the numbers in the group, that is half the numbers are bigger and half the numbers are smaller than it. For example, building phytowalls.
- Fashion - the most common numbers in the group are used. Defined as the elementary indicator for calculating a central trend, we will use fashion when considering the amount of investment. In this case - Paulownia plantations and germination machines and ponies, in the range of 1.001 EUR.

Presented information we can summarize, with some conditionality, that: the greatest interest, with the least possible funds, is in the combined cultivation of hazelnuts and truffles.

III. RESULTS AND DISCUSSION

Doing business requires more than ever updating the knowledge and skills of those employed in the agricultural sector.

In Bulgaria 98% of farmers do not have the necessary education. Many small farms do not know what digital agriculture is [3].

At European level, the Index of Digital Entry into the Economy and Society (DESI) is used to measure Member States' progress in the field of digital technologies - Table 5 [12].

The presented indicator is a set of selected significant factors. The following are considered to be the most important for digitalization:

1. human capital connectivity;

2. connectivity;

3. integration of digital technologies;

4. digital public services [13].

Individual achievements by Member State and averages at European Union level are presented in Table 6.

In rural areas, the coverage of very high capacity networks is only 1% (EU average: 28%). In addition, Bulgaria ranks very low in the overall distribution of broadband internet access, with only 59% (an increase of 1 percentage point compared to 2019) of households having a subscription (EU average: 77%) [12].

Despite the actions taken, Bulgaria ranks last in the EU according to the index for the penetration of digital technologies in the economy and society (DESI) for 2020. It is well below the EU average in all measured values [14].

TABLE 5 «DIGITAL ECONOMY AND SOCIETY INDEX (DESI)» 2021 RANKING

Indicator	Rank	Score
EU	**-**	**50.7**
1. Bulgaria	26	36.8
2. Austria	10	56.9
3. Belgium	12	53.7
4. Croatia	19	46.0
5. Cyprus	21	43.5
6. Czech Republic	18	47.4
7. Denmark	1	70.1
8. Estonia	7	59.4
9. Finland	2	67.1
10. France	15	50.6
11. Germany	11	54.1
12. Greece	25	37.3
13. Hungary	23	41.2
14. Ireland	5	60.3
15. Italy	20	45.5
16. Latvia	17	49.5
17. Lithuania	14	51.8
18. Luxembourg	8	59.0
19. Malta	6	59.6
20. Netherlands	4	65.1
21. Poland	24	41.0
22. Portugal	16	49.8
23. Romania	27	32.9
24. Slovakia	22	43.2
25. Slovenia	13	52.8
26. Spain	9	57.4
27. Sweden	3	66.1

Source: The Digital Economy and Society Index – Countries` performance in digitization (2022)» [12]. Compiled by the author on the basis of publicly available information.

«Following the approval of the National Recovery and Sustainability Plan by the European Commission, in 2022 the agricultural sector will be able to benefit from additional financial resources for investment. They will support activities to ensure the protection of environmental components and mitigation of the effects of climate change, introducing innovative production and digital technologies, electronic processes in the industry and communication between administration and business» [5].

With regard to the current state of farms in the agricultural sector, their declining number is visible.

Crop farms are significantly ahead of livestock farms - Tables 1 and 2.

Recent years have reflected a positive age management profile – Table 3. The trend continues with regard to the participation of women farm managers.

Significant efforts are needed to increase the digital skills of the population - with special emphasis on increasing the indicators for measuring the degree of digitalization not only at the national level – Table 5 and 6, but also in the agricultural sector in particular.

Human resources will soon be a limiting factor for the development of the national agricultural sector. The presented results support this statement – Table 6. The low educational level of its employees is indicative in the field of mechanization, animal husbandry, viticulture, fruit growing and vegetable production. We believe that this fact will have a negative effect on the development of modern agriculture and the introduction of innovations in the industry, respectively its competitiveness.

