

Description of scientific achievements of Doctor Agnieszka Baer-Nawrocka (PhD)

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1. Full name

Agnieszka Baer-Nawrocka

2. Diplomas, degrees (name, place and year awarded, and the title of the applicant's Ph.D. dissertation)

- 1) **Ph.D. in agricultural sciences** in the field of Food Economics; Faculty of Agriculture, August Cieszkowski Agricultural University in Poznań (currently, Poznań University of Life Sciences); title of the doctoral dissertation: *Competitiveness of Polish agriculture compared to new member countries of the European Union, 2005.*
- 2) **Teaching methodology certificate** delivered by the Poznań Agricultural University (currently, Poznań University of Life Sciences), 2004
- 3) **Training in Agricultural and Applied Economics: Challenges of Agriculture in Transition**, a certificate delivered by the Department of Agricultural Economics of the University of Kiel, 2002.
- 4) **Certificate of completion** of “Rural areas and agriculture in the European Union integration process (principles of accessing the EU pre-accession, agricultural and structural funds),” a **Post-graduate TEMPUS PHARE Program** No. *IB_JEP-14205-1999 – Formation européenne en développement agricole et rural – DAR*, 2001.
- 5) **Master's degree in engineering**, field of study: food economics, August Cieszkowski Agricultural University in Poznań (currently, Poznań University of Life Sciences), 2000.

3. Information on previous employment in scientific institutions

Since October 1, 2005, the applicant has been employed as Assistant Professor at the Department of Economics and Economic Policies for the Agribusiness, Faculty of Economics and Social Sciences of the Poznań University of Life Sciences.

From April 6, 2006 to August 9, 2006 and earlier from July 4, 2003 to November 7, 2003, as a student of the doctoral program, the applicant was on a maternity leave.

4. Scientific achievement provided for in Article 16, Para. 2 of the Act of March 14, 2003 on Academic Degrees and Academic Title and Degrees and Title in Art (Journal of Laws [Dz.U.] of 2018, item 1789):

The applicant indicates the series of 11 thematically connected papers jointly titled as *INCOMES OF AGRICULTURAL PRODUCERS IN THE CONTEXT OF CHANGES TO THE COMMON AGRICULTURAL POLICY* as the scientific achievement provided for in Article 16, Para. 2 of the Act of March 14, 2003 on Academic Degrees and Academic Title and Degrees and Title in Art, and believes these papers to be a considerable contribution to the development of economic sciences in the field of economics. The publications are the outcome of planned research carried out in 2010–2019, and represent a series of thematically connected scientific papers.

4.1. Title of the scientific achievement

INCOMES OF AGRICULTURAL PRODUCERS IN THE CONTEXT OF CHANGES TO THE COMMON AGRICULTURAL POLICY

4.2. Source of inspiration to address this research topic

The main source of inspiration to address the research topic presented in a series of publications indicated as a scientific achievement was a study of economic and agricultural literature focusing on changes in the farming environment and their impact on the production and economic situation of that sector. At the initial stage of the applicant's scientific career, her research was centered around processes taking place in the agri-food sector in Poland and in selected Central and Eastern European countries in the context of their accession to the EU. To complete this part of research, the applicant defended her Ph.D. thesis (*Competitiveness of Polish agriculture compared to new member countries of the European Union*) with honors in 2005. The thesis addressed the then-current problems and challenges related to the adaptation and functioning of the agriculture sectors in new member states in the context of the EU Single Market. The research was focused on the competitiveness of manufacturing capacity, outcomes of efforts taken, and competitive processes taking place in the agriculture. These topics supplemented the literature (relatively scarce at that time) on agriculture in countries who joined the EU together with Poland in 2004. Already when preparing her Ph.D. thesis, the applicant paid particular attention to issues related to the standards of living of the farming population, determined by agricultural income. She developed her interest in these aspects by undertaking research to identify them in European Union countries.

Subsequent research objectives set by the applicant were largely affected by her participation in a training session on the *Integrated Assessment of Agriculture and Sustainable Development in Central and Eastern European Countries*, held as part of SEAMLESS — *Integrated Framework for Integrated Assessments of a Multi-functional Agriculture*¹, an international research project. For the applicant, this was an opportunity to learn the principles of economic modeling based on the CAPRI (*Common Agricultural Policy Regionalized Impact*) partial equilibrium model. When discussing the importance of modeling in predicting the effects of CAP with experts from international scientific centers, including the authors of CAPRI, the applicant realized this field of study could largely contribute to ensuring a systemic approach to processes of identifying and setting goals and priorities for development problems, and to the selection of implementation instruments for the agricultural policy. To enhance her knowledge on how the model functions and how it can be used, the applicant attended another training session (*Impact Assessment with the CAPRI modeling system — training session with a focus on environmental impacts*) organized by the University of Bonn, the main scientific center that offers research cooperation opportunities to CAPRI analysts and users. The applicant's interest in that field of study translated into an own research project (*Agricultural income in European Union countries in the light of the evolution of the Common Agricultural Policy*) endorsed by the Ministry of Science and Higher Education. In addition to *ex post* analyses, the project included *ex ante* analyses based on the CAPRI partial equilibrium model.

In the next step of research, considering her intent to publish a series of scientific papers centered around agricultural income, the applicant initiated a study on how to use an integrated approach to predict the consequences of changes in the EU CAP not only for agricultural producers but also for general economic welfare. This approach consists in predicting the economic effects of potential changes to the CAP based on CAPRI simulations. Afterwards, the theory of games is used to determine the system of preferences of different stakeholders. This field of research is covered by the *Use of quantitative methods in predicting the effects of changes to the Common Agricultural Policy of the European Union*, a project currently implemented by the National Science Center.

Research tasks addressed and implemented at different stages involved some theoretical, methodological and empirical aspects of incomes of agricultural producers. Their final

¹ The project was implemented by the Humboldt University of Berlin, the Academy of Sciences of the Czech Republic (ILE-ASCR) and the Leibniz Institute of Agricultural Development in Central and Eastern Europe in Halle (IAMO)

outcome are methodologically managed scientific papers consisting of a thematically connected series of publications presented as the applicant's scientific achievement.

4.3. Content of the thematically connected series of publications ²

1. Baer-Nawrocka A. (2011): *Ewolucja Wspólnej Polityki Rolnej a kwestia parytetu dochodów rolniczych*, Polityka ekonomiczna, Prace naukowe Uniwersytetu Ekonomicznego we Wrocławiu, nr 166, (red). Sokołowski J., Sosnowski M., Żabiński A., s.26-36.
2. Baer-Nawrocka A. (2016): *The role of agriculture in the national economy of EU countries*, Journal of Agribusiness and Rural Development, 4(42) 2016, s.501-510.
3. Baer-Nawrocka A. Markiewicz N. (2012): *Procesy konwergencji/dywergencji w zakresie wydajności pracy w rolnictwie Unii Europejskiej – analiza regionalna*, Journal of Agribusiness and Rural Development 3(25) 2012, s.13-23.
4. Baer-Nawrocka A. (2010): *Potencjał produkcyjny rolnictwa i jego wykorzystanie w krajach Unii Europejskiej – analiza typologiczna*, Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, Tom XII, Zeszyt 1, s.12-16.
5. Baer-Nawrocka A. (2009): *Dochody rolnicze w nowych krajach członkowskich Unii Europejskiej w świetle Rachunków Ekonomicznych dla Rolnictwa* (w:) Wspólna Polityka Rolna Unii Europejskiej. Uwarunkowania, mechanizmy, efekty. (red.) M. Adamowicz, Wyd. SGGW, Warszawa, ISBN 978-83-7583-101-6, s.153-166.
6. Kiryluk-Dryjska E., Baer-Nawrocka A. (2014): *Polityka rolna Unii Europejskiej, kierunki zmian i konsekwencje dla rolnictwa polskiego*, Wyd. Uniwersytetu Przyrodniczego w Poznaniu, ISBN 978-83-7160-737-0, ss. 208.
7. Poczta W., Baer-Nawrocka A. (2016): *The sustainability of agriculture in the European Union against a global backdrop* (w:) Political Rents of European Farmers in the Sustainable Development Paradigm: International, national and regional perspective, (red.) B. Czyżewski, Wyd. PWN, ISBN 978-83-01-18766-8, s. 60-68.
8. Baer-Nawrocka A., Błocisz J. (2018): *Efficiency of Polish organic and conventional farms*. Studies in Agricultural Economics 120 (2018), s. 55-60, <https://doi.org/10.7896/j.1724>.
9. Baer-Nawrocka A., Poczta W. (2018): *Die Veränderungen in der polnischen Landwirtschaft - eine langfristige Analyse*. Berichte über Landwirtschaft, Band 96, Heft 1 s.1-25, <http://dx.doi.org/10.12767/buel.v96i1.188.g381> (IF – 0.23)

² Information on my contribution to the co-authorship work is provided in Annex I, point I B and Annex 5.

10. Baer-Nawrocka A., Kiryluk-Dryjska E., Poczta W. (2018): *Przewidywanie kierunków zmian Wspólnej Polityki Rolnej Unii Europejskiej – podejście zintegrowane*. *Ekonomista* 6/2018, s.664-681 (**IF – 0.15**)
11. Kiryluk-Dryjska E., Baer-Nawrocka A. (2019): *Reforms of the Common Agricultural Policy of the EU: Expected results and their social acceptance*. *Journal of Policy Modeling* 41 (2019), s. 607-622, DOI: 10.1016/j.jpolmod.2019.01.003 (**IF – 1.237**).

4.4. Rationale behind addressing this research topic

Income is one of the key issues of economic theory. Mainstream economists agree that the pursuit of income is the initial motivation behind an economic activity and, thus, is one of major determinants of how producers behave. In neoclassical models, income earning is considered as a profit maximization effort. A series of enterprise theories exist which address an alternative approach to, and the complexity of, decision-making processes going beyond profit maximization (Gorynia 1999). The diversity of objectives faced by enterprises is also experienced by agricultural producers. This is determined by several aspects, including the multitude of factors resulting from the particularities of agricultural production (Gasson and Errington 1993, Tracy 1997) and from the conditions involved in the agricultural policy in place. In this context, note that agriculture—which is a strategic sector as it addresses the basic needs of societies—also plays a major role in ensuring environmental sustainability. Therefore, in addition to its basic function (which is to produce food), it delivers environmental goods and utilities. By changing its potential, it creates new standards of living for human communities, including living and housing conditions, environmental quality and new social structures. No other sector is as highly dependent upon the environment, and no other sector has such an important environmental impact. The ecological aspect of economic activity in agriculture is broadly discussed in the relevant literature (including by Cole et al. 1997, Johnson et al. 2007, Okularczyk 2000, Runowski 2004, Czekaj et al. 2013, Falkenberd 2016, Hart et al. 2016). Without contesting the importance of the complexity of decision-making processes, note that the economic practice of farming shows that both short-term and long-term objectives pursued by farms, just as in the case of non-agricultural undertakings, are focused on attaining an amount of economic surplus. The key role of income in explaining the efforts taken by agricultural producers is also emphasized by the vast majority of agricultural economists, including Woś (1996), Reisch and Zeddies (1995), Rembisz (2013), Drummond and Goodwin (2004) and Tracy (1997).

The particularities of agricultural income comprise several factors. First, farms are the place of living for farming families and their income is used to directly address their vital consumption needs. As the economy develops, the household naturally separates from manufacturing activities; this is the consequence of production growth and of stronger connections with the market environment (Tomczak 2000). Second, the income earned by farmers is the outcome of their own farming work; a remuneration for taking business risks; a rent for land and production assets; and the farm's value added. Third, in addition to business risks, the farmers face natural risks resulting from the production processes being largely dependent upon weather conditions and contribution of living organisms; that contribution also results in a time shift between production inputs and outputs. As emphasized by Czyżewski (1994), *the cumulative risk of losses—against which the farm is often powerless—is therefore greater than in other sectors*. Therefore, the farmers' business performance depends not only on the level and efficient use of inputs (as it is the case in most industrial sectors) but also on the combined effect of external conditions which are virtually beyond the producers' control. Also, Olson (2011) emphasizes that the economic situation of farms is largely affected (through a complex transmission mechanism) by macroeconomic trends related to progressing internationalization and broadly defined political processes taking place in the economy. These developments, together with the geographic distribution of production and the low bargaining power of producers, is what makes agriculture weaker than other sectors of national economy. This is referred to as a policy-independent property of agriculture (Czyżewski 1994) and is equated with the agrarian question (Wilkin 1986)³. Many problems voiced already in the 1800s as part of the agrarian question (Roseberry 1993) continue to be relevant to this day. At the same time, the analysis of the literature on the subject suggests that not all adverse consequences of the participation of agriculture to the economy must coincide. The intensity and accumulation of various aspects of the agrarian question largely depends on the country's socioeconomic development level. In developing countries, where agriculture plays a decisive role in the economy, the main threats to development are the low productivity of farming labor, and poor elasticity of agriculture in terms of production structure and manufacturing methods. Also, the consequences of any distortions in the functioning of agriculture are felt across the economy. Conversely, in highly developed countries, where agriculture has a low share in domestic product and employment structure, the main problem of the agrarian question is the disparity in agricultural incomes

³ Topics related to the agrarian question and its symptoms are broadly discussed by numerous authors, including Gardner (1992), Woś (2010), Zegar (2010), Akram-Lodhi (2013), Czyżewski and Kułyk (2015) and Zegar (2018).

and the social antagonisms. Income disparities are one of the most fundamental issues of economic policy. The relevant literature mentions it in the context of the income (or productivity) gap concept or of income deprivation in agriculture (Czyżewski 2017). However, that problem is relatively poorly highlighted in the discussion on the forms of the CAP. Kowalski and Rembisz (2002) believe that the disagreement as to the consequences of the market mechanism in a given period and in the context of social justice, rather than the market mechanism itself, is the basis for agricultural interventionism.

