



ORIGINAL ARTICLE

The effect of climate change on agricultural production in Bulgaria

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ABSTRACT

Plant organisms are phenological indicators of weather and climate and are often used as a non-instrumental tool for its analysis. The reactions of crops, their growth and development are a direct result of environmental conditions. Solar radiation, air temperature and precipitation are the main factors that determine their productivity. In search of the environment-plant connection, the science of agricultural meteorology emerged. This publication systematizes some of the main challenges facing agriculture and the main measures for adapting the sector to modern climatic conditions. Climate change and fluctuations lead to changes in the conditions of growth and development of agricultural crops. This has a direct bearing on the way the world produces, distributes and consumes food. Climate is directly related to the way and prospects for global production needed to sustain the human population. The population of people in the world is expected to reach to 10 billion by 2050. This poses a huge challenge to the global community on how to feed an additional 2.3 billion people through environmentally friendly methods and climate change.

Keywords: Climate change, agricultural production, Bulgaria

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1. INTRODUCTION

At the beginning of the 21st century (as of 2017) in Bulgaria, scientists from the National Institute of Meteorology and Hydrology (NIMH) report an increase in average air temperature by 0.8 °C as compared to the period between 1961-1990, as well as a change in precipitation distribution (Unlike the end of the last century, when the upward trend was well expressed in Northeastern Bulgaria (Kirova & Alexandrov, 2019) not given in references section), research now shows rising temperatures in southern and southeastern Bulgaria, defined as an area of frequent droughts in which cultivation of spring crops is risky in terms of humidification conditions in general. There has been an increase in the number of hot days (t max. <32 °C) in recent decades. In most stations there was a statistically significant trend of increasing the number of hot days by an average of 3 (4) full days per decade. On icy days, which are related to the nature of winter, there is a statistically significant decrease of 2 to 3 full days (Gospodinov, I. ed. (2020) because precise, local studies related to the conditions of the individual regions are needed here. In this direction, the researches in the field of agrometeorology and agroclimatology are also oriented. This leads to a change in the length of the potential growing season, faster accumulation of the required temperature sums and shortening of the interphase periods, which affects the yield of agricultural crops, irrigation, selection of appropriate types and varieties of crops.

The agricultural sector is focusing on environmentalists, as food production is one of the main causes of global environmental change: agriculture accounts for 40% of world land production

and food is responsible for 21% of global greenhouse gas emissions and 70% of freshwater use. In the context of several key drivers of change (demographic and economic growth, changing consumption patterns, technological progress, integration of global trade or climate change), all of which will affect the agricultural value chain, the agri-food sector will have to adapt to this growing demand for food, while tackling the challenges of sustainability and health.

2. CLIMATE CHANGE IN BULGARIA AND THEIR CONNECTION WITH AGRICULTURAL SECTOR

Some climate models simulate an increase in air temperature for Bulgaria in the 21st century by between 2 °C and 5 °C when doubling the amount of carbon dioxide in the atmosphere. The projections are for more precipitation during the cold half of the year, in the period of moisture accumulation, when the plants do not have vegetation. During the warm half of the year the precipitation will maintain its levels or will decrease, which will increase the intensity and frequency of droughts and torrential rains. Modern climate forecasts are indicative and provide guidelines for the development of sectors.

The agri-food industry is a key pillar of the Bulgarian economy. It accounts for approximately 20% of total industrial production.

It has a strong impact on both domestic and foreign trade, affecting Bulgaria's export earnings, domestic consumption and the overall living standard of the population. The value of the sector's final production was recorded as EUR 5.4 billion in 2018 (Table 1), which marks a 38% increase since 2010.

Table 1. Annual production value of food and beverage manufacturing in Bulgaria

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Production value (EUR million)	3 945	4 222	4 380	4 511	4 476	4 690	5 025	5 321	5 456

Source: Eurostat, 2019

The accession of Bulgaria to the EU in 2007 has significantly affected the Bulgarian agri-food sector. (Kirova, M., Montanari, F., Ferreira, I., Pesce, M., Albuquerque, J.D., Montfort, C., Neiryneck, R., Moroni, J., Traon, D., Perrin, M., Echarri, J., Arcos Pujades, A., Lopez Montesinos, E., Pelayo, E., (2019).) Enterprises in the sector, which were already subject to privatization, buy-outs and foreign direct investments, needed to comply with much stricter food safety regulations and to adapt to higher levels of competition from the common market. Like the agriculture sector, this has resulted in restructuring and consolidation. Increased investments into technologies, know-how and marketing have been necessary for the continued competitiveness of Bulgarian agri-food enterprises.

On-farm processing is the most popular in the fruit and vegetable, dairy and meat sub-sectors. These farmers sell directly to consumers (e.g., in dairy, it is now common to have vendor machines with fresh milk to be placed in villages and daily re-charged from the dairy farm). As a next step, their marketing strategies cover contracting with local (in villages or small town) small-sized supermarkets and the careful expansion of sales, first, regionally, and then in more regions or nation-wide. The setting up of farm direct sales markets (where also processed food could be sold) is rather difficult at the moment, with the Wednesday market at the Ministry of Agriculture, Food and Forestry in Sofia being the most prominent and successful example. The RDP is yet to open the relevant measure, which can be a turning point for many small-scale farm processors as well as the farmers.

