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ПРОЕКЦИЯ НА БАЗОВИ ПОКАЗАТЕЛИ В РАЗВИТИЕТО НА ЗЪРНЕНИЯ МОДЕЛ В БЪЛГАРИЯ
BASELINE PROJECTIONS OF CEREAL CROPS IN BULGARIA

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Abstract

The cereal sector in Bulgaria is the main sector, providing 75% of the gross output out of crop production and accounting for 43% of the gross agricultural output in 2011. The cereal crops covered by the developed model are: wheat, barley, maize, sunflower and rapeseed. These five crops make up for 55% of the utilized agricultural land in Bulgaria and over 90% of the arable land. Around 63 000 farms are specialized in growing these crops in 2010 and they are the largest agricultural producers in Bulgaria.

The main goal of the study is to project the development of the selected crops till 2017 and to reveal the changes of the baseline indicators concerning these productions assuming certain policy framework and linked with the global cereal market development and predisposing as exogenous factors the development of the other agricultural sectors (livestock) and macro economic situation. The results from the model show that these sectors will keep their ascending trend in coming years mainly driven by the favorable global market environment of growing demand for cereals and comparative advantages of these productions in Bulgaria collated with other field and permanent crops.

Key words: baseline projection, cereal, model, indicators, development

INTRODUCTION

The study is run under the project “Establishment of centre for agri-policy analysis – CAPA” financed by the Foundation “America for Bulgaria”. The project focusing on the modeling of the development of the selected sectors from Bulgarian agriculture is implemented by a team from Institute of agricultural economics, Sofia in association with Food and Agriculture Policy Research Institute (FAPRI) to Missouri University (USA). The concept of the project is to elaborate the specific models complying with the local circumstances and conditions, relying on the experience of the FAPRI in implementation of such activities and methods.

Specific subject of the current article is the crop sector, composed of cereal and oilseed crops, which acquire significant role recently in terms of the area they form up and the output they provide to the gross agricultural output (43% in 2011) and national agricultural export. The analysis provides results that could be useful for guiding the policy and production decision making process.

The agriculture is the only sector in the economy, which in recent years has formed a positive trade balance. This indicator defines it as a viable industry able to contribute to the development of a competitive and efficient production and business potential.

The covered crops in the study are wheat, barley, maize, sunflower, and rapeseed. They account for 43% of the gross production in the agriculture in 2011 and about 75% of the gross production in the crop sector. The number of farms growing one or more of the five crops is about 63 000 in 2010.

The export of wheat, barley, maize, sunflower and rapeseed for the period 2004-2011 shows a trend of gradual increase, except the 2007/2008 marketing year. After 2006 due to the high international prices the rapeseed becomes the second most important oilseed crop. The higher prices and the growing demand for rapeseed increased the areas in the country. Globally, Bulgaria ranks on 12th place in the export of wheat and is the 2nd largest exporter of sunflower seeds (according to FAO).

The main modeling elements are consistent with the preposition that the crop models are “dynamic, partial equilibrium, multi-product, non-spatial, econometric-based designed to derive the basic supply and use tables, as well as estimates of prices” (Meyers at al., 2010) for the five crops subject to modeling. The current political situation and the future changes of the CAP were taken into account. The model is predominantly deterministic, while stochastic analysis could be used in future for defining different scenarios and outcomes. The Bulgarian crop model is also linked with the major steps in the GOLD (grains, oilseed, livestock and dairy) model for EU elaborated by FAPRI. However, the Bulgarian model for cereal baseline projection is not an adapted model used by FAPRI it is rather a new model founded on the FAPRI model basis and the Bulgarian needs and conditions in terms of data availability and sought goals.

The research outcome is baseline projection of the major indicators for the period 2013-2017. The baseline projection is not a forecast. It is a useful indicator of emerging issues or market directions, and most importantly as a point for comparison for impact analysis. One of the most important features of the baseline projections is that the current policy is always assumed to continue, which allows the impacts of possible policy changes to be analyzed (Meyers et al., 2010). However this analysis is neither bias to one or another policy. The goal of the study is to project the development of the selected crops till 2017 and to reveal the changes of the baseline indicators concerning these productions assuming certain policy framework and linked with the global cereal market development and predisposing as exogenous factors the development of the other agricultural sectors (livestock) and macro economic situation.

MATERIALS AND METHODS

A dynamic, partial equilibrium model was used for generating baseline projections of the included cereal and oilseed crops. The model includes detail information for all of the commodities. It is a system of single equations simulated in Excel. The equations and the parameters have not been estimated; instead the selection has been guided by theory and expert feedback. (Hanrahan, 2001).

The data used for the projections was based on historic period data from 1998 to 2011 (2012 in some cases). The data sources used were mainly national – National Statistics Institute; Ministry of Agriculture and Food as external sources were also used: EUROSTAT; FAO, USDA. When there were a lack of data, the experts' judgment were applied facilitated by the establishment of the particular network from experts and practicians, reviewing the raw data and evaluating the exodus outcomes.