Income disparities, which determine the share of the existing pool of goods accessed by different members of the society (and by their households), are one of major problems in development economics. Attempts to explain the issue of income inequalities were also made by representatives of various other schools, including Neoclassicism and Marxism. In addition to assessing the organizational efficiency of the economy (i.e. whether a change in resource allocation could result in improvements to business efficiency), the question whether the distribution of resources among individuals and social groups is fair also provides a basis for welfare economics. An excessive income gap leads to many complex social problems of different intensity (Esping-Andersen and Myles 2009). It is one of the major barriers to a rational allocation of productive inputs between the sectors of the national economy; it also establishes a barrier to demand which may ultimately result in the economic growth rate falling below the potential level (Banerjee and Duflo 2003). As emphasized by Gorzelak (1990), efforts taken to minimize the income gap not only result from social and political reasons but are also a condition for the economic development of a country. Thus, the most even possible distribution could promote stable economic growth also because it reduces the risk of social unrest. From that perspective, the role of the distribution should be perceived both as a way to implement the policy of social equality and justice to a greater extent, and as a booster of the economy. This is reflected in a broadly defined dilemma: efficiency vs. justice. Due to its global nature that dilemma is usually considered in a context of the entire economy. However, it also has an implication for the agriculture sector and agricultural policy (Wilkin 1997). The ratio between the income of agricultural producers and that of employees from other sectors is an issue usually perceived in a socioeconomic context defined as unequal opportunities to improve incomes and standards of living in professional farming families. This is strictly related to the income inefficiency of the agriculture sector, as mentioned earlier, which results from natural and economic conditions, and to the depreciation of agriculture by the market mechanism. The reasons for the above include (Woś 1996, Ciechomski 1997, Czyżewski 2007, Rembisz 2007, Zegar 2008): limited demand for agri-food products; low elasticity of demand for agri-food products to an increase in consumer

income; the supply of agri-food products growing faster than the corresponding demand; long period of return on capital invested; and the particularities of land as a productive input. For reasons which include the above phenomena, most agricultural economists agree that an intervention policy must be put in place (Lipton 1993, Tomczak 1994, 2000, Sarris 1995, Baland and Kotwal 1998, Czyżewski 2000, Zegar 2018, Wilkin 2003). Another aspect of importance in the context of the development of economic standing of agricultural producers is the downward pressure which affects agricultural income in the long run (which, however, does not mean that agricultural income follows that trend). This results from the patterns and relationships which exist between supply and demand in the agri-food market. Technological advancements have an effect on production growth; in a situation where the supply of agri-food products grows faster and the demand is restricted, this results in a decline in prices and, ultimately, in reduced agricultural incomes (Czyżewski 2007).

Ensuring a satisfactory income for agricultural producers was defined as one of the initial goals of the Common Agricultural Policy. Despite the numerous reforms, support for agricultural incomes continues to be a top priority of interventions taken under the CAP. Currently, aid allocated to the stabilization of farmers' incomes represents ca. 1% of total public spending of EU states and 32% of the total EU budget. Even though the public opinion believes that the overarching goal of the CAP should be to ensure healthy and safe foods to consumers, most of EU society agrees that aid for agricultural producers should be maintained. However, they set new requirements for high-quality products and sustainable production methods. While the need itself to support agricultural incomes is also generally accepted by the economists, the scope, type and forms of support remain debatable. The dilemmas faced when selecting these instruments are made even tougher by the sometimes different interests of various social groups and restricted information on the possible outcomes of CAP reforms for the interested parties. Meanwhile, the understanding and acceptance of the policy by its stakeholders is believed to be a necessary condition for success in setting the agenda, in formulating and implementing the policy (Ingold, 2011; Kriesi and Jegen, 2001; Simantov, 1973) and in simulating changes thereto (Dermont et al., 2017).

In their economic and social policies, highly developed countries devote a lot of attention to topics related to agricultural income. This is because they are not only a synthetic indicator of the population's economic standing, but also a specific indicator of efficiency of the agricultural policy. Considering the emerging, relatively new conditions which include environmental (ecological) barriers to agricultural production growth, the impact of globalization (Zegar 2018) and the importance of social acceptance of support for agricultural producers, agricultural income continues to be an issue which requires a close observation and

ongoing assessment. What matters in this context is to identify the income levels in both absolute and relative terms.

The series of publications is consistent with mainstream economics and in sectoral terms, agricultural economics and agricultural policy, and provides a multifaceted, synthetic assessment of agricultural income in EU countries in the context of changes to the CAP. The presentation of agricultural producers' incomes from various perspectives was determined by the multifaceted nature of this issue. On the one hand, the developed methodological concept of research, including the use of a sophisticated simulation model, enhances the methodology and practice of investigation into agricultural income. On the other hand, the research provides an opportunity for a more extensive identification of the impact of potential changes to the CAP on the economic standing of agricultural producers and, as a consequence, on the functioning of farms. This is all the more important since any changes in the allocation of funds under the CAP have an indirect effect on the entire economy and on the society. Therefore, research carried out in this field allows to identify the targets and recommendations for a policy regarding the development of the economic situation of agricultural producers. Therefore, these research findings serve both cognitive and utilitarian objectives.

4.5. Purposes of the series of publications

The main purpose of the series of thematically connected publications presented above was to **identify and assess the income situation in the agricultural sector of EU countries in the context of actual and simulated changes to the CAP.**

Once set, the main objective enabled defining the following sub-goals implemented in the publications presented above:

- to review the changes to the European Union's agricultural policy in terms of their impact on incomes and income parity in the agriculture sector;
- to identify the convergence/divergence processes followed by agricultural labor efficiency and level compared to total labor efficiency;
- to determine the agricultural production potential (and the degree to which it is used) as a basic endogenous determinant of agricultural income;
- to identify the incomes earned in agriculture of EU countries at macro-, meso- and macroeconomic levels (pace and nature of changes);
- to assess agricultural incomes viewed in the framework of conventional and organic farming;

- to assess the changes in the Polish agriculture sector in the context of the developing economic situation of agricultural producers;
- to forecast the income of producers for different lines of production (as illustrated by the example of selected scenarios);
- to adopt an integrated approach in forecasting the effects of changes in the CAP on agricultural producers' incomes and on overall economic welfare in the EU;
- assessing the sustainability of European Union agriculture compared to global agriculture, with particular focus on the economic aspect of that equilibrium.

In the series of publications presented above, the applicant made an attempt to verify the following research hypotheses:

- The implementation of the Common Agricultural Policy contributes to reducing the downward pressure on the income of agricultural producers.
- The modifications to the Common Agricultural Policy are accompanied by heterogeneous changes in agricultural producers' incomes and in overall economic welfare in the EU.
- The partial equilibrium model may be combined with some elements of the theory of games to predict the effects of changes in the European Union's agricultural policy.

. 4.6. Methodological concept and research methods used

Because of the complexity of this topic, a comprehensive approach was required to take account of various research methods. As a consequence, the methodological concept which is the basis for research in the series of publications discussed takes the achievements of several economic schools into consideration. The successive stages of empirical studies on agricultural income were based on *ex post* and *ex ante* analyses.

I. *Ex post* analyses

The *ex post* analyses conducted by the applicant are in line with the comparative methods in economics. The comparisons are based on spatio-temporal analogies. The geographic scope includes all EU countries and, as regards the analysis of labor efficiency,

NUTS 2⁴ regions. A distinction was made between new and old member countries, with the EU's enlargement in 2004 being the boundary date.

Agricultural income was identified at three levels: the macro-, meso- and microeconomic level. Data was used in the form of time series calculated in line with three types of accounts, i.e. national accounts, Economic Accounts for Agriculture, and the Farm Accountancy Data Network. The use of mutually complementary approaches to income measurement enabled an assessment for different perspectives. The macro- and mesoeconomic approaches allow for a broader comparative analysis which also takes into account the contribution of the agricultural sector to value added in the whole economy. In turn, the microeconomic approach (based on FADN) enables a more in-depth analysis of differences in incomes across agricultural types and economic sizes of farms.

The analyses of incomes and contributing factors were based on several measures of descriptive statistics, such as the Lorenz concentration index and structural and growth ratios (relative direct and chain indices, medium-term growth rate). The research also relied on multidimensional analyses, including the clustering analysis carried out to separate the groups of countries at similar levels of agricultural development (referred to as production potential and its use efficiency). In the clustering procedure, the similarity of objects was determined based on the Euclidean distance. The Ward's method was used to estimate the distances between clusters.

The parity of agricultural incomes was assessed based on the ratio of farming incomes per non-salaried Annual Work Unit (AWU)⁵ to the average remuneration of employees in other sectors. Using this category of incomes allows to determine the actual level of: the remuneration for the farm's own labor; the remuneration for the use of land owned by the farmer in his/her agricultural activity; and the profits, if any, from capital employed.

Regional disparities in labor efficiency in agriculture of the European Union were estimated with the σ -convergence. The analyses carried out to explore the

⁴ The Nomenclature of Territorial Units for Statistics (NUTS) is used in the EU to unify the administrative division of member countries. Three levels are identified (NUTS 1, NUTS 2 and NUTS 3) based on minimum and maximum population thresholds for a specific territory in different states. For instance, from January 1, 2018, Poland has 7 NUTS 1 units (macroregions composed of voivodeships), 17 NUTS 2 units (regions: voivodeships or parts thereof) and 73 NUTS 3 units (sub-regions: groups of several districts). The EU includes 98 NUTS 1 units, 276 NUTS 2 units and 1342 NUTS 3 units.

⁵ A conventional unit of labor inputs, equivalent to full-time employment which is 1800 hours per year in the agricultural sector. However, in most EU countries (including Poland), the annual working time corresponding to 1 AWU is defined under national regulations. In Poland, full-time equivalent employment is defined as 2120 hours of work per year, i.e. 265 working days, 8 hours each. However, in accordance with the Eurostat methodology, a maximum of 1 AWU per person is allowed

convergence/divergence processes are consistent with the development economics. The following formula was used to verify the σ convergence (Fiedor and Kociszewski 2010):

$$\sigma(t) = \sqrt{\frac{1}{n} \sum_{i=1}^n (\log y_i(t) - \bar{y}(t))^2}$$

where:

$$\bar{y}(t) = \frac{1}{n} \sum_{i=1}^n \log y_i(t)$$

$\sigma(t)$: dispersion of GVA per agricultural employee in all regions in year t ,

$y_i(t)$: GVA per agricultural employee in region i in period t ,

$\bar{y}(t)$: mean GVA per agricultural employee in period t .

The reduction in σ -convergence in the time horizon studied suggests that the disproportions in the levels of the characteristic analyzed tend to decline. Otherwise, divergence takes place.

II. *Ex ante* analyses

The methods used in *ex ante* analyses refer to the neoclassical theory of partial equilibrium, welfare economics, and the theory of public choice. As part of these investigations, the partial equilibrium model was used to forecast the impact of the expected CAP reforms on the production and economic condition and on the welfare of selected CAP stakeholders. Using econometric models to forecast economic processes is a widely adopted approach in economic sciences. Due to complexity of processes and the development of forecasting models, forecasting plays an increasingly important role in assessing the outcomes of political measures. The importance of forecasting to economic sciences is emphasized by numerous authors, including Sobczyk (2008) who identifies its three basic functions: the information function (solving cognitive problems); the preparative function (support in decision-making processes); and the activation function (stimulating actions consistent with the forecasted trend). According to Witkowski and Klimanek (2006), the auxiliary functions of forecasts include the argumentation, advisory and mediation function.

In the agriculture sector, political decision-making is supported by tools such as the Partial Equilibrium Models used around the world. They differ between one another in the degree of spatial aggregation, the number of markets covered, the parameter estimation method or the type of the model (static or dynamic). They include CAPRI (Common Agricultural Policy Regionalized Impact), developed at the initiative of the European

Commission under the 4th Framework (FAIR3-CT96-1849)⁶, which was used in this research. What makes CAPRI stand apart from other models is the regionalization at NUTS 2 level. CAPRI comprises two main modules: the supply module and the market module. The supply model includes nonlinear optimization models developed for a group of representative farms who keep accounting records for different lines of production in all EU regions (at NUTS 2 level). These models maximize the farming income at a given price level, under the assumption that the available productive inputs are used optimally:

$$\begin{aligned} \mathbf{max} \pi &= \sum_{i=1}^n mg_i x_i \\ \mathbf{s.t.} \sum_{i=1}^m a_{li} x^i &\leq b_l \quad [\lambda] \end{aligned}$$

where:

π : objective function (agricultural income)

x_i : output for production line i

b_l : coefficient of limitation l

mg_i : excess output from production line i (revenue + payments – costs)

n, m : number of production lines and limitations

a_{li} : entries of the limitations and production lines matrix

λ : marginal value related to limitation l

The maximum entropy / Positive Mathematical Programming (PMP) approach is used to calibrate the nonlinear income functions for farms in different regions. This enables a good calibration of supply models and a smooth simulation of response to changes in policy. In the supply module, prices are determined through the market module in an iterative process which runs between these modules until an equilibrium is attained in the agricultural market, taking trade flows into consideration⁷ (Britz and Witzke 2014). The assumption that the market concerned (in this case, the agricultural market) is in equilibrium, is the basic difference compared to general equilibrium models which assume an equilibrium of the entire economy. An unquestionable advantage of partial models is the definitely greater disaggregation of markets and products analyzed, making it possible to analyze the sector in much greater detail.

The use of CAPRI in this research consists in developing some scenarios of changes in agricultural policy and, then, loading them to the model with the use of GAMS software

⁶ That model is progressively developed. The development works are coordinated by scientists from the Institute for Food and Resource Economics at the University of Bonn.

⁷ CAPRI determines the equilibrium for 47 unprocessed and 29 processed agricultural products in 77 countries and 40 trade blocks. CAPRI takes into account processed products in international trade flows. This is an indisputable advantage as these products have an increasingly large share in international trade.

(General Algebraic Modeling System) (Fig. 1). Thus, in order to develop the scenarios, the applicant needed not only to learn the operational principles of the model itself but also of the related software. To enhance her skills in that field, the applicant attended two training sessions organized by the University of Bonn. The first one (*Impact Assessment with the CAPRI modeling system — training session with a focus on environmental impacts*) was about the operational principles of GAMS, whereas the second one focused on GAMS software. At each successive stage of research, the applicant developed a proprietary scenario of potential changes to the Common Agricultural Policy. After loading the scenarios to the model, she specified the predicted response of agricultural producers in EU countries with respect to various lines of agricultural production. The simulation analyses were determined by the model's database, by forecasted macroeconomic indicators and by the forecasts for the global agricultural market published by the European Commission in the EU Agricultural Outlook Prospects for EU agricultural markets and income, in line with the OECD–FAO forecasts set out in the Agricultural Outlook. Each time, the assumptions and outcomes of modeling were consulted with Marcel Adenauer, Ph.D. (one of the co-authors and users of CAPRI), as part of cooperation established during the training.

CAPRI was also used, in addition to yardsticks of production effects and incomes of agricultural producers, to simulate the changes in welfare levels as the outcome of potential modifications to the CAP. In partial equilibrium models, welfare is usually defined as the consumer and producer surplus which takes costs and benefits into consideration in accordance with the allocative efficiency requirement. The surplus is a key category in analyses carried out in welfare economics. Consumer surplus reflects the difference between the price the consumer is willing to pay for a specific good and the market price of that good. Hence, it measures the benefit derived from the consumption of a specific quantity of that good. Conversely, producer surplus means the extra value obtained by the producers beyond the opportunity cost of production of the good concerned. The CAPRI model is also underpinned by a similar concept of welfare. It is estimated based on changes in production and consumption of agricultural products as a consequence of changes in prices which, in turn, result from model simulations. In this case, total welfare is the sum of:

- producer income, expressed as value added calculated in accordance with the methodology of the Economic Accounts for Agriculture;
- consumer surplus, calculated with the consumer utility function;
- profits of agri-food operators, estimated based on the derivative of the normalized profit function;

- public sector welfare, determined based on the difference between budget expenditure on agricultural policy (taxpayers' costs) and customs revenue.

