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Scenarios for the development of Bulgarian livestock sector

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Abstract: The future is complex and uncertain, there are many factors affecting agricultural production that cannot be considered in advance. The aim of the study is to design scenarios for the future development of the dairy and meat sector in Bulgaria until 2027 and to assess the possibilities for their fulfilment.
The different scenarios were designed on the basis of model calculations and expert opinions. The relative comparative assessment (RCA) methodology is applied to evaluate the probability for fulfillment. The scenarios for the dairy sector indicate a decline in production and number of animals, but a positive development for buffalo herd and milk production. The scenarios for the meat sector indicate a more positive development, as increases in the moderate and optimistic variants. For both sectors, the probability is the highest in the optimistic scenarios.

Keywords: dairy; meat; production; scenarios; probability

Сценарии за развитие на българския животновъден сектор

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Резюме: Бъдещето е сложно и неопределено. Съществуват много фактори, влияещи върху селскостопанското производство, които не могат предварително да бъдат взети под внимание. Цел на изследването е да представи сценарии за бъдещото развитие на млечния и месния сектори в България към 2027 година и да определи вероятността за тяхното реализиране.
Изготвянето на различните сценарии се основава на моделиране и експертно мнение. Методологията за относителна сравнителна оценка (RCA) е приложена, за да се оцени вероятността за осъществяване. Сценариите за млечния сектор предполагат спад в производството и броя на стадата, но са позитивни по отношение на стадото с биволици и производството на мляко. Сценариите за месния сектор са за по-позитивно развитие, показващи увеличение при умерения и оптимистичния вариант. И за двата сектора вероятността за оптимистично развитие е най-висока.

Ключови думи: млечни продукти; месо; производство; сценарии; вероятност

INTRODUCTION

The future is complex and uncertain, from diseases-related disruptions [1] to extreme weather events (such as drought in Europe in 2022) there are many factors affecting agricultural production that cannot be accounted for in advance. Nevertheless, in order to set reasonable targets for a sound and predictable agricultural policy, experts and decision-makers need credible forecasts for the future developments presented in a few likely scenarios, which are considered as process tools.

The aim of the study is to develop scenarios for the future development of the dairy and meat sectors in Bulgaria until 2027 and to assess possibilities for the fulfilment of the different scenarios. We assume that the new CAP will have a positive or neutral impact on the development of livestock and production.

MATERIALS AND METHODS

Scenario analysis is a classical method of strategic planning, that essentially aims to produce better forecasts by focusing experts' attention on the long-term future, accepting uncertainty as part of the model[2] and mental models that offer the possibility of taking subtle signals into account (Wack, 1985). A characteristic feature of these scenarios is their *plausibility,* i.e. their relation to existing knowledge about the subject (van der Heijden, 2005). It is described as a sequence of events that can occur within a set of universal/natural/physical laws (Crawford, 2019).

Bradfield et al. (2005) classify different methodological approaches for the development of scenarios in three main directions – Intuitive-Logic (IL); La Prospective (LP) and Probabilistic Modified Trend[3] (PMT) models. The characteristics of these models include: purpose, perspective, starting point, time horizon, methodological orientation, type of team participants, output of the scenario exercise and number of scenarios created. Depending on the scope, they can address a global topic or be limited to a specific sector/company. The evaluation of scenarios varies depending on the approach on which they are based: IL – coherence, comprehensiveness, internal consistency, novelty; LP – coherence, comprehensiveness, internal consistency – underpinned by rigorous structural and mathematical analysis; PMT – plausible retrospectively verifiable trends.

According to Fotr et al. (2014) analysts work with a few scenarios in practice, which can be divided into a *base scenario* with the highest probability of occurrence and the highest probability for key risks, an *optimistic* and a *pessimistic* scenario. In the optimistic path, other existing possibilities are taken into account by utilizing the external potential, while in the pessimistic path, treats and negative circumstances are considered. Most of these risk components are external in nature and are not under the control of management, so very pessimistic scenarios can lead to early *warning* and *alert* signals.

The application of scenarios in agriculture has a broad spectrum. The global challenges facing humanity, such as population growth and food security, resource scarcity, climate change and degradation of biosystems, raise the question of how agricultural production can be developed sustainably which is directly related to agricultural policy. Scenario development offers policy makers the opportunity to identify of knowledge gaps and the context for a common definition of the problems before proposing solutions, which helps to broaden the decision-making process between different types of stakeholders. The method helps to identify research needs and priorities planning over technical and natural science aspects of the production process (Öborn et al., 2013).

[1] Bulgarian husbandry has been heavily affected in recent years by Nodular dermatitis (ND) and African swine fever (ASF).