The development of the model required creation of a database not only with data for the crop sectors, but also macroeconomic data, data about the specific agricultural policy, and technological data (regarding chemicals and fertilizers use in the agricultural production). The macroeconomic outlook included data about GDP, population, GDP/Cap, exchange rates, inflation, etc. Most of the data were from the Bulgarian national statistics; the exchange rates are from IHS Global Insight (2013). The policy outlook had data about the current agricultural policy (SAPS payments, top-ups, others) and the expected future expenditures (Basic payment, "greening" payment etc.). The distribution of the payments under the new CAP was based on the final agreement, published by EC (2013). The Bulgarian crop model was connected with the FAPRI world and EU-Model through the commodity prices on EU level.

The main approach used was econometric modeling, where:

$$y = f(X_1; X_2; X_3) \quad \textbf{(1)}$$

that could also be presented as:

$$y = \alpha + \varepsilon\beta_1 X_1 + \varepsilon\beta_2 X_2 + \varepsilon\beta_3 X_3 \ldots + \xi$$

α – intercept
ε – price elasticity
β – regression coefficient
X_{123}– variable
ξ – error

The 5 crops – wheat, barley, maize, sunflower, and rapeseed have a similar specification for the supply side of the model, so the equations below were applied to all crops.

The yield equation depends on the yield trend for the specific crop and the precipitation during the year most correlated with the yield movements. It is predisposed that the crop production greatly depends on the weather and climate conditions (Kazlauskiene et al., 1991) and the climate is reflected in the model not as a proxy but with the precipitation actual data. It was assumed that for the projected period there will be a normal weather, represented by the smothered

values of the precipitation. Any changes in the weather conditions could be used for scenarios. The yield function for the different crops could be presented as follows:

Yield = *f*(trend yield, precipitation) **(2)**

The parameters in these equations are calculated from the average data of the variables modified by the anticipated elasticity. The crops' prices were modeled as function of the EU prices. This is due to the fact the based on the historical data indicating that the Bulgarian prices follow the trends in the EU prices and the main hypothesis that Bulgaria is a price-taker rather than a price-maker in a market with robust competition. Moreover, most of the production is exported, so that means the prices in Bulgaria are transmitted to the foreign, world prices (Keats et al., 2010).

Price = *f*(EU price) **(3)**

It was assumed that the elasticity coefficient is 1. The other parameters were calculated, based on the average from the historical data. The prices were calculated on marketing year basis.

The harvested area for the 5 crops was modeled as a total area, and then the shares of each crop in this total area was modeled. The specific crop harvested area is calculated as an identity (6).

Total 5-crop area = *f*(Adjusted total 5-crops expected real return) **(4)**

Wheat share in total 5 crop area = *f*(Wheat expected market return/Total 5-crops expected market return) **(5)**

Area identity:
Wheat area = Wheat share in total 5 crop area * total 5 crop area **(6)**

The equations for the other crops were similar. The Sunflower area was considered residual in the model, which means that it was calculated as a difference between the total projected are and other four individual crops' areas. The expected market returns are calculated using the trend yields, the prices for the last three years and the production costs from the last three years (each year with different weight – 0.5, 0.3 and 0.2). The adjustment for the total area was made by including the subsidies. The total production was also calculated as identity for each crop.

Production = area harvested*yield **(7)**

The demand side of the project is more complex. It includes the equations for modeling the human consumption, the use for animal feeding (exogenous), the use for seeds, imports, stocks. For the two oilseed crops are also run crush equations. The export was residual to the model. The equations used for each crop are presented in the table below (Table 1).

Table1

Demand equations

<table>
<tr><th>Crop</th><th>Human consumption</th><th>Crush</th><th>Feed</th><th>Imports</th><th>Stock</th></tr>
<tr><td>Wheat (WS)</td><td rowspan="4">HC=f(real crop price, GDP/cap, population)
(8)</td><td>----</td><td rowspan="3">Feed use=f(Crop feed demand, sunflower meal price, wheat price, barley price, maize price)</td><td rowspan="4">Stocks = f(Self-sufficiency ratio)
(12)</td><td rowspan="4">Stocks = f(Self-sufficiency ratio, Crop price)
(13)</td></tr>
<tr><td>Barley (BA)</td><td>---</td></tr>
<tr><td>Maize (CO)</td><td>---</td></tr>
<tr><td>Sunflower (UF)</td><td>Sunflower crush = f(The difference between (the UF oil price + UF meal price) and the UF seed price in Bulgaria; UF production)
(9)</td><td>Feed use=f(Total meal demand, sunflower meal price, wheat price, barley price, maize price)
(11)</td></tr>
<tr><td>Rapeseed (RS)</td><td>----</td><td>Rapeseed crush = f(The difference between the EU rape oil price and the RS price in Bulgaria; RS production)
(10)</td><td>----</td></tr>
</table>

The seed use was calculated as identity from the seeding rate per ha and the total area for each crop. When calculating the feed use of the crops the current state of the animal production in Bulgaria was taken as exogenous variables, assuming a slight enhancement in the production coming from the poultry and pork sectors and a downward trend in the production delivered by the milk – cattle and sheep farming. After the dairy and meat models are prepared and incorporated there will be more precise information about the needs for feeding of the animals.