The changes in welfare estimated with the use of CAPRI served as a basis for analyses in the next stage of research where, in cooperation with Ewa Kiryluk-Dryjska, Ph.D., the applicant made an attempt to integrate model simulations with some elements of the theory of games. The research procedure based on CAPRI and the theory of games is shown in Figure 1. The total welfare and the welfare of particular stakeholder groups of the CAP was the basis for determining the system of profits and losses derived from the proposed changes to the agricultural policy. This became the starting point for estimating the initial utility of players used in models of the theory of games. The solution of the game is the equilibrium, usually assimilated with Nash equilibrium. This research relied on the theory of transitions which is an alternative approach developed by Brams (1994). In this case, the solution of the game consists in finding the nonmyopic equilibrium which allows the players to change their strategies during the negotiation process. Therefore, that theory allowed to answer the question if, starting from the resulting condition and continuing the game by predicting the behavior of other players, the player is able to attain a greater profit. The outcome of negotiations is the selection of a strategy resulting from previous arrangements and essential changes resulting from the analysis of previous effectiveness, and therefore the reforms of the EU CAP comply with the initial assumptions of the theory of transitions.

Hence, the methodological approach adopted in this study consisted in predicting the potential modifications to the CAP by considering the economic effects of solutions put in place (the result of CAPRI simulations) and the resulting system of preferences of parties to the conflict (theory of games). An approach which combines the two research methods referred to above in analyzing the effects of changes to the CAP has not yet been used in economic research.

In summary, the applicant's publications were created with the use of various methods, in accordance with the detailed definitions of research objectives. This was supplemented with deductive inference, used to develop a simple descriptive model. The analyses of time series in *ex post* research provided a basis for inference on trends followed by the variables described. In turn, the international analogies, used both in *ex post* and *ex ante* research, allowed to put the processes and phenomena in relative terms through various points of reference.

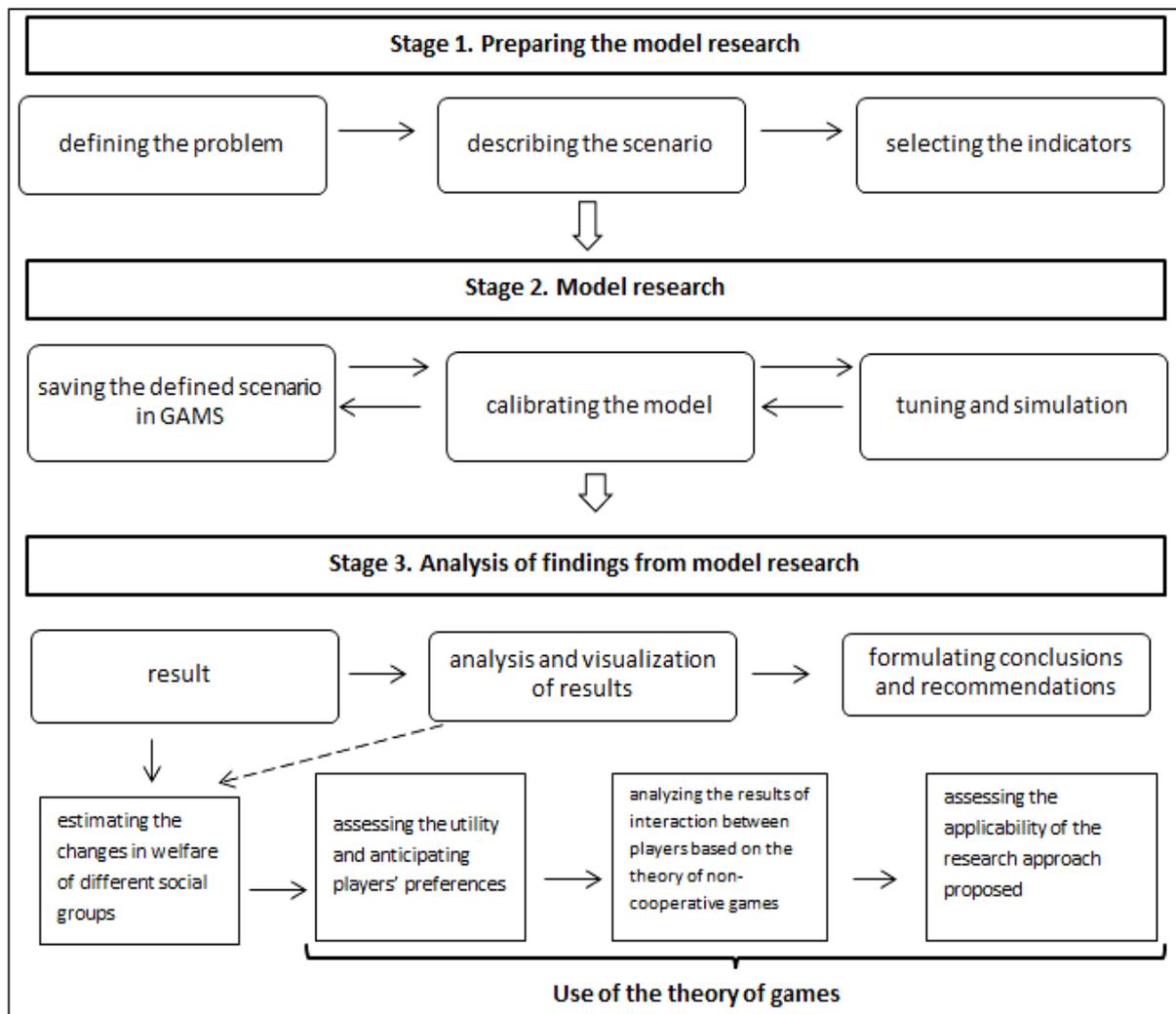


Fig. 1. Diagram of research based on CAPRI and the theory of games.
Source: own study.

4.7. Results of the study

4.7.1. Agricultural income and income parity in the light of changes to the European Union's agricultural policy: a theoretical and empirical approach

Having in mind that in the context of the EU common market, institutional mechanisms are a fundamental exogenous determinant of agricultural incomes, the applicant performed a critical review of reforms to the Common Agricultural Policy (CAP), considering their impact on the development of the economic situation of agricultural producers (*paper: **Polityka rolna Unii Europejskiej, kierunki zmian i konsekwencje dla rolnictwa polskiego, no.6, point 4.3***). Ensuring adequate standards of living for the rural population, primarily by increasing the level of agricultural producers' income, was defined as one of priorities for the CAP. As shown by political practice, even the initial definition of goals was unclear, making them partially contradictory. Without a defined hierarchy, this often resulted in an escalation of interventions. Since the beginning of the CAP, the key aspect of intervention measures was to employ instruments that support agricultural prices. With a gradual enhancement of the scope of instruments comprising the protection system for the internal market and for the support of agricultural incomes, and as time went by, in addition to desired outcomes, this also had some unintended impacts in the form of surplus food and environmental threats. The analysis of successive CAP reforms clearly revealed a process which consists in a gradual shift from internal market protection tools and from a policy of direct impact on agricultural incomes towards instruments focused on supporting agricultural producers through direct payments⁸. That support was gradually modified by decoupling direct payments from production, and by introducing the modulation mechanism and the cross-compliance principle which requires that environmental protection and animal welfare standards be met. In the most recent period of CAP development, greening was put in place to intensify the environmental protection efforts. At the same time, the second pillar of the CAP pursues a goal which goes beyond direct impact on the agricultural sector while taking into account the creation of alternative incomes and employment opportunities outside agriculture.

⁸ As provided for in Agenda 2000, as one of many successive attempts to arrange the assumptions of the agricultural policy, the CAP was divided into two pillars: the first pillar, which includes market and price interventions and direct payments, and the second pillar, which includes the rural development policy (structural policy). The current framework for intervention funds allocated under the first pillar is the common organization of the markets in agricultural products which replaced the previously coexisting 21 separate markets for agricultural products.

The conclusion from the assessment of the implementation of objectives set in the CAP concept is that the greatest success was the development of production and efficiency. Conversely, the CAP proved to be less effective in the implementation of objectives related to the development of agricultural incomes. The reason for the above was the persisting income gap between the farming population and other population groups. Based on the analysis of relevant literature, it was concluded that despite the rapid growth in labor efficiency, agricultural income grew slower than in other sectors in the first years following the establishment of the common market for agricultural products (1968–1978) (*paper: Ewolucja Wspólnej Polityki Rolnej a kwestia parytetu dochodów rolniczych, no.1, point 4.3*). It was also emphasized that a form of support which mainly consists in maintaining high intervention prices and coupling the income with the volume of products sold resulted in making the farms engaged in large-scale intensive agricultural production the largest beneficiaries of that support. In turn, that form of support was much less beneficial to smaller farms with a limited production capacity. The above was found to contribute to an increase in the agricultural income gap both between farm groups and between Community regions. These developments became more intense in the 1980s. The relative decline in agricultural income slowed down only in early 1990s after the MacSharry reform⁹ and the introduction of direct payments. As shown by empirical analyses, in 2000–2009, average agricultural income both in old and new member countries was below the average remuneration of employees in other sectors of the economy. Another conclusion was that this ratio went down in EU-15 countries and went up in EU-10 countries over the study period; this was related to the implementation of CAP instruments in the latter group. While in 2000 the average level of agricultural income in EU-15 was 70% of income earned in non-agricultural sectors, it was less than 50% in 2009. In EU-10, that ratio was 18% and 30%, respectively. Income disparity was found in nearly all member countries. In the recent years, as shown by the applicant's continued own research on the ratio between agricultural and non-agricultural incomes in the EU, agricultural producers have continued to be the disadvantaged group as the ratio has fluctuated between 40% and 44%.

In the context of research on agricultural income disparities, two types of methodological barriers were identified which hamper the construction of the relevant measurement index. First, they result from the calculation method of agricultural incomes and from the selection of the type of yardstick which can be based either on labor income per

⁹ CAP reform implemented in 1992, conceived by Ray MacSharry, the then Commissioner for Agriculture at the European Commission.

employee or on incomes from all sources per household member. Indeed, it was emphasized that agricultural incomes may be supplemented with non-agricultural incomes which have an effect on increasing the actual amount of income earned by farming families¹⁰. Second, the assumption behind the analysis of economic situation from the perspective of the agricultural sector is that profit/loss at sector level is the total of individual profits/losses of production companies active in the national agriculture sector. However, it does not mean that different companies achieve the same outcomes. In that context, the conclusion was made that the while the outcomes presented do not clearly reflect the actual standards of living of the farming population, they contribute to the discussion on agricultural income disparities and provide an important requirement to be addressed in the agricultural and economic policy.

4.7.2. Agricultural labor efficiency vs. income and development disparities

As emphasized in the economic literature, because the remunerations of non-agricultural employees usually grow faster than agricultural income, it is extremely difficult to reach a parity. The identified drivers of agricultural income growth (in addition to payments and other intervention transfers), i.e. tools intended to narrow the income gap between the farming and non-farming population, include increasing labor efficiency in the agriculture sector. Based on assumptions of the neoclassical theory of economics, the remuneration for productive inputs employed by agricultural producers—just as it is the case for other producers—is determined by marginal efficiency of these inputs (including labor). As shown by empirical research (*paper: The role of agriculture in the national economy of EU countries, no.2, point 4.3*), the average efficiency of farming labor across the EU in 2015 (measured as gross value added per employee) was ca. three times lower than in the economy as a whole. That difference was even larger when compared to such production sectors as industry or processing. A positive development is the increase in labor efficiency in the agriculture of EU-28 countries, at a rate of 3.4% in 2000–2015 (compared to 0.9% across the entire economy). The key determinant of the growth rate of labor efficiency in EU agriculture was identified to be the reduction in the number of agricultural employees, which is largely the case especially in new member states of the Community. As shown, the increase in gross value added in the agriculture sector of most EU countries was also a factor of importance. However, the average annual growth rate of GVA was definitely lower than what was

¹⁰ The lack of unified statistics at EU state level prevents the sources of non-agricultural income from being taken into consideration.

recorded in the economy as a whole (0.3% in the agriculture vs. 1.4% across the entire economy). This was found to be consistent with the general patterns of economic development. It was emphasized that in addition to natural barriers to growth of agricultural production (resulting from the contribution of living organisms), the above can be explained by two principles. The first one, caused by demand-related factors, is related to the low income and price elasticity of demand for agricultural products. In turn, according to the second principle (underpinned by production- and supply-related factors), the slow growth in agricultural value added is caused by the disproportion in labor efficiency between agriculture and other sectors of the economy.

It was also demonstrated that although in most new member states labor efficiency grows faster than in EU-15 countries, the level of efficiency continues to lag behind that recorded in EU-15. Poland has the lowest level of agricultural labor efficiency among EU-28 countries while also being bottom-ranked in terms of efficiency in the entire economy. Romania and Bulgaria are the only countries to report a smaller gross value added per agricultural employee than Poland. This is believed to be primarily caused by the disadvantageous agrarian structure dominated by small farms with an excessive workforce. In that context, the role of capital in the substitution of labor was also highlighted.

Having in mind that one of the key objectives of integration is to promote sustainable regional development in the European Union, it was also found important to identify the disproportions in agricultural labor efficiency between regions of different countries (*paper: Procesy konwergencji/dywergencji w zakresie wydajności pracy w rolnictwie Unii Europejskiej – analiza regionalna, no.3, point 4.3*). As the Community was enhanced with new member countries, problems related to disparities in socioeconomic development between EU regions grew bigger. This became particularly important after the recent enlargements, including with the largest group of countries at much lower levels of economic development than the highly developed Community countries. This is also true for the agricultural sector, including the production potential, manufacturing efficiency and the resulting production and income performance. The assessment of the extent and reasons of inter-regional differences includes addressing the convergence process (which is part of the theory of economic development). In that context, analyses were carried out to verify whether convergence or divergence in agricultural labor efficiency occurs between NUTS2 regions in the EU. As shown by research, σ -convergence for all EU countries followed a downward trend in 2000–2008. This suggests that the variable considered follows a convergence process.

Also, β -convergence¹¹ was discovered based on the observation that changes in agricultural labor efficiency are faster in regions which started from a low level. It was emphasized that the basic source of the progressing interregional convergence was the growth in gross value added per employee in the EU-12, driven by instruments of the Common Agricultural Policy put in place in these countries. They were found to act as a catalyst in the process of narrowing the labor efficiency gap across regions, which is consistent with sustainable development objectives of the European Union. Nevertheless, having in mind that the efficiency of labor resources in most new member states continued to be relatively low, further changes are required in their respective agricultural sectors. As emphasized, this is particularly important in the context of agricultural competitiveness in the international market, which is also reflected in the income situation of agricultural producers.