[2] Pierre Wack a planner in Royal Dutch/Shell group apply for the first time the concept of "scenario planning" method by development of a formal procedure. But the method of strategic planning was applied before in post-war period by Herman Khan at the RAND Corporation (Crawford, 2019).

[3] There are other attempts for classification of scenario methodology field as Huss & Honton (1987). They catalogue approaches into three major schools: Intuitive Logics, Trend-Impact Analysis, and Cross-Impact Analysis.

Composing the forecast scenarios for Bulgaria

The key hypothesis in the forecast scenarios composition is that the future is a logical continuation of the past and the present, where probabilistic events and trends can be projected for the future based on extrapolations of past and present trends and outcomes of events.

To create scenarios for a study, one goes through several stages, the aim of which is to achieve results[4]. The preparatory work begins with the determination and extraction of the values of the indicators to be included in the scenarios in the field of agriculture, agroecology, and rural areas. The period chosen for the study is the base year 2019 – 2020 and as a rule two years of data are monitored to avoid any fluctuations and cycles. The selected indicators describe how each scenario can vary. The aim is to select key indicators, which can describe and depict the situation in the specific areas and sectors.

The condition for the selection of indicators is that they belong to one of three categories – resultative, derivative and for impact (outside the sector). A separate test for multicollinearity between the selected indicators was not performed. In order to avoid interdependence between the indicators, care was taken to include process indicators in the scenarios that are heterogeneous, logically and functionally independent.

In the second phase, we forecast and extrapolate the values of these indicators up to 2027. The estimated values for the three scenarios are most often determined by experts, and this is an important phase of work. All known characteristics, trends, external influences, potential catalysts and internal processes in the relevant sectors and areas, which are taken into account and assessed for their manifestation and occurrence, in order to extrapolate the state of the sectors up to 2027. The year was chosen as a cut off year in which the new CAP program period 2023 – 2027 expires, but it is not considered as a discrete, specific year, but as an indicator for the trend. This means that the design values obtained from the linear function will be considered based on the actual readings observed for the period up to 2027, not specifically the last year. In addition to the expert evaluation method, other means of forecasting the values of the indicators were also applied, using statistical tools, such as trend functions, linear equations, as well as discrete assumptions in which the values of the indicators are differentiated according to the three scenarios. After determining the indicators and predicting their future value levels, an evaluation regarding the probability of realization of different scenarios is carried out using the RCA method (a variation of PMT), and after that, they are finally modified according to expert judgment.

[4] *For a detailed methodology of the study, see Ivanov (2023).*

RESULTS AND DISCUSSION

1. Dairy sector scenarios

Possible scenarios for the development of the dairy sector are with horizon 2027 i.e. the end of the new CAP programming period (presented in Table 1). Weighted average values from 2019 and 2020 were used to determine the baseline scenario (current state) for the sector. In order to describe the development of the sector, indicators representing the number of dairy herds by breeding, the volume of milk produced, and the significant share of final production in milk from the "Agriculture" sector were selected[5]. The indicators are divided into two groups: those for the number of herds belong to the performance indicators; derivatives include the volume of milk produced and the ratio of the production to the total production of agriculture.

The development in different types of farms is similar: a combination of insufficient efficiency in production, labour shortages and lacking mechanization of processes (especially for sheep and goat breeding farms), and slow growth in farmgate prices lead to the retention of income per unit of production, making pasture animal

[5] *Produced output is taken at current producer prices relatively to the Gross Added Value of Bulgarian agriculture (from the Annex to the MAFF (2021b)).*

Table 1. Scenarios for the development of the dairy sector by 2027
Таблица 1. Сценарии за развитие на млечния сектор до 2027 г.

No	Indicators/ Индикатори	Units/ Единици	Base Values/ Базов сценарий (2019/2020)	Pessimistic scenario/ Песимистичен сценарий	Moderate scenatio/ Умерен сценарий	Optimistic scenario/ Оптимистичен сценарий
1.	Dairy cows/Млечни крави	heads/глави	227 795	150 000	175 000	195 000
2.	Milk ewes/Млечни овце	heads/глави	975 531	760 000	790 000	820 000
3.	Goat mothers/Кози майки	heads/глави	207 714	140 000	160 000	180 000
4.	Buffaloes/Биволици	heads/глави	14 147	16 000	20 000	25 000
5.	Produced milk/ Произведено мляко	K. litres/ Хил. литри	975 810	700 000	760 000	850 000
6.	Share of the final production of milk of the production of the "Agriculture" branch (%)/Дял на крайното производство на мляко от продукцията на отрасъл „Селско стопанство" (%)	%	9.25%	6.9%	7.2%	7.5%

Source: MAFF (2021a), MAFF (2022), expert opinion
Източник: МЗХГ (2021а), МЗХГ (2022), експертно становище

husbandry unattractive, a result leading to a decrease in the number of specialized farms and the exit of some of the smaller farms from the sector. Additional problems are caused by the insufficient land provision for fodder production and the ongoing problems with the distribution of state and municipal pastures between farms[6].