The agri-food sector exports a total of 160 markets worldwide. In 2018, Bulgaria's total exports were recorded as EUR 28.6 billion, of which 11.8% (EUR 3.4 billion) were from the agri-food sector. While this marked a year-on-year increase of 3.8%, exports have been relatively stable over the longer term. The top agri-food exports are cereal and vegetable products, at EUR 1.9 billion, and foodstuffs (baked goods, chocolate, canned vegetables, etc.), at EUR 1.3 billion. EU countries are the main customers for Bulgarian agriculture and agri-food goods due to the more favour-

able trade conditions within the European Single Market. In 2018, the trade of agriculture goods with the EU increased by 5.3% as compared to 2017, and accounted for 75% of Bulgaria's total agriculture exports.

3. THE FORMULATED MEASURES FOR ADAPTATION ACTIVITIES IN BULGARIA

According to a study, conducted by the European Parliament's Committee on Agriculture and Rural Development in 2019, following measures are recommended:

- methods of genetics and selection;
- usage of crops having higher nutritional value;
- IoT (Internet of things) technologies for collecting and publishing information about production processes and the farm;
- agricultural automation;
- automatic management, monitoring and analysis of soils, areas, health status;
- optimization of agricultural processes;
- transparency, efficiency and accountability in the chain from producer to consumer.
- In our country, the efforts include blue-green government policies aimed at investing in precision research and sustainable development in the sector.

Seventy percent of the water resources are formed at higher altitudes and forest vegetation, 60% of which meet the needs for irrigation. Irrigation is an active measure of impact that is needed both in relation to drought and in general. The expected warming and reduction of precipitation amounts, especially, in the warm half of the year, directly affect water quantities. Due to the condition of the irrigation facilities, irrigation is not used rationally. Several initiatives stand out in this direction like;

- The main goal of the SuWaNu project is to develop technologies offering services for transnational cooperation within "research-oriented clusters", including universities, local authori-

ties, research centers, technology-based companies, enterprises, farmers and agricultural associations related to waste treatment,

➤ These services will provide and facilitate the exchange of knowledge on water and food alternatives for all project members, create business opportunities in the field of focusing and further expand the support of stakeholders from countries outside the consortium, while providing solutions to the above-mentioned problems facing in Europe (Mention the source here).

➤ Project proposals from Irrigation Systems “EAD”, project proposals from irrigation associations and other legal entities for the restoration of existing hydro-ameliorative irrigation facilities. The first will support only projects submitted by the company. The total amount of financial assistance under this procedure is EUR 45,419,274. The maximum amount for one project is 6 million euros. The second eligible candidates are legal entities established and registered under the Irrigation Associations Act (LAA) and entered in the register of Irrigation Associations and legal entities, as well as established and registered Cooperatives Act. The total amount of financial assistance under the procedure is EUR 5,046,586. The maximum amount of eligible costs for the entire period of implementation of the RDP 2014-2020 per applicant is 1.5 million euros.

The National Program “Intelligent Plant Breeding”, funded by the Ministry of Education and Science (MES) for a period up to 2024 and with a total budget of BGN 4.5 million provides through targeted scientific and applied research related to the application of artificial intelligence in agriculture, to reduce costs for farmers, improve soil management and water quality. The aim is to reduce the use of fertilizers and pesticides, greenhouse gas emissions, improve biodiversity and create a healthier environment for farmers and citizens.

The second program “Intelligent Animal Husbandry” envisages the creation of innovative methods and tools for intelligent and efficient development of animal husbandry with reduced human resources and reduced environmental effects. Researchers and breeders will have easy

and controlled online access to tools, resources and tools for collaboration, to high-performance information and communication technologies for calculations. They will have the ability to connect, store data, access virtual research ecosystems and client networks.

4. ANALYSIS OF DEMAND FOR FINANCE

The potential total demand for finance combines both met and unmet demand. The met demand consists of the value of all applications for finance which were approved by the financial institutions in the relevant year. The unmet demand consists of the assumed value of applications rejected by a financial institution, offers of credit refused by agri-food enterprises, alongside cases where farmers are discouraged from applying for credit due to an expectation of rejection or refusal (Mention the source here).

The lending market for the agri-food sector is less concentrated than for the agriculture sector. While Unicredit Bulbank also dominates lending to the sector (around 20% share), other important players include DSK Bank, United Bulgarian Bank, Eurobank and Raiffeisenbank, each of them having around 10% of the market.

Financial products

While banks view the agri-food sector as being less risky than agriculture, the agri-food sector still receives more loan rejections as compared to other sectors of economy. This is caused by the fact that, in general, their businesses are connected to the agriculture business cycle and are therefore exposed to similar risks (e.g., weather, seasonality), although processors can mitigate these risks since they can also

Based on the agri-food survey, the unmet demand for the agri-food sector in Bulgaria is estimated at EUR 178.5 million.