4.7.3. The level and use of production potential as endogenous determinants of agricultural income

The initial (and essential) analytical procedure which provides the necessary basis for conclusions on the production capacity is the analysis of productive inputs that comprise the production potential. As an important aspect in that context, the relationships between these inputs should be noted. In addition to a rational use of inputs, the relationships between them are a basic condition for the efficiency of the manufacturing process. All of the above is the fundamental exogenous determinant of agricultural income. The clustering analysis was used to identify seven typological groups of countries which are similar in terms of selected characteristics of the manufacturing potential and of the efficiency of productive inputs (*paper: Potencjał produkcyjny rolnictwa i jego wykorzystanie w krajach Unii Europejskiej – analiza typologiczna, no.4, point 4.3*). As shown in this study, the most favorable system of relationships between productive inputs (accompanied by a high use efficiency) is present in the Dutch agriculture which forms a separate cluster. This was demonstrated to be primarily caused by the fact the Netherlands report the highest land use intensity and, as a consequence, the highest land productivity of all the countries studied. High productivity of land also has an indirect impact on the high efficiency of labor. The second cluster was composed of Denmark and Belgium which largely owe their high agricultural production potential to a high amount

¹¹ β -convergence refers to the relationship between the growth rate and the initial level of the variable under consideration. The lower the initial level, the higher the growth rate. Conversely, σ -convergence means the differences in the level of the variable considered between regions/countries tend to decrease over time.

of capital employed. A slightly lower level and use productivity of production potential (yet still high compared to the next groups) was observed in the third group which includes highly developed EU-15 countries: France, Luxembourg, Germany, Sweden and UK. In these countries, the capital-to-labor and capital-to-land ratios are relatively high, though lower than in the second group. However, this group was found to exhibit the greatest concentration of agricultural land in farms with an area over 50 ha (nearly 80%, on average). As emphasized, that group also recorded the lowest average annual labor inputs per 100 ha of agricultural land (barely 2.7 AWU) across the Community.

Countries from other groups (from the fourth to the seventh one) are at lower levels of agricultural development in terms of both production potential and productivity of inputs. However, the fourth group of countries, composed of Austria, Finland, Ireland and Italy, is distinct in that it has the highest assets-to-labor ratio and the highest productivity of particular productive inputs. Another conclusion regarding this group of countries is the relatively low share of agricultural land held by farms with an area over 50 ha. The next group includes Czech Republic, Estonia, Spain, Slovakia and Hungary. In these countries, agriculture was found to demonstrate a more advantageous area structure of farms than the previous group (mainly thanks to Czech Republic and Slovakia where the share of agricultural land held by farms with an area over 50 ha exceeds 90%, the highest level of all Community countries). However, the capital-to-land and capital-to-labor ratios are definitely lower, making these inputs less productive.

The agricultural sector of the sixth group (Bulgaria, Lithuania, Latvia and Portugal), demonstrates the lowest capital-to-land and land productivity ratios of all Community countries. In turn, the key reason behind the lowest level of variables designating the production potential and productivity of inputs in countries of the seventh group (Greece, Poland, Romania, Slovenia) was found to be the fragmented agrarian structure (in this group, only 23% of total agricultural land is held, on average, by farms with an area over 50 ha) and the related high amounts of labor used in agricultural production¹². As a consequence, the capital-to-labor ratio is the lowest of all groups identified.

The resource and efficiency criteria enabled to identify groups of countries which are internally coherent in terms of resources and efficiency. This is how a new dimension was established (in addition to the division into new and old member countries) which is used in

¹² The applicant carried out a multidimensional analysis of the structure of production farms in a monograph titled *A comparison of Polish and European Union farms*, presented for evaluation as part of other scientific achievements.

cause-and-effect analyses of the economic situation of agricultural producers in European Union countries.

The differences in the distribution of productive inputs across production sites between EU countries are particularly strongly influenced by historical events and the country's political and economic situation (*paper: Die Veränderungen in der polnischen Landwirtschaft - eine langfristige Analyse, no.9, point 4.3*). Nearly all European countries were affected by the deficiencies of the agrarian structure. However, the nature, intensity and—above all—the starting time of transformation processes in the agrarian structure in post-war Europe differed across Community countries, resulting in discrepancies which persist to this day. The largest differences are particularly noticeable between Central and Eastern European countries and Western and Northern European countries which were the first to start the transformation of the farm structure. This evolution took place in parallel to changes in labor and capital resources, driven by rapid economic development. Meanwhile, most new member countries implemented these processes in a centrally planned economy as a socialist model of agriculture. The extended state-owned and cooperative agriculture sector, converted into other legal forms under privatization processes, kept its dominance in some of these countries (e.g. Czech Republic and Slovakia). In Poland, just as in the former Yugoslavia, agricultural collectivization was very limited. As a consequence, the private sector always held a predominant share of agricultural land. This has largely affected the current structure of farming land which is highly fragmented.

4.7.4.Pace and nature of changes in the agricultural income situation across European Union countries: a macro- and meso-economic approach

At macroeconomic level, incomes were measured based on the national accounts system which includes agriculture as a section of the national economy. The contribution of particular sectors, including agriculture, to national income is determined based on aggregated value added of the sector concerned. The experience of many highly developed countries shows that as the economy develops, the share of agriculture in the national economy declines. However, the absolute level of agricultural value added grows. Based on the empirical study, that pattern was also observed in the group of EU countries, especially in new members (*paper: The role of agriculture in the national economy of EU countries, no.2, point 4.3*). That phenomenon was found to usually coincide with growth in agricultural value added. Nevertheless, the group of countries with a high level of GDP per capita accompanied by a small share of agriculture in GDP (varying in the range of 0.3% to 2%) and in total

employment is composed exclusively of EU-15 members. Conversely, new EU members are a vast majority in the group of countries which report the lowest national income per capita across the EU and, as a consequence, a higher share of agriculture in GDP (varying in the range of 2% to 4%). In EU-15, similar ratios can only be found in southern European countries, especially in Greece.

Information on particular items of national accounts which enable determining agricultural income at sector level is provided in Economic Accounts for Agriculture. Comparative analyses based on these accounts relied on the category referred to as “income of the agricultural entrepreneur” which includes the remuneration of non-salaried workforce (including the farmer’s own labor) and the remuneration for own land and capital employed, plus payments received (*paper: Dochody rolnicze w nowych krajach członkowskich Unii Europejskiej w świetle Rachunków Ekonomicznych dla Rolnictwa, no.5, point 4.3*). It was demonstrated that agricultural income grew progressively in 1999–2007 in nearly all new member countries (except for Bulgaria). An acceleration could clearly be observed right after the CAP instruments were extended to cover new member countries. At the same time, it was emphasized that changes in agricultural producer income in these countries were faster than in the EU-15. That process was partially caused by the effects of an increase in prices faced by new member countries right after they joined the EU. But most of all, it was related to an increase in financial support, as reflected in the rapidly growing share of payments in agricultural incomes in these countries. To illustrate the changes in income levels and to assess the effects of the accession, the analysis also covered income indicators, i.e. Indicator A (Index of the real income of factors in agriculture per AWU) and Indicator B (Index of the real net agricultural entrepreneurial income per unpaid AWU). Indicator A refers to real incomes from productive inputs per full-time agricultural employee; whereas Indicator B illustrates real net income of agricultural entrepreneurs per non-salaried (unpaid) annual work unit. The analysis of the indicators suggests that all new member countries witnessed an improvement in agricultural labor efficiency during the study period, with faster growth recorded for indicator A. At the same time, producers’ income in these countries was clearly more variable than in the EU-15. This could result from the new strong impulses affecting income growth in these countries. Although some positive trends and sharp increments in the income categories analyzed were identified in the agriculture of new member countries, they still lag considerably behind the average level for EU-15 countries.

Further research on agricultural income enabled drawing some conclusions on the trends which prevailed in the last decades (*paper: Polityka rolna Unii Europejskiej, kierunki zmian i konsekwencje dla rolnictwa polskiego, no.6, point 4.3*). First, it was observed that the

increase in agricultural income, in both real and nominal terms, was mainly true for new member countries (except for Bulgaria, Romania and Czech Republic). In the EU-15, only Germany and the UK experienced that trend. That increase resulted from a higher production value which was mainly due to higher production volumes. In countries such as the UK, Poland, Hungary, Latvia and Romania, it was additionally driven by an increase in agricultural prices. However, extending the scope of CAP instruments to cover the agriculture of new member countries had a decisive impact on the level of incomes. These countries recorded a considerable increase in the total amount of subsidies, with the highest growth being reported in the Polish agriculture. *Second*, most EU-15 countries experienced a decline in agricultural income. This was true both for countries with a prevailing role of intensive agriculture (Benelux) and for countries with less intensive forms of farming (southern European countries). The reasons include the deteriorating conditions of agricultural trade and the decrease in amount of funds (in real terms) transferred to the agricultural sectors of these countries (except for Ireland and the Netherlands). Moreover, the French, Belgian and southern European agriculture witnessed a decline in the real value of output; this was mainly caused by the relatively largest decrease in agricultural prices while also being driven by a reduction in production volumes (except for Spain and Belgium). Meanwhile, all countries in that group experienced an increase in the real value of intermediate consumption; together with a decline in financial support expressed in constant prices, this had a decisive impact on the deterioration of the economic situation in the agricultural sector. *Third*, it was demonstrated that in the Czech and Slovak agriculture (just as in Denmark), the bottom line was negative in some years.

It was emphasized that although the improvement in economic performance of agriculture sectors in most new member states can be regarded as positive, it should be noted that the average level of agricultural income per AWU and per farm is ca. five and six times, respectively, lower than in the EU-15. This is the direct consequence of a less developed agrarian structure (except for the Czech agriculture) and of excessive employment, especially in the Polish and Romanian agriculture.

4.7.5. Agricultural income disparity based on farm accountancy data

As mentioned earlier, the production and economic performance at sector level does not reflect the actual condition of individual producers. They can be looked at in more detail with the use of FADN data which also makes it possible to determine the incomes of farms grouped by economic size or type of farming. Income categories covered by FADN include

Family Farm Income calculated as net value added plus the balance of investment payments and taxes less the costs of externalities. As emphasized, the conclusions from the analysis of the income situation in farms covered by the FADN in particular countries and years (though generally largely consistent) may slightly differ from those derived from aggregated sectoral accounting data which takes all farms within a country into consideration¹³.

The analyses paid particular attention to the impacts of the economic recession on the farms' income levels (*paper: Polityka rolna Unii Europejskiej, kierunki zmian i konsekwencje dla rolnictwa polskiego, no.6, point 4.3*). As a consequence of the economic downturn in agriculture, the profitability of agricultural production declined, and the average family farm income in the EU-27 went down by more than 23% from 2004 to 2009. At the same time, it was stressed that some EU countries (including Poland) witnessed an improvement in average farm income. The detailed analysis of changes in incomes in farms grouped by economic size showed that very large farms in terms of economic size (above 100 ESU¹⁴) were relatively the most sensitive to changing business cycles. The reason for the above could be their stronger links with the market. Another remark was that in new EU countries, these developments were more intense and accompanied by a stronger variation in incomes. However, in all countries, despite being highly sensitive to changing business cycles, the average income per farm in this group was by far the highest. This confirms the general pattern that the increase in production scale favorably affects production efficiency and, as a consequence, financial performance.

Conversely, the smallest farms (less than 4 ESU) experienced an increase in incomes both across the EU and in new and old member states. This was found to be primarily related to the increase in direct payments which make a much greater contribution to incomes of small farms than to those of large farms. Also, the incomes of economically weak farms were more than ten times lower than those of the economically strongest holdings. Due to low incomes, investments are usually a matter of secondary importance to economically weak farms, the priority being assigned to current consumption. In light of the above, it was emphasized that small farms (up to 16 ESU) have a much greater share in the structure of farms covered by the FADN in new member countries than in old Community states.

¹³ The field of survey of the FADN includes commercial farms which make up at least 90% of standard output (SO) in the region or country considered. SO means the 5-year average value of a specific agricultural production per hectare or per animal during a year under average production conditions for the region concerned. Standard Gross Margin which (unlike the SO) takes production costs into account was used until 2010.

¹⁴ European Size Unit; 1 ESU = 1200 EUR. ESU became the basis for the classification of farms by economic size. After SO was introduced, the classification of the economic strength of farms has been based on standard output expressed in EUR.

The conclusion from the analysis of incomes by type of farming was that no clear trends could be observed in the evolution of incomes in different areas of agricultural production in EU countries. In the study period, a similar direction of changes (a reduction in incomes) was only discovered in grazing livestock farms. This was especially (but not only) true for new member states; as emphasized, this could result from the need to comply with several environmental, healthcare, sanitary and animal welfare standards (cross-compliance). The relevant adjustment measures (which involve important costs) were found not to have a true economic justification in the case of small animal numbers which is the prevailing situation in most new EU countries. The gap in incomes between new and old countries was particularly considerable in the case of dairy cow farms and granivore (pig and poultry) farms. The latter group was concurrently found to demonstrate the highest profitability across the EU but also the strongest variation in incomes compared to other farm types. Remarkably high incomes were also reported by horticultural farms and vineyards. It was emphasized that of all farm types, horticultural farms demonstrated the weakest dependence of income upon payments. Conversely, direct payments had the relatively greatest importance to family farm incomes in the group of field farms and grazing livestock farms.

Based on FADN data, an income analysis was carried out from the perspective of Polish conventional and organic farming (*paper: Efficiency of Polish organic and conventional farms, no.8, point 4.3*). The two diametrically opposing farming systems primarily differ by the efficiency of pursuing economic and environmental objectives. The use of extensive production methods, high labor intensity and low capital expenditure of organic farming make it less efficient than conventional farming; this translates into lower effectiveness in providing production effects. Conversely, conventional farms, in their efforts to supply food, have a relatively greater environmental impact and were therefore found to be less effective in the pursuit of environmental objectives. In that context, research was undertaken to identify the extent of differences in production efficiency and profitability between conventional and organic farms. To determine the actual levels of efficiency, the basis for calculating the sub-indicators of efficiency of productive inputs was defined as net value added plus operating subsidies. In turn, the level of income was expressed as family farm income per Family Work Unit (FWU). The research suggests that land efficiency and labor efficiency in organic farms were on average ca. 35% and nearly 70% lower than in conventional farms. This largely results from the lower technical efficiency of production processes. The smallest differences between organic and conventional farms existed in capital efficiency. As emphasized, this may be related to lower levels of expenditure in organic farms; at the same time, it could possibly be explained by the law of diminishing marginal

efficiency of expenditure. The low income generating capacity of organic farms was accompanied by an average level of subsidies being approximately two times higher (or, in the case of crop farms, three times higher). This was reflected in the fact that subsidies usually had a greater contribution to incomes than in conventional farms. As a consequence, family farm income per FWU was greater than incomes earned by conventional farms. The latter were found to be more profitable only in the group of dairy cow farming. Based on the above, it was concluded that the economic situation of organic farms depends more strongly on subsidies as an instrument which compensates for the lower efficiency. The importance of these issues was highlighted in the context of the future of organic farming. The unknown development of the Common Agricultural Policy after 2020 and the foreseen reduction of funds allocated to support the agricultural sector are factors that make the organic producers face a difficult, precarious situation. Dilemmas surround many issues, such as various strategies that contribute to improving the economic situation as the subsidies are restricted (including the ability to reduce production costs as a consequence of extending the production scale). It was noted that in addition to undisputable environmental benefits for the entire population, organic farming may also become an opportunity for farmers operating under less favorable conditions which make conventional farming difficult and economically unviable. In the long run, this could provide positive economic effects.