The reduction of herds in 2021 is: for dairy cows – 5.6%; for dairy sheep mothers – 11.8%, for goat mothers – 13.4%. The decrease in farms is: for cattle-breeding – 9.9%, for goat-breeding – 10.7% and for sheep-breeding – 2.2% (MAFF, 2022). A positive development is observed only in buffalo farming – the size of the herd and the volume of production have been growing steadily in recent years, with buffalo numbers increasing by 8.9% for 2021 and the number of holdings being maintained. As a result of a combination of factors – demand for produce and purchase prices are higher, support is similar to that of dairy cows, and herds are on average more than twice as large as dairy cows' herds.

During the two base years, the Bulgarian economy was affected by the epidemic situation surrounding Covid–19, but that situation does not reflect in the interruption of the activity of dairy farms, as they are located in rural areas where restrictive measures are rather exceptional and problems arise mainly in cases of illness of farm staff.

For dairy cattle, all three scenarios predict a herd reduction, with the decline ranging a range of 14.4% to 25.3%. For dairy sheep farming, the downward trend is expected to continue with between 15.9% and 22.1%. A reduction between 13.3% and 32.6% is also foreseen for goat breeding. Only for buffaloes, the scenarios are positive and predict an increase in the herd between 13.1% and 55%. As a result of the reduction in the dairy herd, a reduction in milk production of between 12.9% and 24.7% is expected.

In the calculation of different scenarios, weight coefficients were applied, which for different types of milk reflect the share of each in the total production of the sector. Based on scenarios developed for the dairy sector the following conclusions can be drawn – dairy cows' herd will decrease, but that process will be partially offset by an increase in productivity. Milk ewes and goat

[6] *It is expected that the allocation of pastures according to the geolocation of the holdings based on data from the Bulgarian Food Safety Agency information system will offer a solution to this problem, with the changes made by the Bulgarian parliament to the Law on the ownership and use of agricultural lands.*

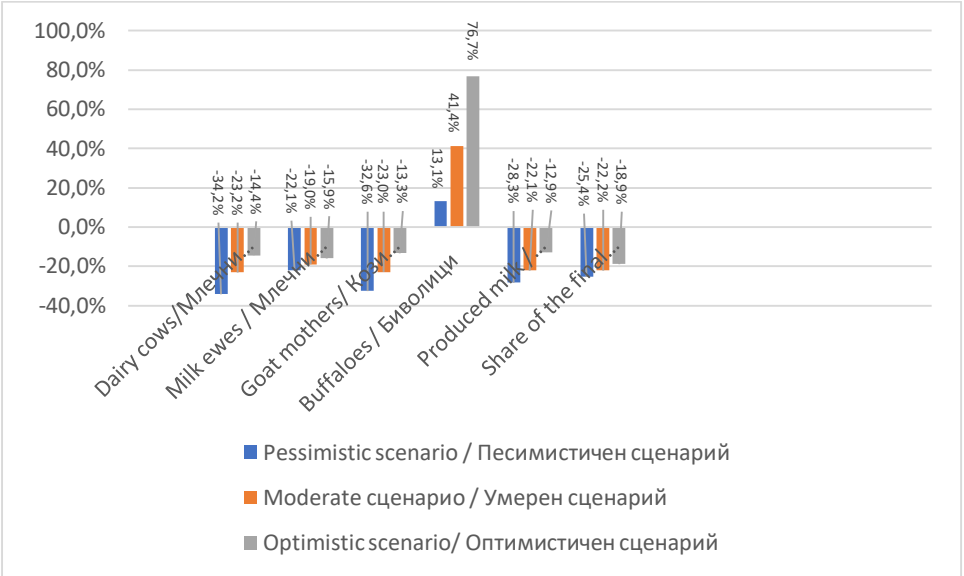

Fig. 1. Expected rate of change of the milk herds and milk production by 2027
Фиг. 1. Очакван темп на изменение на броя на млечните стада и производството на мляко до 2027 г.
Source: Experts opinion./Източник: Експертно становище.

herds, there will be a decrease due to limitations in labour force supply in Bulgarian rural areas. Buffaloes will keep the positive trend, but the increase in the herd will be limited by market demand for buffalo milk. The share of milk production in overall agricultural production will fall in all scenarios.