IV. CONCLUSIONS

The analysis on the topic, made within the discussed issues, examined the main trends in the agricultural sector, including the factors that have the greatest impact on trends in the context of the country's priorities.

The methodology used, which is based on a three-step deductive method - an overview of the general picture, reflecting current attitudes in the sector and recommendations for future action in specific areas, includes analysis of data from national and international statistical and information sources.

Theoretical conclusions:

1. In recent years, Bulgarian agriculture has taken shape as monocultural agriculture.

Commodity agricultural production, carried out in the current and even more so in the future market conditions, requires *adequate conditions for the development of human potential in the agricultural sector*.

2. Today, Bulgarian agriculture is becoming increasingly dependent on climate change.

Efforts are also needed for *the sustainable management of soil and water resources*.

TABLE 6 «INDICATORS FOR MEASURING THE DEGREE OF DIGITIZATION IN THE MEMBER STATES OF THE EUROPEAN UNION»

Indicator	Human capital		Connectivity		Integration of digital technology		Digital public services	
	Rank	***Score***	***Rank***	***Score***	***Rank***	***Score***	***Rank***	***Score***
EU	**-**	**47.1**	**-**	**50.2**	**-**	**37.6**	**-**	**68.1**
1. Bulgaria	27	32.7	26	38.1	27	20.5	21	56.0
2. Austria	9	53.3	11	53.0	11	41.3	9	79.8
3. Belgium	10	50.8	16	48.4	6	498	17	65.8
4. Croatia	16	46.7	20	45.4	13	40.0	24	52.0
5. Cyprus	23	39.7	24	41.8	20	30.5	19	61.8
6. Czech Republic	15	47.2	22	44.6	15	39.1	20	58.6
7. Denmark	4	61.2	1	74.0	2	57.9	2	87.1
8. Estonia	5	57.9	18	46.6	9	41.5	1	91.8
9. Finland	1	71.1	13	51.3	1	59.5	3	86.7
10. France	14	47.4	17	47.4	19	34.8	13	73.0
11. Germany	7	55.2	6	58.0	18	35.5	16	67.5
12. Greece	21	41.0	27	37.7	22	28.5	26	41.9
13. Hungary	22	40.5	12	52.0	26	23.3	25	49.2
14. Ireland	8	54.1	7	56.4	7	48.9	6	82.6
15. Italy	25	35.1	23	42.4	10	41.4	18	63.2
16. Latvia	20	41.1	14	50.4	23	26.8	10	79.6
17.Lithuania	17	46.1	25	41.7	12	41.2	12	78.0
18. Luxembourg	6	56.2	4	61.0	14	39.4	11	79.4
19. Malta	11	49.1	8	54.1	4	50.8	4	84.2
20. Netherlands	3	61.5	2	68.4	5	50.7	8	79.9
21. Poland	24	37.7	21	45.3	24	25.9	22	55.1
22. Portugal	18	45.6	15	48.5	17	36.6	14	68.5
23. Romania	26	33.1	10	53.2	25	23.8	27	21.5
24. Slovakia	19	43.8	19	46.3	21	29.1	23	53.7
25. Slovenia	13	47.8	9	53.2	8	42.3	15	68.0
26. Spain	12	48.3	3	62.0	16	38.8	7	80.7
27. Sweden	2	64.6	5	59.6	3	56.3	5	83.9

Source: The Digital Economy and Society Index – Countries` performance in digitization (2022)» [12]. Compiled by the author on the basis of publicly available information.

Practical conclusions:

1. The development of a sustainable agricultural sector depends to a large extent on the subsidies paid in the context of the European Union's Common Agricultural Policy. The financing indisputably guarantees the income support of large farmers. *A digital platform is needed to monitor the sector*.

2. The development of human potential requires *training adequate to modern technologies* - a prerequisite for the development of the individual and human capital in general.

The preconditions for economic development of the country fail to realize their potential. For this reason, it is not necessary to mechanically list specific activities, but *real indicators for measuring and evaluating specific measures*.

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