4.7.6. Agricultural income in Poland in the context of agricultural transformation

Agricultural income is both the consequence of and the reason for many processes taking place in the agriculture. In that context, it was found important for a complete evaluation of the income situation of the Polish agriculture to carry out a multi-level assessment of changes which took place in that sector, first as part of the economic transformation and then under a strong influence of Poland's accession to the European Union (1989–2016) (*paper: Die Veränderungen in der polnischen Landwirtschaft - eine langfristige Analyse, no.9, point 4.3*). An analysis of essential areas of changes made it possible to assess the key conditions affecting the production and economic situation of Polish agriculture in the past quarter of a century, and to identify the development drivers of that sector for the years to come. The investigation into economic and social structures and changes they experience is a major topic in the theory of economic development. Characteristically, economic development involves a reduction in agricultural employment. As demonstrated, that process takes place very slowly in Polish agriculture, largely because of the relatively slow structural transformation conditioned by demographic factors. As a consequence, the share of agricultural employees is

nearly 16%, a very high level in the European context. The persistently high labor inputs are a direct determinant of the unfavorable labor-to-land ratio which was made even worse by the decline in the area of agricultural land in the study period. In turn, the decrease in the area of agricultural land—with a simultaneous increase in capital expenditure—resulted in a slight improvement in the capital-to-land ratio. As emphasized, in the Polish agriculture, the ratios between labor and the two other productive inputs are decisive for the low level of labor efficiency which is barely 30% of the average value recorded in the EU-28 and as little as 17% of agricultural labor efficiency in the EU-15. As regards production structures, it was demonstrated that the concentration of agricultural land (accompanied by a decline in the number of the smallest farms) has been the prevailing trend for nearly 30 years. However, the Polish agrarian structure was concluded to be inadequate because it lags considerably behind northern and western EU countries, as also reflected in the comparison of the average area of farms. It was emphasized that a causative link exists between the large number of employees and the structure of agricultural land. As demonstrated by the analysis of production effects, the value of commercial production has progressively increased since mid-1990s. This was the basis for concluding that the farms gradually strengthen their market connections. After Poland's accession to the European Union, the annual value of agricultural output (in real terms) was higher by ca. $\frac{1}{4}$ than before the accession. The reasons were the more than 20% increase in production volume (due to various factors, including the discovered improvements in technical efficiency) and the 3.5% increase in real prices of agricultural produce. However, based on the exploration of long-term trends of price scissors, it was concluded that in the recent years, relative prices of agricultural products have reached 65–70% of what was recorded at the beginning of the transformation period, which is a much worse condition. At the same time, it was emphasized that a long-term decline in price relationships of agricultural products is a common development in the market economy. Usually, the policy of public support for agriculture is a specific way of compensating for the partial loss of income. Poland's accession to the EU led to a sharp increase in opportunities for agricultural support; as a direct consequence, the value of subsidies (in real terms) grew from EUR 272.2 million (average level recorded in 2001–2003) to PLN 3.7 billion per year (average level recorded in 2004–2016). In that period, the average amount of agricultural income grew by 150% in real terms (from ca. PLN 3 billion to PLN 7.5 billion). The share of total subsidies in the value of agricultural production increased more than 10 times, and the contribution of subsidies to incomes grew from ca. 9% to nearly 49%. Also emphasized was the role of international trade in the development of the agri-food sector. As shown by relevant analyses, after joining the EU, Poland witnessed rapid growth of agri-food exports. This is a finding of major

importance because an increase in domestic demand for food is a recessive growth which takes place much slower than GDP growth. Therefore, agri-food exports accompanied by growth in agri-food production were an important market outlet for the domestic food industry and, thus, a stabilizing factor for the domestic agri-food market. In that context, it was found that agricultural support under the CAP (in addition to trade development opportunities and access to the single European market) was the basic determinant of the functioning and development of the agricultural sector.

4.7.7 Forecasting the producers' income by line of production: findings from model simulations

The scope and forms of market interventions are a vivid part of the discussion on the shape of the CAP. The debate is mostly fueled by the pressure to reduce agricultural budgets and by critical opinions on how the instruments are redistributed under the first pillar. One of the scenarios discussed assumed a total discontinuation of market support and income support offered under the first pillar. It is generally known that this concept has not yet been accepted because of the important role of direct payments in the stabilization of agricultural income and in the creation of public goods. However, in the future, the implementation of the scenario proposed by the European Commission may involve market intervention. The gradual reduction in the use of instruments covered by this type of intervention is noticeable in subsequent CAP reforms. The direct consequence is the decreasing share of expenditure on export subsidies and market support in the agricultural policy budget (from 20–30% in early 1990s to ca. 6% in 2010–2011 and 1,5% in 2017–2018). As emphasized, at the current stage of CAP development, the use of market intervention instruments is primarily a safety net. In view of the above, the question was asked about the possible impact of discontinuing the market intervention on the economic situation of agricultural producers in European Union countries (*publication: Polityka rolna Unii Europejskiej, kierunki zmian i konsekwencje dla rolnictwa polskiego, no.6, point 4.3*). Scenario 1 assumes the discontinuation of market intervention instruments, including¹⁵ milk quotas by 2015 (with a phasing out process being implemented until that time); sugar quotas by 2017; aid for exports and storage; and aid for consumption, processing and intervention purchasing. In turn, the direct payments system remained unchanged. The results for 2020 were compared with those obtained in scenario 2 which assumes the continuation of market intervention in its current form (maintaining the

¹⁵ Model simulations related to market interventions were carried out at the end of 2009, beginning of 2010

status quo). Additionally, a scenario was planned and implemented which assumed that only milk quotas would be abolished in 2015, as per the guidelines set out in the 2008 Health Check reform¹⁶. The results obtained for 2020 under that scenario were presented with respect to milk producers and compared with the scenario where production quotas are maintained. Conclusions regarding incomes of operators engaged in different lines of production were drawn based on income per hectare or per animal.

As shown by findings from the simulation analysis, the elimination of market intervention would result in a decrease in incomes of all agricultural producers across the EU (by 0.3% on average). At the same time, it was demonstrated that the adverse impact of discontinuing the intervention on agricultural incomes would be stronger in new member states than in the EU-15. As emphasized, this could suggest that producers from EU-15 countries are better adapted to market changes by taking measures to neutralize the impacts of market fluctuations. The differences in the evolution of incomes (driven by the abolition of intervention measures) between the new and old member states were particularly noticeable in the group of sugar beet producers and pig producers. In the status quo scenario, the production and economic situation of sugar beet producers was determined to the largest extent by agricultural policy instruments, especially including the administrative limitations to sugar production volumes (sugar quotas). As regards Polish sugar beet producers, the simulations revealed that a total discontinuation of market intervention instruments may result in the highest decline in incomes of all lines of agricultural production (above 17% compared to the status quo scenario). A decrease in incomes of sugar beet producers was also expected in most other new member states. Conversely, a different trend (growth in incomes) was foreseen in EU-15 countries. It was demonstrated that the expected 8.8% decrease in beet prices in the Community market—in relation to the scenario where market intervention mechanisms are maintained—would make the production less profitable and, as a consequence, would result in eliminating from the market the smallest operators which exist in many of the new EU member states. Old and new EU countries clearly differ in the production structure of sugar beets. In new member countries, over 30% of operators cultivate up to 1 ha of land which

¹⁶ Model simulations which assume the abolition of milk quotas as per the Health Check CAP reform were also presented by the applicant in: *Consequences of the abolition of milk quotas for Polish milk producers, taking into consideration the regional disparities (results of model simulations)* and *Impact of the abolition of milk quotas on the production and economic situation of milk producers in the European Union (results of model simulations)*.

should be regarded as a deficient structure. In the EU-15, only a few percent of farms own less than 1 ha of land, with the largest group having from 2 to 49.9 hectares under beet¹⁷.

A decline in incomes in new member countries and an increase in incomes in the EU-15 in scenario 1 compared to scenario 2 was also found to be true for pig production. As emphasized, that market is among the least regulated under Common Agricultural Policy mechanisms. The technological particularities of that production line drives considerable instability in production levels which, in turn, translates into price fluctuations. It was concluded that due to a higher concentration degree, EU-15 producers, especially those based in countries which are major producers of pork (Germany, Spain, France, Italy, Denmark, Netherlands) are more competitive in the Union market. At the same time, it was stressed that because of its frequent adverse environmental impacts, large-scale breeding of pigs is considered to be the least consistent with CAP assumptions derived from the MacSharry reform. As demonstrated, incomes would increase especially in regions specializing in this very type of production (German, Spanish, Danish and Belgian regions).

Findings from simulation analyses proved that an improvement in incomes in new EU member countries could be expected by cereals and oilseeds producers; in the case of EU-15 producers, a slight decrease in incomes from cereal production (by ca. 1%) and an increase in incomes of oilseeds producers (mainly rapeseeds) was discovered. In the recent years, the EU has witnessed an increase in rapeseed cultivation which was explained by its increasing importance in biofuel production. It was emphasized that in the Community, just as in other parts of the world where agricultural development contributed to meeting the demand for food, agricultural land may be reallocated to serve other purposes, including those related to renewable energy production. In that context, it was found that the development of rapeseed production would be largely determined by demand from the global biofuel market while being only slightly driven by the increase in demand for rapeseed for the purposes of human consumption.

The incomes of milk and beef producers, both in new and old member countries, were found to follow a similar (downward) trend, though to a different extent. The changes in incomes of milk producers were found to be similar to those forecasted in the scenario which

¹⁷ The impacts of the abolition of sugar quotas in Poland and other EU countries were also the subject of an expert assessment commissioned by the Ministry of Agriculture and Rural Development as part of the activity of the Team in charge of developing the concept and proposition for CAP conditions and principles after 2013. The findings were also presented at a lecture on the *Milk and sugar market reforms in the European Union: impacts on producers* delivered at the invitation of the Agricultural Consultancy Center during the Agricultural Entrepreneur Days (Przysiek, March 5, 2014).

assumed only the abolition of milk quotas, and would decline across the EU by ca. 17% and 19%, respectively, per animal. Therefore, the discontinuation of other market intervention instruments would slightly increase the expected decline in incomes. In that context, it was found interesting to analyze in detail the consequences of the abolition of milk quotas in different EU countries (the scenario related to the implementation of arrangements made under the Health Check reform). It was demonstrated that following the abolition of the quota system, the greatest decline in incomes (per animal) in 2020 would probably be experienced in countries with the fastest growth of the cow population and milk production (in relation to the scenario where the quota system is maintained). This means such countries as the Netherlands, Belgium, Spain, Italy and Austria. As explained, upon abolition of production quotas in the EU milk market, the expected reduction in milk prices in these countries could be compensated with production growth and intensification, especially in the case of development farms which were unable to increase their production volume under the quota system. At the same time, the group of the smallest farms is expected to be eliminated from the market. Their incomes were largely driven by the quota system. As demonstrated, the decline in milk producers income in old EU countries would generally be much greater, reaching nearly 20% as against 2.4% in new member states. This was explained by the initially lower level of milk prices in these countries. In Polish agriculture, the reduction in incomes may reach 3% compared to the scenario where milk quotas are maintained. The regional analysis of the effects of implementing the Health Check reform showed that in Poland, the abolition of the milk quota system will contribute to the concentration of production activities in farms and regions which initially had better production performance. Thus, it was demonstrated that the intervention which consists in maintaining the production limits contributed to narrowing the development gap between producers while reducing the milk production efficiency at a countrywide basis. Similar conclusions were drawn from the investigation into the abolition of milk quotas in other countries of the European Union: it was demonstrated that the abolition of the quota system would contribute to the evolution of milk production structures towards increased production efficiency¹⁸.

¹⁸ The findings were discussed at a conference (*Degree of preparedness of Poland and European Union for the abolition of milk quotas*) held in the Senate of the Republic of Poland by the Parliamentary Commission in charge of Agriculture and Rural Development, the Senate Commission in charge of Agriculture and Rural Development and the Parliamentary Analytical Office of the Chancellery of the Parliament (November 26, 2014). The impacts of the abolition of milk quotas on the milk market in Poland and other EU countries were also the subject of an expert assessment commissioned by the Ministry of Agriculture and Rural Development as part of the activity of the Team in charge of developing the concept and proposition for CAP conditions and principles after 2013. The assessment was presented on May 27, 2010 at the meeting of the Team held at the premises of the Ministry of Agriculture and Rural Development.

Actual changes in agriculture have already largely validated the results of simulations which testifies to the adequacy of tools employed.

4.7.8. Adopting an integrated approach in forecasting the effects of changes in the CAP on economic welfare

The major challenges facing the CAP include the unsolved issue of liberalizing the trade in agricultural products and the definition of the scope of support under the agricultural policy which would be acceptable to the World Trade Organization (WTO). Note that WTO puts strong pressure on the EU to narrow the scope of intervention. The main controversial issues in agricultural trade are internal support and levels of market access. In that context, an attempt was made to answer the question on the extent to which the EU would be willing to further modify the CAP based on negotiations with the WTO, and what could be the targets for these modifications (*paper: Przewidywanie kierunków zmian Wspólnej Polityki Rolnej Unii Europejskiej - podejście zintegrowane, no.10, point 4.3*). The pursuit of the research objective was based on two scenarios. The first one assumed the removal of the first pillar of the CAP, i.e. the discontinuation of market intervention instruments and of the direct payments system. This means a radical reduction of internal support in EU countries. In turn, the second scenario provided for a partial removal of barriers to trade in agricultural products, including the formula for a staged reduction of customs tariffs in accordance with the proposition set out in the last arrangement between WTO members. The results were compared against the scenario which assumes the maintenance of the status quo in the EU's agricultural policy. The essence of this research was to determine the pay-off matrix for a non-cooperative game where the utility of the players (in this case, the European Commission as the main contributor to the EU's decision-making process, and the WTO) was the result of a CAPRI simulation. The analyses relied on the elements of the standard theory of non-cooperative games and on the theory of transitions.