RESULTS AND DISCUSSION

The 5-year projections of the main Supply and Use indicators, as well as the prices, for the five crops are the main result of the modeling process. Having in mind the current situation and the macroeconomic background we were able to project the area, yield and production numbers, and also the numbers for human

consumption, feed use, crush (for the oilseed crops), seed use, stocks and net trade. The trend in the area for the different crops could be different (Table 2). A small decline in the wheat (about 11%) and barley area (about 32%), as well as rapeseed area (30%) is evident for the period 2013-2017, while there is expected growth in the areas with maize and sunflower – 14% and 9%, respectively. There is expected decline in the total area which we believe will be partly due to the new policy measures – "greening" requirements of the new CAP.

The projected data for the yield and total production are presented also in Table 2 and Fig. 1. There is a positive growth trend in the yields for all modeled crops.

Table 2

Area and yield projections

	2012	**2013**	**2014**	**2015**	**2016**	**2017**
Area	000 ha					
Wheat	1185	1240	1238	1172	1103	1094
Barley	191	168	162	152	124	114
Maize	467	462	465	483	511	526
Sunflower	781	769	782	800	822	839
Rapeseed	135	194	182	168	160	159
Yield	ton/ha					
Wheat	3,76	4,15	3,95	4,00	4,04	4,09
Barley	3,46	3,92	3,73	3,77	3,82	3,87
Maize	3,68	4,93	4,91	4,97	5,03	5,09
Sunflower	1,78	2,06	2,07	2,12	2,17	2,22
Rapeseed	2,01	2,20	2,20	2,26	2,31	2,37

Source: CAPA calculation, part of the Bulgarian Crop Model

The production, however, depends not only on the yield per ha but from the harvested area too, which explains why some crops have decline in the numbers, while others have kept the positive trend. For example the total production of wheat at 2017 is projected to be about 4474 thousand tons that is still higher than the total production in 2012, but less the production in 2013.

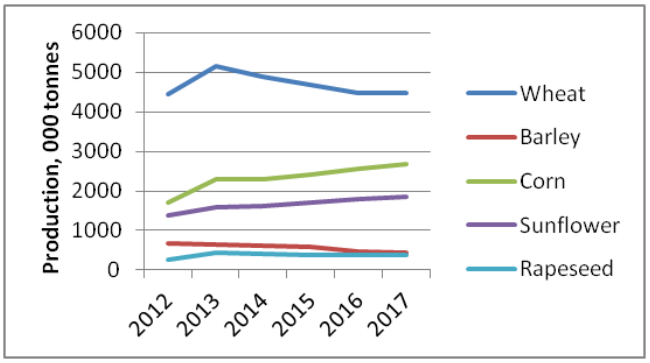

Fig. 1. Production projections, thousand tons

Source: CAPA calculation, part of the Bulgarian Crop Model

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The total demand of the cereal and oilseed crops is stable, and depends on the livestock production and the opportunities for export. The projections show that the wheat total demand in 2017 will be close to the demand in 2012 (4948 thousand tones and 4930 thousand tons respectively). For all other crops the total demand in 2017 is higher than that of 2012, but only for the maize and sunflower it is higher than 2013. For example, the projected demand for maize in 2017 is 3183 thousand tones, while in 2013 it is 2672 thousand tones. The demand for sunflower in 2017 is projected to be 2107 thousand tones and in 2013 – 1801 thousand tons. The human consumption is driven by the incomes, commodity prices and population (Kazlauskiene et al., 1991) and keeps a consistent development very similar with the trend in the last years.

CONCLUSIONS

The main outcome of the baseline projection is to create a relevant basis for analysis of the markets and policy and in simulation of different scenarios. The elaborated cereal model is founded exclusively on the Bulgarian needs and specifications linked by the models run by FAPRI, particularly for projection of the agricultural sectors in EU known as GOLD model. The covered 5 crops – wheat, barley, maize, sunflower and rapeseed stand for the most important and staple production in Bulgaria forming us a significant share in the utilized area of Bulgaria and contributing immensely to the gross agricultural output and foreign trade balance.

It is very important to underline that this is not a forecast; it does not include assumption for the market volatility or any other unpredictable situation. The results demonstrate the continuation of the domination of these crops in the agriculture in Bulgaria and regardless a slim decline in the area is estimated these crops will continue to cover majority part of the arable land in Bulgaria. The intercrop differences are also observed as it is expected the area with sunflower to go up

following the trend from the previous years, accompanied with a tangible drop in the area grown by barley and slim reduction in the area with rapeseed. The areas with wheat and maize are subject to minimal changes, as the corn production may tiny ascend after a years of area falls less than 0,4 million ha. Altogether, the baseline projection will be a subject of ongoing update and they will serve as a base for scenarios and other policy and market analysis.

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