2. Meat sector scenarios

The meat sector in Bulgaria has an indispensable role in supplying the population with quality products of animal origin and helps to limit unemployment in villages and rural areas by providing job opportunities to people with mostly lower educational levels. The meat sector faces a number of problems, the main ones being low productivity and efficiency, limited investment opportunities for some of the farms (Mitova, 2016).

In 2021, according to the Ministry of Agriculture, there were 166 483 heads of beef cows and 152 680 heads of ewes for meat in the country; the number of pigs was 695 thousand, and that of poultry – 14 168 thousand. 18 196 tons of carcass weight of bovine meat were produced; 12 427 tons of meat from small ruminants; 83 119 tons of pig meat and 116 649 tons of poultry meat. In 2021, the indicator "Share of the final production of farm animals (cattle; pigs; sheep and goats; poultry)" of the production of the "Agriculture" branch occupies a value of 8.97%.

For the meat sector, positive development in the number of beef cows and meat production is driven by consumer demand and changes in tastes. Due to the decrease in dairy herd, there will be an increase in the number of special breeds of cattle for meat. For meat ewes we expect the number of animals to increase, but some of them will be directed for export, so the amount of meat production stays at the same level. If there are no substantial obstacles (like diseases), we expect the number of pigs and meat production to grow significantly. For the number of poultry, we expect to grow at the same rate and to increase poultry meat production.

Table 2 presents the scenarios for the development of the meat sector by 2027. The average value of the studied indicators for 2019 and 2020 was calculated as a base period.

Fig. 2 represents expected growth rate of the farm animal numbers and meat production by 2027, according to the three scenarios.

Table 2. Scenarios for the development of the meat sector by 2027
Таблица 2. Сценарии за развитие на месния сектор до 2027 г.

No	Indicators	Units	Base scenario (2019/2020)	Pessimistic scenario	Moderate scenario	Optimistic scenario
1.	**Beef cows**	heads	127 965	177 000	206 000	259 000
2.	**Meat ewes**	heads	127 435	162 000	182 000	197 200
3.	**Pigs**	heads	541 956	615 100	686 500	736 900
4.	**Total poultry**	thousands	14 764.5	12 900	15 000	16 200
5.	**Bovine meat**	tons carcass weight	16 776.5	16 800	18 900	21 900
6.	**Meat from small ruminants**	tons carcass weight	10 760	7 054	9 564	10 200
7.	**Meat from pigs**	tons carcass weight	74 741.5	73 800	83 800	88 500
8.	**Poultry meat**	tons carcass weight	115 307	97 800	114 000	123 300
9.	**Share of the final production of farm animals**	%	12.13	7.0	10.4	12.5

Source: MAFF, Department "Agrostatistcs", Experts opinion.
Източник: МЗХГ, отдел „Агростатистика", експертно становище.

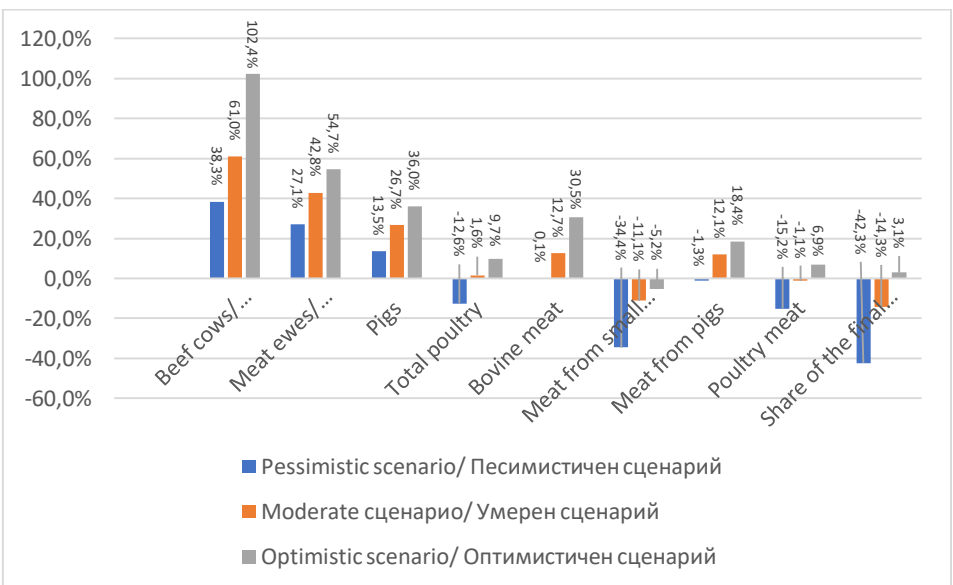

Fig. 2. Expected growth rate of farm animal numbers and meat production by 2027
Фиг. 2. Очакван темп на нарастване на броя на селскостопанските животни и производството на месо до 2027 г.
Source: Experts opinion./Източник: Експертно становище.