Based on the model analysis, it was found that in both scenarios, total welfare (including producers' income, consumer surplus, profits of agri-food operators and welfare of the public sector) would slightly increase compared to the status quo scenario. If the first pillar was removed, the improvement in welfare would mainly result from smaller amounts of public funds being allocated to support agricultural producers and to agricultural market interventions. However, the expected outcome of removing the subsidies granted to agricultural producers is a decline in sectoral income by ca. 40%. As demonstrated, this could result from the fact that some producers would have no other option than to discontinue their

business, especially those whose income depends most on subsidies and who therefore are unable to compete in the market without external support. As emphasized, other producers would need to take measures to adapt to the new farming conditions. This would result in a decline in supply in the agricultural market and a rise in prices which, in turn, would contribute to a reduction in consumer surplus. Another conclusion was that the increase in prices of Community-made products would adversely affect their competitiveness in the global market and could therefore reduce Community exports to third countries. At the same time, due to lower product supply, the EU would experience increased imports which explains a 0.64% increase in customs revenue against the base scenario. An increase in the supply of cheaper imported products would partially offset the negative consequences of the rise in consumer prices. Hence, in this scenario, consumer welfare would only slightly deviate from the status quo scenario. Conversely, a greater increase in consumer surplus was observed in the trade liberalization scenario, which would result from the reduction in agricultural prices in the EU market. As emphasized, this would be reflected in a deterioration of the agricultural producers' income situation. At the same time, it was noted that on the one hand, trade liberalization will increase competition in the Community market. On the other hand, EU producers will gain broader access to third-country markets, and therefore the decrease in agricultural income at sectoral level was estimated to be ca. 3%. It was demonstrated that budget revenue from customs duties will decrease much more (by over 14%). However, budgetary expenditure on the implementation of the trade policy will reduce by nearly 2% in parallel. In summary, the conclusion was that a reduction in budget costs and an increase in consumer welfare would offset the losses suffered by the producers and the loss of tariff revenue to the budget. As mentioned earlier, this would result in an increase in total welfare.

Based on the above findings, two options were defined for the system of preferences of the European Commission (EC) towards changes to the CAP. Afterwards, pay-off matrices were established for the non-cooperative games between the EC and WTO. The conclusion from this study is that whether the European Commission adopts a system of preferences focused on the interests of agricultural producers (option 1) or a system of preferences aimed at general welfare (option 2), trade in agricultural products could be liberalized while keeping the first pillar of the CAP. That outcome is the Nash and Brams equilibrium for both options of the non-cooperative game presented above. Therefore, in order to address the preferences of various social groups in the EU, the European Commission should endeavor to maintain the first pillar of the CAP while agreeing to the liberalization of trade in agricultural products. The resulting equilibrium is the combined effect of changes in welfare of various groups of

CAP stakeholders. Therefore, targeting the reforms in line with the guidelines of the model presented above should contribute to social acceptance of the policy.

Considering its multidimensionality, **Würstenhagen et al. (2007)** distinguish between three levels of social acceptance: socio-political, social and market acceptance (*paper: Reforms of the Common Agricultural Policy of the EU: expected results and their social acceptance, no.11, point 4.3*). The proposed research refers to the dimension with the broadest perspective, i.e. the socio-political aspect of social acceptance. This means the acceptance of current policies by key stakeholders and political entities. Based on the relevant literature, it was found that a disagreement exists as to the way of defining and measuring social acceptance. In that context, an approach was proposed which consists in measuring the welfare of various socio-economic groups under the influence of changes to the CAP, and determining their utility which then becomes the framework for a non-cooperative game between the European Commission and the agricultural producers lobby¹⁹. Three scenarios of changes to the CAP were established. The first scenario included the complete removal of the first pillar; the second scenario provided for the removal of the second pillar; and the third scenario assumed a total discontinuation of agricultural support.

The model research proved that the largest decline in agricultural producers' income (at sector level in the EU-28) would take place in the third scenario (discontinuation of the CAP), but the difference against the first scenario would be relatively small. This is because currently producers are largely supported with direct payments. For the consumers, the consequences of both scenarios (the first and the third one) would be the same. Conversely, the removal of the second pillar of the CAP would have a much less adverse impact both on the economic situation of producers and on consumer surplus. As stressed, this is partially because the expenditure under the second pillar is currently lower than under the first pillar; another reason is the nature of the rural development policy implemented under that pillar. In that context, the following was emphasized: first, expenditure under the second pillar is allocated to general rural development, and therefore the farmers are not the only beneficiaries of that policy (unlike under the first pillar); second, the agricultural producers lobby (especially in the EU-15) is not in favor of increasing the expenditure under the second pillar in the total CAP budget, primarily because currently the main beneficiaries of the rural development policy are producers from new EU member states while the already modernized

¹⁹ The rationale behind considering the agricultural producers lobby as a player is that, as demonstrated by Dermont et al. (2017), the response of entities with formal decision-making authority and the lobbying groups (with the agricultural producers being the largest one) have generally the greatest importance in formulating policies.

farms of EU-15 producers access that kind of aid to a smaller extent. This is corroborated by the findings of the simulated removal of the second pillar which would reduce the incomes of EU-13 and EU-15 producers by ca. 6% and nearly 3.5%, respectively.

At the same time, it was emphasized that the extreme scenario (involving the discontinuation of the CAP) was a purely theoretical procedure employed to provide a benchmark for other scenarios. That scenario could only be put in practice if the agricultural intervention measures were included in the general economic, social and environmental policy. The second scenario, related to the removal of the second pillar of the CAP, is also of a theoretical nature. In the 2013 reform, the European Commission clearly highlighted the importance of that pillar as a priority for the rural development policy focused on environmental objectives and designed to promote multi-purpose rural development. Therefore, based on this rationale, and considering the shift in focus from direct support to intermediate support as part of sustainable development (as emphasized in the debates on the future form of the CAP), the scenario which assumes the discontinuation of the first pillar of the CAP will be further analyzed and, hence, will be the subject of the game. The results of the model simulation served as a basis for the construction of the pay-off matrix between the EC and the agricultural producers lobby. Two strategies were defined for each player. It was assumed that the EC may decide to leave the first pillar as is or to remove it, while the producers may opt for increasing or maintaining the current level of expenditure under the CAP. Another assumption was that in their decisions on the future policy, the EC will consider not only producer welfare but also consumer welfare. The result of the game showed that the first pillar would be maintained and the total expenditure under the CAP would remain at the current level. Hence, without the first pillar, the acceptance of the CAP by its direct stakeholders would be smaller than in status quo. In other words, it was demonstrated that the removal of the first pillar of the CAP would adversely affect the socio-political acceptance of the CAP. That aspect should be taken into consideration when determining the future form of the EU's agricultural policy.

4.7.9. Sustainability of European Union agriculture with particular focus on economic equilibrium

In addition to environmental sustainability, topics related to the economic situation and social acceptance mentioned earlier in this summary are fundamental requirements for a sustainable development of agriculture (paper: *The sustainability of agriculture in the European Union against a global backdrop*, no.7, point 4.3). This is because the essence of

sustainable development is to ensure economic viability and social acceptability for agriculture while pursuing production and environmental goals. In turn, sustainable development of agriculture is an inherent part of the sustainable rural development concept which requires that simultaneous efforts be taken to improve the standards of living for the population and business conditions in rural areas while preserving the specific natural resources, rural landscape and cultural heritage. As regards the standards of living of the rural population, particular focus is placed on the farmers' current and future incomes and standards of living. As part of these considerations, it was emphasized that a reduction in externalities involved in agricultural production processes and the production of public environmental goods are contradictory—at least in the short run—with the basic function of agriculture which is to ensure global food security. With limited land resources and the continuous growth of the world population, that problem becomes particularly important. In this context, an attempt was made to assess the sustainability of European Union agriculture compared to global agriculture, taking the economic, social and environmental equilibrium into consideration. It was indicated that in EU, the requirements for sustainable agricultural development are the responsibility of the European Model of Agriculture (established under the influence of the CAP), and that family farms are the place where these requirements are met²⁰. The synthesis of the economic capacity of family farms is an amount of agricultural income which, at a defined time and place, meets the conditions of sustainability. As shown by global research, in the vast majority of regions across the world, the level of farming income precludes the attainment of economic and social sustainability. At the same time, the issue of excessively low incomes in the agriculture sector is a major barrier to sustainable agricultural development across the globe. This is because low levels of per capita income preclude the fulfillment of social functions. Moreover, the paper states that these farms often fail to respect the natural environment in their operation. Northern American and European Union agriculture stands out with the gross value added²¹ per employee being 55 and 20 times higher, respectively, than the global average. This was the basis for concluding that the agricultural sector in these parts of the world is economically sustainable. As demonstrated in parallel, the environmental “costs” of agricultural energy production (measured in kilograms of greenhouse gases per kcal of energy generated in the agricultural sector) in the EU are lower than in Northern America. This was explained by the rapidly progressing concentration

²⁰ The conclusion from the relevant literature is that in the EU, family farms make up ca. 30% of the total number of farms, hold ca. 51% of all agricultural land and contribute $\frac{3}{4}$ to agricultural production in the EU.

²¹ Due to lack of complete reliable information on agricultural incomes in worldwide statistics, gross value added (a category which is closest to potential income of agricultural employees) was used as reference when comparing the economic situation in agriculture.

of production in the latter countries. In turn, EU agriculture was found to have made the biggest progress in reducing the pollution intensity of production (expressed as the quantity of greenhouse gases per kcal of energy produced) over the last nearly 50 years. The implementation of an environmentally-friendly policy (which has gained in intensity since the early 1990s as a consequence of the MacSharry reform), on the one hand, and the implementation of solutions derived from scientific and technical progress, on the other, were identified as important parts of this process. In most other regions of the world, except for Asia, the environmental “costs” of agricultural energy production are higher than in European farming. In turn, compared to other regions, the EU reports of one highest levels of pollution intensity per hectare of agricultural land. However, it was emphasized that, first, this happens in a context of a relatively small area of arable land per capita; and second, the EU is the only part of the world to have witnessed a decrease in agricultural greenhouse gas emissions per unit area over the last years. In summary, the conclusion was that no region could be identified around the world where the food supply objective and the full set of environmental objectives are pursued in parallel on a short-term basis. Nevertheless, in a global and long-term approach, the European Union agriculture meets the durability and sustainability requirements to the greatest extent. Against the backdrop of global agriculture, under institutional conditions guaranteed by the CAP, the EU agricultural sector meets the requirements of economic and social sustainability to the relatively greatest extent, and develops while decreasing the environmental burden.

4.7.10. Summary and conclusions

Incomes, as the financial basis for the livelihood of each social and economic entity, are one of the key issues of economic theory. There are several aspects which make incomes so important, including a measurable impact on demand, consumption and producers’ behavior, or the social security of economic operators. Despite the complexity of decision-making processes, the economic practice shows that the objectives of business operators are centered around economic surplus. This is also true for farming activities. In agriculture, incomes determine the farm’s ability to continue its development while impacting the level of consumption of goods by people related to the farm. Thus, the level of agricultural income has an indirect impact on rural development, both in the economic and social dimension. As a consequence, it remains a basic field of research in agricultural economics. Also, in their economic and social policies, highly developed countries devote a lot of attention to topics related to agricultural income. Because of the particularities of agricultural production, performance depends not only on the level of productive inputs employed but also on several

external conditions beyond the producers' control. The poor income generation capacity of agriculture, combined with its basic function which is to guarantee food supplies to the population, is one of the fundamental reasons for implementing an intervention policy in the agricultural sector. Supporting the incomes of agricultural producers, as a measure taken to ensure adequate standards of living for the rural population, was also defined as one of priorities for the Common Agricultural Policy. The income situation of agricultural producers continues to be influenced by interconnected socioeconomic factors and by dynamically changing production and political conditions. Therefore, agricultural income is a complex subject of research which still has relevance.

Research undertaken by the applicant provides a synthetic and multilateral assessment of agricultural income in European Union countries. The need to look at this topic from different perspectives resulted from its multifaceted nature. Because of the complexity of this topic, a comprehensive approach was required to take account of both ex post and ex ante analyses. This was reflected in the thematically connected series of publications under the common title: *Incomes of agricultural producers in the context of changes to the Common Agricultural Policy*.

The research allowed to conclude that the processes of extending, enhancing and strengthening the integration within the European Union were significant determinants of the importance and dimensions of the objectives defined in the agricultural policy in place. That policy has been, and continues to be, aligned with internal and external pressures (from the WTO) on an ongoing basis, as reflected in the varying selection of intervention instruments deployed. It can be concluded that the implementation of the CAP undoubtedly contributed to production and development objectives of the agricultural sector. Its adverse consequences were also identified, such as surplus food production, high implementation costs or environmental threats posed by agricultural activities. Also, despite the deployment of various intervention solutions, the social objective related to incomes of agricultural producers was not fully met. Indeed, as shown by research, across the EU, agricultural income continues to be below the average level of remunerations of employees in other sectors. In an effort to verify the research hypotheses, a series of other phenomena and trends were identified which are related to the agricultural producers' income situation in the context of functioning under the Common Agricultural Policy.

The first hypothesis is that the implementation of the Common Agricultural Policy contributes to reducing the downward pressure on the income of agricultural producers. Based on research findings, this cannot be clearly confirmed. Only some countries (mainly new members, including Poland) were found to have experienced an increase in agricultural

income in both real and nominal terms. Usually, that growth was essentially caused by an increase in production value, an improvement in labor efficiency and, most of all, the progressive increase in payments under the CAP. These processes were accompanied by an increase in agricultural value added which, at the same time, contributed less and less to GDP. Generally, these developments were found to be the right course of transformation for the agriculture and economic structure of these countries. Based on the analysis of long-term changes in Polish agriculture, conclusions were also drawn on the sector's capacity to adapt to changing conditions with institutional support for the processes in place. In turn, slightly different developments were discovered in the agricultural sector of many EU-15 countries (except for Germany and UK); especially in the recent years, a decline in agricultural income has taken place, often accompanied by a decrease in the real value of production, a reduction in funds transferred (in real terms) and a growing contribution of funds to income. Therefore, the research showed that the impact of the CAP on reducing the downward pressure on incomes of agricultural producers is ambiguous and depends on the group of countries analyzed.

It was also demonstrated that the incomes of agricultural producers vary strongly across EU countries, the reason being the combined effect of multiple endo- and exogenous factors. Among the endogenous factors, a fundamental role is played by the production potential together with the relationships between the constituent productive inputs which, as a consequence, determines the efficiency of the manufacturing process. Another matter of importance is the agrarian structure which has a strict causative link to that process. To that extent, it was demonstrated that despite some positive changes, the gap between the agricultural producers from most new member states and the most developed EU-15 countries is large. This directly translates into a weaker production capacity and, thus, into poorer business performance. In the context of Polish agriculture, structural transformation and reduction of employment were identified as key factors of further development.

Despite the important contribution of endogenous factors to economic outcomes of production, the conclusion from this study was that the level of agricultural producers' income in both groups of EU countries is mostly determined by direct payments which therefore are a fundamental exogenous factor. The role of funds obtained in the development of the income situation is even stronger in farms which comply with organic farming principles. This proves that the ability for the farmers to pay for their own labor largely depends on external factors which are political decisions.

Based on simulations underpinned by the partial equilibrium model, it was demonstrated that the modifications to the Common Agricultural Policy are accompanied by heterogeneous

changes in incomes of agricultural producers and in total welfare across the EU, which corroborates **the second hypothesis**. The differences in the economic situation caused by actual and expected changes to the agricultural policy were observed to exist both between countries and between farm types. Any reallocations of funds under the CAP also had an impact on the entire society, which can be measured with the total welfare level. It was emphasized that focusing the reforms on the equilibrium between benefits to agricultural producers and to other stakeholder groups will contribute to increased social acceptance of this policy. The research on this topic, which is in line with the analyses carried out in welfare economics, enables determining standard measures which contribute to the best possible implementation of the defined social goals.