According to the agri-food survey, most of the funding in the agri-food sector comes from self-fundings (87%). The importance of banks in meeting financial needs is below the EU 24 average for all loan products Hata! Köprü başvurusu geçerli değil.Hata! Köprü başvurusu

geçerli değil. Interviews with agri-food enterprises confirmed that the main reason why they rely on their own funds is to ensure full control over their business risk. These considerations explain why the majority of enterprises had not applied for external finance. Of the 33% of agri-food enterprises that applied for bank financing in 2018, long-term loans (17%), credit lines (14%) and medium-term loans were the most popular products.

The level of non-performing loans (NPL) in Bulgaria has been on a declining trend but remains higher than the EU average. According to figures from the National Bank of Bulgaria, NPLs as a share of total loans had decreased to 5.94% in 2019. The share of NPLs to non-financial corporations was slightly above those levels and stood at 6.8%. While the NPL ratio for loans to non-financial corporations was 17.15% at the beginning of 2016 (Mention the source here).

Large-sized agri-food firms have contributed to the high NPL ratio. Banks mentioned that not all investments made by their agri-food clients have had a positive return. Increased volatility on local and foreign markets has resulted in lower cash flows and in the crippling of the enterprises' ability to pay their instalments.

As indicated above, while interest rates have been decreasing over the last few years (write the years here like 0000-0000), they remain at relatively high levels. This is particularly the case for short-term credit. Interest rates have also been fluctuating recently, making financial planning challenging for agri-food enterprises. Long-term loans show a downward trend in interest rates and at present keep the lowest ever rates, at approximately 2.8% (for local currency loans).

Some of the small-sized enterprises are relying on informal credit providers to re-finance their debt, paying high interest rates and often being impacted by hidden terms in the contracts.

Banks require collateral for loans. They primarily accept buildings, land and facilities but, in general, all assets that can be easily converted into cash and for which the banks can have access to the legal titles are acceptable. For new entrants that are establishing their own start-ups and do

not possess any assets, banks require property of the owner (real estate in urban areas) or contracted financial aid under the measures of RDP. For medium and long-term investment loans, agri-food entrepreneurs often cannot provide the required collateral. They remain interested in guarantees providing higher than the current guarantee rate and of bigger supply (Mention the source here).

The main criteria that influence the decisions of the agri-food companies in choosing the most suitable financing partner are 96 the longer grace periods and lower interest rates they could be offered (Mention the source here). This finding indicates that, when it comes to larger-sized enterprises, there is competition among the finance providers. This also means that large-sized agri-food enterprises can shop around for the best offers in terms of interest and fees, maturity, collateral and repayment schedule.

Product features and accompanying lending policies do not adequately reflect the business cycles of banks' clients. Banks are often unaware of the slow ramp-up time of investments, and the subsequent returns from them, per sub-sector, because of the time needed to establish agri-food assets and production facilities.

Moreover, banks do not have a tailored marketing strategy for agri-food SMEs and are unaware of how to approach in a best way with this client segment, as indicated in interviews with agri-food enterprises. This means that enterprises are not being made aware of new credit products available to them. The main communication tools that banks use are personal advisors who are responsible for providing information about new products and services.

5. CONCLUSIONS

Firstly, climate change is already affecting people and ecosystems: dangerous events caused by changing weather patterns, including floods, droughts, forest fires and extreme heat are becoming more common around the world. Climate change directly affects food and water security. Any warming can lead to reduce yields in conditions of growing demand for food and raw materials.

Secondly, among the causes of climate change are anthropogenic activities such as changes in the structure and use of land, which cause approximately a quarter (23%) of human emissions; food production, deforestation and desertification are among the causes of climate change on land; degraded lands do not have the ability to absorb carbon and can actually release carbon.

Climate change and human activities can harm the earth to the point where it becomes a net source of carbon emissions, and soil is also an element that can have a significant effect on climate change depending on management decisions. More than 2.7 billion people worldwide are affected by desertification, which means that nearly 1/3 of the world's population has lost productive land, to be used for agricultural purposes. Proper soil management can be applied to depleted soils in an area slightly larger than Europe, improving people's livelihoods and economic opportunities.

Thirdly, to adequately respond to climate challenges, action is needed to protect ecosystems, because approximately 72% of the icy land is affected by human activity. Among the conclusions made is the thesis (Dries L., N. Noev & J. F. M. Swinnen, (2009), that maintaining wild and free from human pressure areas is crucial to saving biodiversity and reducing emissions.

It is necessary to change the culture and healthy diet, associated with the reduction of waste. If food waste is reduced, an additional one billion people will be provided with food. Reducing the consumption of food of animal origin can contribute to reducing pollution from livestock.

The agricultural sector is focusing on environmentalists, as food production is one of the main causes of global environmental change: agriculture accounts for 40% of world land production and food is responsible for 21% of global greenhouse gas emissions. And 70% of freshwater use. In the context of several key drivers of change (demographic and economic growth, changing consumption patterns, technological progress, integration of global trade or climate change), all of which will affect the agricultural value chain, the agri-food sector will have to adapt to this growing demand for food, while tackling the challenges of sustainability and health.

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