Under the pessimistic scenario, the number of beef cows will increase by 38.3% compared to the base period, and that of ewes for meat by 27.1% compared to the base period. Under the moderate scenario, the number of beef cows is projected to increase by 61.0%, and the increase in ewes by 42.8%. The optimistic scenario assumes an increase of 102.4% in the number of

cows and an increase of 54.7% in ewes for meat by 2027.

According to the pessimistic and moderate scenarios, the number of pigs is predicted to increase by 13.5% and by 26.7%, respectively, compared to the base period; according to the optimistic scenario, there will be an increase in the number of pigs of 36% compared to the base period.

According to the pessimistic scenario, the number of poultry will decrease by 12.6% compared to the baseline. The moderate and optimistic scenarios allow an increase in the number of poultry by 1.6% and 9.7%, respectively.

The pessimistic scenario assumes that the meat produced in 2027 is lower than the production in the base period, except for the bovine meat, which quantity is about the same as for the base period. The amount of small ruminants' meat decreases by 34.4%; from pigs - by 1.3% and from poultry – by 15.2%.

In the moderate scenario, an increase in the production of bovine meat by 12.7% and meat from pigs by 12.1%, respectively is predicted. Poultry meat will decrease by 1.1%, and the meat from small ruminants will be below the base level by 11.1%. The optimistic scenario envisages an increase in the amount of meat production, with the exception of meat from small ruminants.

According to the pessimistic scenario, the share of the final production of farm animals (cattle, pigs, sheep, goats, poultry) in the "Agriculture" branch production is expected to be less than the value of the indicator for the base period by 42.3%. According to the moderate scenario, the indicator will be below the base level by 14.3%, and according to the optimistic scenario, the value will be higher by 3.1% compared to the baseline.

3. Evaluating scenarios' probability

According to the applied methodology for a relative comparable assessment, the biggest likelihood to be fulfilled in the forecast scenarios for milk production is the optimistic one, followed by the realistic scenario, and the lowest probability is the negative scenario. For the meat sector, the moderate scenario is most likely to occur (19.1%), followed by the optimistic scenario (15.5%), and the pessimistic scenario is least likely to occur (10.2%). Especially for milk production, we do not expect negative dynamics regarding herd numbers to be reversed (except for buffaloes). Therefore, we can draw the conclusion that general trends for the development of Bulgarian animal husbandry will continue in the explored period, therefore we expect the new CAP to have neutral impact on the development of livestock and production.

Considerable shocks in the economic environment, such as significant increases in the price of feed, fertilizers, and energy – consequences of the war in Ukraine in 2022; an increase in the price of imported (non-EU) feed as a result of the Green Deal; interruption of oil supplies from the Russian Federation before the end of 2024; as well as possible effects on the real economy from the political instability in Bulgaria were not taken into account.

Table 3. Probability for development of different scenarios
Таблица 3. Вероятност за развитие на различни сценарии

	Animal husbandry sector/ Сектор животновъдство	**Pessimistic scenario/ Песимистичен сценарий**	**Moderate scenario/ Умерен сценарий**	**Optimistic scenario/ Оптимистичен сценарий**
1.	Milk production/ Производство на мляко	9.5%	12.6%	15.0%
2.	Meat production/ Производство на месо	10.2%	19.1%	15.5%

Source: Expert opinion./Източник: Експертно становище.

CONCLUSIONS

The presented scenarios for Bulgarian dairy sector development assume, to a large extent, the preservation of the trends for the development of individual livestock productions – a continued decrease in herds and production for dairy cattle, sheep and goat breeding, and an increase in the herd and output for buffalo breeding. Economic instability as a result of external factors for the Bulgarian economy leads to significant uncertainty for future development. It is unlikely to observe an increase in investment in the farms and respectively an increase in herds and productivity. Therefore, the realization of moderate scenarios seems even more likely than the applied methodology indicates.

For the meat sector, a positive development is expected for the number of beef cows and beef production, driven by consumer demand and changing tastes. For meat ewes, we expect the number of animals to increase, but some of them will be directed for export, so that the amount of meat produced from small ruminants will decrease. If there are no significant obstacles (diseases), we expect the number of pigs and meat production to increase. For the number of poultry and the amount of poultry meat, it is expected to be close to the baseline level.

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