The multifaceted outcomes of changes to the Common Agricultural Policy could be identified with the use of an innovative integrated approach which consists in the combination of the CAPRI partial equilibrium model with some elements of the theory of games. The above confirms the **third hypothesis** advanced in this study. The use of findings from the model research in calculating the pay-offs in the game based on the theory of transitions enabled assigning methodologically substantiated assumptions for the players' preferences while also allowing to consider the preferences of different social groups. The development of this approach and the identification of its suitability in discovering the impact of actual and simulated modifications of the EU agricultural policy serves both an utilitarian and a cognitive purpose. The use of that type of methodological solution in forecasting the effects of the CAP can be useful in alleviating the negative consequences of and increasing social acceptance for this policy.

The applicant's comprehensive research on incomes of agricultural producers takes account of various intervention measures in the EU agriculture and makes a theoretical, methodological and empirical contribution to economic sciences in the field of economics.

1. In the theoretical dimension, a critical review was performed of subsequent CAP reforms with focus on their impact on agricultural incomes and income parity. With reference to the theory of interventionism, it was demonstrated that maintaining the profitability of agricultural production continues to be a priority for the EU agricultural policy. However, the consequences thereof for the agricultural sector vary across countries. The existing system of agricultural producer support has a strong social dimension in new member states while having a noticeably weaker impact in the EU-15. This is all the more important since it can widen the income disparity

between agricultural producers and the remaining part of the society in these countries. It was also shown that in all countries, the effects of CAP modifications are unevenly distributed between farm types. Having in mind that their income situation largely depends on political factors, this gives rise to institutional risk in addition to economic and environmental risks. Furthermore, all countries witness a shift in importance from endogenous to exogenous determinants of income. These conclusions contribute to the modern theory of interventionism in the agricultural sector.

2. In the methodological dimension, the applicant believes the application of the approach which combines the CAPRI partial equilibrium model with some elements of the theory of games to be a considerable contribution to economics. This solution consists in predicting the potential changes to the CAP by considering their economic effects (the result of CAPRI simulations) and the resulting system of preferences of parties to the conflict (theory of games). Hence, this approach fills the research gap related to determining the consequences of modifications to the agricultural policy while taking into account the economic welfare and priorities of different socioeconomic groups, as a matter of crucial importance to the social acceptance of the policy. The combination of the two methods referred to above was not used in previous economic research. Therefore, the applicant's approach is a pioneering work in both domestic and international context.
3. In the empirical dimension, the analyses allowed first of all to identify and assess the income situation from a macro-, meso- and microeconomic perspective; to highlight the issue of income disparities; to explore the convergence processes followed by labor efficiency; to determine the production potential and manufacturing efficiency; to assess the transformation of the Polish agricultural sector in the context of its impact on the economic situation of producers; and to highlight the role of incomes in ensuring agricultural sustainability. As demonstrated, incomes largely depend on the instruments deployed, and therefore are a yardstick for the effectiveness of the agricultural policy. Therefore, as an important part of CAP evaluation, the results of ex post analyses enable the verification of intervention instruments used. In turn, the results of ex ante analyses, which present the consequences of actual (yet different) propositions of CAP solutions, play an important preparatory role while providing the ability to rationalize planned changes to the agricultural policy.

4.7.11. Usability of this research project

As regards the applicative aspect, this research not only contributes to the discussion but most of all allows to identify the real benefits and costs of instruments and solutions used under the CAP. Note that a large part of the results of simulations was discussed during the deliberations of the Team in charge of developing the concept and proposition for CAP conditions and principles after 2013 at the Ministry of Agriculture and Rural Development. Therefore, findings from this research may support the decision-makers in formulating the recommendations and solutions under the Common Agricultural Policy after 2020. Also, having in mind the results of the assessment of welfare of other stakeholder groups, it can also provide some guidelines for the recommendations as to the social and economic policies.

5. Overview of other research and scientific achievements

5.1. Research problems

The applicant's scientific interest is centered around economic processes and events taking place in the agri-food sector of European Union countries, with particular focus on developments driven by political factors. The research on these issues, based on a wide range of variables, analytical dimensions and research methods, allowed to observe and identify the phenomena under investigation and to synthesize the findings into patterns that govern the development of that sector. The analyses were primarily carried out at a meso-economic level or, with respect to selected topics, also at micro- and macroeconomic levels. Presented in scientific publications and expert assessments, the findings were discussed at national and international scientific conferences.

The applicant's scientific work extends over four complementary fields of research, namely:

- **Research on general agricultural economics and on the development of sustainable multi-purpose agriculture;**
- **Forecasting the impacts of actual and potential changes to the Common Agricultural Policy on the production and economic situation of agricultural producers and on total welfare in the EU;**
- **Research on food consumption economics and household economics;**
- **Transformation of the agri-food sector in European Union countries in the light of the theory of agribusiness.**

Referring to subsequent fields of research, a total of 10 major publications were identified (in addition to those listed and presented as a scientific achievement in Section 4). These papers were presented in more detail in the corresponding thematic areas.

Ad 1. Research on general agricultural economics and on the development of sustainable multi-purpose agriculture

Topics involved in the first field represent the broadest area of the applicant's scientific interest. The decision to tackle this line of research was largely influenced by the applicant's participation to the KATO research project titled *Comparative Analysis of the Transition Process in the Agricultural Sector of Central and Eastern European Countries*, coordinated by the Humboldt University of Berlin (Section IIG, Appendix 4). The project was implemented to assess the consequences of the agricultural transformation process in selected Central and Eastern European countries. The applicant published her first papers addressing that field of research before defending her Ph.D. thesis. The topics included: the assessment of manufacturing efficiency (Item 3.1.1, Appendix 4); regional diversification of agriculture in Central and Eastern European countries (Items 2.1.1 and 2.1.2, Appendix 4). Polish foreign trade in agri-food products in the context of integration with the EU was also a subject of interest (Item 3.1.2, Appendix 4).

In her later research, as a Ph.D., the applicant paid particular attention to issues related to the manufacturing potential and production efficiency in agricultural sectors of EU countries (Item 3.2.2 - 3.2.5., 3.2.10., 3.2.13., 3.2.16., 4.1., 5.1. - 5.3., Appendix 4). The relevant analyses relied upon various research methods and tools (including synthetic indicators, multidimensional analyses and TOPSIS). In turn, the σ -convergence index was used in the research on agricultural labor efficiency. In addition to the publication discussed in Section 4 (no.3, point 4.3), convergence processes followed by labor efficiency were investigated at European Union level (Item 3.2.29., Appendix 4) and the level of selected trade groups (Item 2.2., 3.2.23., 4.2., Appendix 4). Convergence in agriculture was addressed by Ms. Natalia Markiewicz, M.Sc., in her doctoral dissertation titled *Regional convergence in European Union agriculture* for which the applicant acts as assistant supervisor.

Research on agricultural economics was also dealt with in other publications in addition to those submitted for evaluation as a part of series which forms the scientific achievement related to the evolution of incomes of agricultural producers in EU member countries (Item 2.2.4., 3.2.17., 3.2.19., 3.2.30., 5.4., Appendix 4). Topic addressed also include the impact of Poland's accession to the European Union on changes in prices and

price relationships of agricultural products in Poland (Item poz. 3.2.11., Appendix 4). The analyses related to this scope of research also addressed the economic rationale behind the VAT accounting method for farms (Item 3.2.14., Appendix 4) and the structure of agricultural holdings (Item 3.2.1., Appendix 4). The problems related to the extent and lines of changes to agrarian structures in Poland and other EU countries are also broadly addressed in the publication titled *Gospodarstwa rolne w Polsce na tle gospodarstw Unii Europejskiej* (Section I B-Item 1.2., Appendix 4) which will be discussed later as part of this research field. Other topics covered by the applicant's research include total production performance in agriculture (Item 3.2.15., Appendix 4) and selected lines of agricultural production (Item 3.2.20., 3.2.26., Appendix 4). The identification of production priorities which were found to require financial support in order to boost the competitiveness of the Polish agri-food sector in the Single European Market became the subject of an expert assessment co-authored by the applicant, commissioned by the Foundation of Assistance Programs for Agriculture (FAPA) for the purposes of the Ministry of Agriculture and Rural Development (Section III M, Appendix 4). An analysis of purposefulness of public support was carried out for plant production (cereals, potatoes, sugar beet, rape and vegetables) and livestock production (milk and live bovine and porcine animals).

Multifaceted analyses related to regional disparities and agricultural transformation in Poland and to the condition of the Polish agricultural sector compared to other European Union countries were also posted in the "*Polska Wieś. Raport o stanie wsi*" journal periodically published on the initiative of the Foundation for the Development of Polish Agriculture (FDPA) (Item 2.2.3. and 2.2.3A., 2.2.6. and 2.2.6A., 2.2.7. and 2.2.7A., Appendix 4). Also, they were the subject of numerous speeches delivered at Polish and international conferences and seminars organized by many organizations, including the European Association of Agricultural Economists (EAAE), Organization for Economic Cooperation and Development (OECD), International Agricultural Trade Research Consortium (IATRC) and Polish Economic Society (PTE) (Section II I, Appendix 4).

As a part of this field of research, the applicant also addressed some topics related to multifunctional agriculture. In addition to traditional goals centered around food production, the European multifunctional agriculture model also takes into consideration other functions of that sector, including those related to environmental protection and rural development, in broad terms. The relevant measures taken at country level are largely supported under the Rural Development Program (RDP). This includes support for agricultural activity in areas affected by specific or other natural constraints (LFAs) which is primarily intended to compensate the producers for the difficulties they face compared to farms located outside the

LFAs. From the perspective of the environmental objective, the above is supposed to ensure: the continuity of agricultural land use (and, thus, to maintain the viability of these areas); the maintenance of rural landscape values; counteracting environmental degradation of agricultural areas; and enhancing the farmers' environmental awareness (through dissemination of good agricultural practice). The assessment of the extent of LFAs and of the level of dedicated support in new member countries is provided in paper: *Obszary o niekorzystnych warunkach gospodarowania w nowych krajach członkowskich* (item 3.1.4, Appendix 4). In turn, paper: *Wsparcie obszarów o niekorzystnych warunkach gospodarowania (ONW) w Polsce i Wielkopolsce na tle krajów Unii Europejskiej-25* (item 2.2.1., Appendix 4) provides an analysis of differences in the use of funds allocated to LFA support between Poland and other EU states; an analysis was also performed for the Wielkopolskie voivodeship (at district level).

Rural development measures taken under the Rural Development Program include the one related to support for local development under the LEADER initiative. That topic is currently tackled by Ms. Paulina Wawrzynowicz, M.Sc., in her doctoral dissertation titled *Implementing the endogenous rural development concept under the Leader Program*, for which the applicant acts as assistant supervisor.

Issues related to the agriculture's environmental function were also considered from the sustainable development perspective. *The role of science in sustainable development of agriculture according to the Polish scientific community* (Item 2.2.2., Appendix 4) is a paper consistent with this line of research which highlights the role of science in creating the principles of sustainable rural development. It attempts to explore the views of the scientific community on the essence and determinants of these development processes. For that purpose, a standardized interview was carried out with 128 representatives of social and economic sciences and of life sciences asking them about their views on sustainable agricultural development. Both respondent groups had convergent opinions on the implementation of general assumptions of sustainable development. This proves that at conceptual level, this issue provides an adequate description of both the current realities and the desired targets. Nevertheless, the representatives of economic and social sciences had a more holistic view on the sustainability of agricultural production whereas the representatives of life sciences focused on recognizing the need for a scientific exploration of topics which primarily referred to environmental governance.

In this field of research, the applicant believes the following two publications to be of importance and submits them for assessment:

- Sadowski A., Baer-Nawrocka A. Poczta W. (2013): *Gospodarstwa rolne w Polsce na tle gospodarstw Unii Europejskiej*. Wyd. GUS, ss. 254.
- Sadowski A., Baer-Nawrocka A. (2018): *Food and environmental function in world agriculture – Interdependence or competition?* Land Use Policy, Volume 71, February 2018, <https://doi.org/10.1016/j.landusepol.2017.11.005>, s.578-583, (IF – 3.194).

Gospodarstwa rolne w Polsce na tle gospodarstw Unii Europejskiej (Section I B-Item 1.2., Appendix 4) is a monograph intended to assess the structural changes in Polish agriculture against the background of other European Union countries in 2003–2010. It presents the grounds for structural changes in agriculture (taking the territorial, ownership, manufacturing, economic, socioeconomic and environmental structure into consideration), and attempts to determine the actual scope and lines of evolution of agrarian structures. The research focused on determining the link between the amount of aid and the lines and extent of structural transformation in the agriculture. It relied on data on the allocation of national direct payment and funds under the second pillar of the CAP, taking into consideration the distribution between different priority axes of the RDP. This was the basis for a multidimensional analysis which resulted in extracting groups of countries with similar characteristics of relationships between the amount of funds and the structural changes that took place. It was demonstrated that the recent enlargements of the European Union (after 2004) contributed to structural heterogeneity of Community agriculture, and the inclusion of the agricultural sectors of new member states in the coverage of CAP instruments did not result in any radical structural changes. In that context, it was emphasized that changes in agrarian structures are usually long-term processes. The findings did not enable a clear identification of the relationship between the extent of access to EU funds and the pace of changes in agrarian structures in different member countries. As demonstrated, aid is only one of stimulants of change, and its impact is adjusted with a series of market, business cycle, economic, political and cultural factors.

Food and environmental function in world agriculture – Interdependence or competition? (Section II A1-Item 1.1., Appendix 4) is a paper addressing the fact that agriculture simultaneously fulfils its food supplying function and pursues the environmental objective that primarily consists in protecting the agricultural production space which is necessary for continued long-term production activities. The study covered the 1961–2009 period and was performed in two steps. In the first step, a proprietary algorithm was used to estimate the amount of energy (expressed in kcal per hectare per person) generated by agriculture across continents in subsequent years of the analysis. An assumption was made that providing the population with an adequate amount of energy, as required for the proper

functioning of the human body, means fulfilling the food supply function in the territory considered. In the second step, the calculated amounts of energy generated by agriculture were compared against the quantity of greenhouse gases associated with energy production process. As shown by the analyses, the amount of energy generated by agriculture around the world grew faster than population growth in the study period; this means that the agricultural sector fulfilled its food supplying function. However, what continues to be a problem is the territorial heterogeneity of agricultural production and the resulting series of issues related to food distribution and economic availability of food at national or household level. In these terms, the worst situation was found in Africa where the amount of energy per hectare per person was the lowest and the progress was slow throughout the study period (with clear regression periods being recorded in the 1980s). Moreover, it was demonstrated that Africa, just as other countries at lowest development levels, reports the highest environmental costs of agricultural energy production. Hence, the need was identified to propagate progress with respect to both production intensification and environmental measures taken in these territories.

Ad 2. Forecasting the impacts of actual and potential changes to the Common Agricultural Policy on the production and economic situation of agricultural producers and on total welfare in the EU

The applicant's knowledge of analytical forecasts based on the CAPRI model, as acquired during internships and trainings, became the framework for the second field of her research, centered around forecasting the impact of actual and potential changes in the CAP on the production and economic situation of agricultural producers. In 2010–2013, this topic was investigated by the applicant as part of her own research project endorsed by the Ministry of Science and Higher Education, titled *Agricultural income in European Union countries in the light of the evolution of the Common Agricultural Policy* (Section II G, Appendix 4).

Some findings regarding this field of research were discussed in *Polityka rolna Unii Europejskiej, kierunki zmian i konsekwencje dla rolnictwa polskiego* (point 4), a publication included in the scientific achievement (Section 4). In addition to the publication referred to above, partial results of analytical forecasts of the effects of actual and expected changes to the CAP (mainly referring to the reform in the EU sugar and milk market) were included in a series of other publications (Section II B–1.1., Item 3.2.6.-3.2.8., 3.2.12., 3.2.18., 3.2.21., Appendix 4). In addition to the one discussed above, the applicant believes the following publications on model analyses to be of key importance:

- Kiryluk-Dryjska E., Baer-Nawrocka A. (2013): *Międzynarodowa konkurencyjność polskich produktów mleczarskich w warunkach liberalizacji rynku mleka*. Gospodarka Narodowa No. 3 (259)/2013, p. 101–118.
- Baer-Nawrocka A., Kiryluk-Dryjska E., Mrówczyńska-Kamińska A. (2014): *Wpływ zniesienia systemu kwotowania na produkcję buraków cukrowych i cukru w Unii Europejskiej*, *Więś i Rolnictwo* No. 1(162) 2014, p. 169–183.

Międzynarodowa konkurencyjność polskich produktów mleczarskich w warunkach liberalizacji rynku mleka (Item 3.2.18., Appendix 4) is a paper which uses the CAPRI model in simulation analyses that assume a gradual liberalization in agri-food trade (including trade in dairy products), as proposed at the final round of WTO negotiations. The findings were compared against the alternative scenario where the existing market intervention and trade policy toolkit is maintained in the market concerned. However, both scenarios take account of the abolition of milk quotas in 2015. In the next stage of research, the results of simulation analyses served as a basis for determining the competitiveness of selected Polish dairy producers in the European market in 2020. The following yardsticks of competitiveness were used for that purpose: export-specialization index (SI), export revealed comparative advantage index (XRCA), relative import penetration index (MRCA) and relative trade advantage (RTA). The conclusion from the comparison of the two 2020 scenarios analyzed is that trade liberalization in the milk market may adversely affect the trade competitiveness of most of the selected Polish dairy products in the EU market compared to the status quo scenario. However, irrespective of the scenario used, it was demonstrated that Poland would remain a net exporter of milk powder, cheese and quark. The comparative analysis of international competitiveness of Polish dairy producers against other European Union countries proved that milk powder is the most competitive of all products covered.

Wpływ zniesienia systemu kwotowania na produkcję buraków cukrowych i cukru w Unii Europejskiej (Item 3.2.21., Appendix 4) is a publication which presented an ongoing evaluation of the situation in the sugar sector across European Union countries together with a projection which took into account the expected impacts of the abolition of sugar quotas in 2017. Findings from the analyses demonstrated that the EU witnessed a decline in sugar beet production by ca. 10% in 2001–2012. As shown by the results of model simulations based on CAPRI, compared to the status quo scenario, the abolition of quotas may result in a reduction of the area of land under sugar beet at EU-wide level and, as a consequence, in a reduction in the production volume of both beet and white sugar in 2020. As noted in the paper, this could entail a deterioration in the income situation of sugar beet producers due to price reduction. Also discovered were some considerable differences in production indexes across member countries. Because the time horizon for the simulation was 2020, and data for 2018 is

currently available, it needs to be emphasized that no clear conclusion can be made regarding the full correctness of the above findings. Nevertheless, the analysis of different types of data sources used in forecasting the conditions of the market concerned (including analyses by the OECD and the European Commission) provides grounds for concluding that following a short-term increase in production performance triggered by the abolition of sugar quotas, a decline in the production volume of sugar beet and sugar in the EU is forecasted. At the same time, the EU is expected to remain a net exporter of sugar.

CAPRI was also used in expert assessments commissioned by the Ministry of Agriculture and Rural Development as part of the activity of the Team in charge of developing the concept and proposition for CAP conditions and principles after 2013 (for the list of expert assessments, see Section III M in Appendix x). As part of the applicant's cooperation with practitioners, findings from these analyses were also presented in a speech *Reformy rynku mleka i cukru w Unii Europejskiej – skutki dla producentów (Milk and sugar market reforms in the European Union: impacts on producers)* delivered during the Agricultural Entrepreneur Days in Przysiek (Section III I, Appendix 4).

Funds granted for the next research project of the National Science Center *Zastosowanie metod ilościowych do przewidywania efektów zmian Wspólnej Polityki Rolnej Unii Europejskiej* nr UMO-2017/25/B/HS4/02513, co-authored and implemented by the applicant, allowed her to continue her research into forecasting powered by CAPRI and to combine it with the theory of games. The first papers with the results of relevant analyses were published in renowned journals such as *Ekonomista* and *Journal of Policy Modeling*. These publications were discussed as part of the series of papers comprising the scientific achievement. The concept of the new research problem, based on a proprietary methodological approach, was accepted for presentation at the *Public Economic Theory*, an international conference held in June 8–11, 2019 in Strasbourg. This is a periodic conference which presents examples of application of the theory of games in different types of practical issues, thus providing a broad range of possible uses in other domains. As part of efforts taken under the funded project, scientific cooperation on the combined use of CAPRI outputs and elements of the theory of games was established with professor Vito Fragnelli from the University of Eastern Piedmont in Alessandria.

Ad 3. Research on food consumption economics and household economics

The next field of research explored so far by the applicant is related to food consumption economics and household economics. The main topic was the estimation of the degree of self-sufficiency in food at EU level following the enlargement in 2004 (Item 3.1.3., Appendix 4) and in 2001–2011 (as a continuation of research) against the backdrop of changes in consumption levels of basic agri-food products (Item 3.2.24., Appendix 4). The issue of self-sufficiency in European Union countries was also presented from a perspective which, although rarely analyzed in the relevant literature, takes account of long-term trends followed by the ratio between energy produced and energy consumed (Item 3.2.27., Appendix 4).

In this field of research, the applicant believes the following publications to be of key importance:

- Baer-Nawrocka A. (2018): *Konwergencja i nierówności dobrobytu ekonomicznego gospodarstw domowych w krajach Unii Europejskiej*, (*Convergence of and disparities in economic welfare of European Union households*), *Gospodarka Narodowa* 295(3): 103–124.
- Baer-Nawrocka A., Sadowski A. (2019): *Food security and food self-sufficiency around the world: A typology of countries*. *PloS ONE*, Volume 14, Issue 3, s. 1-15, DOI: 10.1371/journal.pone.0213448 (IF – 2.766)
- Baer-Nawrocka A., Szalaty N. (2017): *Produkty ekologiczne w opinii producentów i konsumentów-studium przypadku*, (*Organic products as viewed by producers and consumers: a case study*), *Zagadnienia Ekonomiki Rolnej* 4(357), p. 138–153.
- Baer-Nawrocka A., Suchoń A. (2014): *Ochrona produktów regionalnych i tradycyjnych w Unii Europejskiej. Wybrane zagadnienia ekonomiczne i prawne*. (*Protection of regional and traditional products in the European Union. Selected economic and legal aspects*), *Więś i rolnictwo* No. 4(165) 2014, p. 115–130.

In the paper: *Konwergencja i nierówności dobrobytu ekonomicznego gospodarstw domowych w krajach Unii Europejskiej* (Section II A2-Item.2.1., Appendix 4), β and σ -convergence models were used to demonstrate that in 2003–2015, convergence in GDP per capita between EU-28 countries was accompanied by growth in coherence of economic welfare at household level (measured as the amount of actual disposable gross income and consumption expenditure per capita). As demonstrated, the processes were primarily determined by positive dynamic changes taking place in EU-13 countries. However, the analyses did not provide a basis for concluding whether convergence of any of the variables considered took place in the 2010–2015 period both across the entire EU and in the groups of

new and old member states. As emphasized, this had several reasons, including the difficult economic situation which affected the condition of South European households.

Food security and food self-sufficiency the world: a typology of countries (Section II A1-Item.1.2., Appendix 4), is a paper that identifies the current status of food security in different countries around the world, considering both aspects (physical and economic availability) combined together. A set of different types of publicly available variables (including the average demand for energy and actual energy consumption by consumers) were used together with an unpublished variable estimated based on a dedicated algorithm (daily production of agricultural energy) to identify 8 groups of countries characterized by economic development level, net trade in agricultural products, and selected variables related to agriculture and food situation. The purpose of that typology was to identify: *first*, the countries which, due to favorable natural conditions and capital expenditure, are able to produce enough food to feed their own population and that of other countries; *second*, the countries who are unable to produce enough food but, due to their economic condition, are able to import food in quantities sufficient to ensure food security; *third*, the countries which, for various natural and economic reasons, face food problems. As demonstrated by this study, the degree to which food security is ensured with domestic supply varies strongly across the globe. Domestic production provides a foundation for food security in wealthy countries, usually located in areas with favorable conditions for agriculture (Northern America, Australia, New Zealand) and in countries which, though characterized by a relatively small area of arable land per capita, demonstrate high production intensity (mainly European countries). International trade largely contributes to food security in Middle East and Northern Africa as well as in some South American countries which are net importers of food products. The most problematic food situation continues to affect Sub-Saharan Africa and Central Asia.

Paper: *Produkty ekologiczne w opinii producentów i konsumentów-studium przypadku* (Item 3.2.28., Appendix 4) was a publication based on the results of a survey conducted with both producers and consumers of organic products. Two interlinked survey questionnaires were developed for the two groups of respondents. This allowed to compare the scores assigned to the factors that condition the choice and perception of organic products, as well as some distribution and marketing aspects. Compared to research undertaken in the relevant literature, the above is a rare approach because only one part of the market (producers or consumers) is usually addressed. The analyses allowed to identify certain similarities and differences in these scores. The similarities include the convergent perception of organic products as high-quality foods with health-promoting properties, and the identification of these characteristics as the key reason why consumers choose these products. Conversely, the

buyers and producers differed in their knowledge of organic labels. Although organic product buyers exhibited a satisfactory awareness, this was not reflected in feedback from producers who believe the customers' knowledge of these markings to be poor. As emphasized, this should encourage the producers to apply for quality marks for their products because it helps position the product in the market and, as a consequence, drives greater consumer acceptance of organic product prices. Differences also existed with respect to the place where products are purchased and offered, and to how organic food information is accessed and transferred.

Issues involved in organic products and organic production were a priority theme of the applicant's scientific internship at the Federal Institute of Agricultural Economics in Vienna. Austria has a remarkable share of agricultural land under organic crops (nearly 20% of total agricultural land) and is one of leaders in terms of the share of funds allocated to organic production support under the European Agricultural Fund for Rural Development²². During her internship, the applicant analyzed the economic aspects of agricultural organic production, which became the starting point for her cooperation in this field of research with the representatives of the Institute.

The quality of agri-food products was also discussed in the context of regional and traditional products covered by the European quality system. *Ochrona produktów regionalnych i tradycyjnych w Unii Europejskiej. Wybrane zagadnienia ekonomiczne i prawne* (Item 3.2.22., Appendix 4) is a paper that analyzes the sales volume and quantity of registered protected products in the EU and the legal regulations for the functioning of producer groups involved in the production of protected products in France and Italy as countries with the largest number of products entered to the European list of protected products. Based on this research, a proposition was put forth to introduce additional instruments to encourage the creation of such groups in Poland; this would contribute to increasing the importance of Polish regional products in both the domestic and Union market. It was also found reasonable to extend the Polish legislation with a broader definition of agricultural activity. This would provide agricultural producers with better opportunities for participation in the next stage of the food chain, the processing of protected regional products.

Issues related to protected products were the subject of an expert assessment co-authored by the applicant, commissioned by the Foundation of Assistance Programs for Agriculture (FAPA) for the purposes of the Ministry of Agriculture and Rural Development (Section III M , Appendix 4). Also, this is the topic of lectures which attract great interest and

²² The European Agricultural Fund for Rural Development (EAFRD) supports the European rural development policy by financing the national Rural Development Programs. Hence, it contributes to objectives set in the second pillar of the CAP.

are delivered each year by the applicant at the Researchers' Night, a national event held at the Poznań University of Life Sciences; and of lectures for high school students delivered as part of promotional activities of the Faculty of Economics and Social Sciences of the Poznań University of Life Sciences (Section III I, Appendix 4).

Ad 4. Transformation of the agri-food sector in European Union countries in the light of the theory of agribusiness

The fourth field of the applicant's research is related to the theory of agribusiness which emerged in the second half of the twentieth century. It is believed to be authored by J.H. Davis and R. Goldeberg, professors at the Harvard University. Agribusiness, also referred to as food economics, is one of the key subsystems of the national economy. According to an agribusiness principle, as the economy grows, its components change in importance. As shown by the general trend, which is a synthesis of agribusiness development in highly developed countries, two non-agricultural spheres grow in importance in the structure of agribusiness, namely: the industry responsible for productive inputs and for the provision of services to farming (1st sphere of agribusiness); and the agri-food processing industry (3rd sphere). Meanwhile, agriculture itself (2nd sphere) declines in importance. However, in order for the entire food production process to be efficient, all spheres of food economy must operate properly. If one of them is underdeveloped, it becomes difficult to attain the desired volume of final products and, as a consequence, to ensure an efficient production process.

The applicant's research on the theory of agribusiness was mainly conducted in cooperation with Aldona Mrówczyńska-Kamińska, Ph.D., as part of the *Agricultural sector and its transformation in the EU in the light of the theory of agribusiness*, a research project financed by the National Science Center, co-authored and implemented by the applicant in 2013–2018. The analyses focus both on assessing the evolving role of agriculture and agribusiness in the national economy and on changes to the internal structure of agribusiness in different European Union countries (Item 2.2.5., 3.2.9., 4.3., Appendix 4). Empirical research in this field is useful mainly in the context of exploring the development drivers of the agri-food sector and, indirectly, the drivers of economic development in the countries considered, primarily including new member countries of the EU. *The share of agribusiness in national economy in relation to the level of economic development in the European Union countries* is a paper qualified for presentation and subsequently discussed at the *Competitiveness of the agribusiness sector*, the 14th session of the European Association of Agricultural Economists held in Ljubljana. The research topic presented by the applicant met with great interest from conference participants from various international scientific centers.

As part of this field of research, an attempt was also made to assess whether, and to what extent, the income situation of agricultural producers is reflected in the level and structure of material flows to the agriculture (Item 3.2.25., Appendix 4). Also analyzed was the importance of the agriculture and food industry in the creation and allocation of supply of agri-food products in European Union countries (Item 3.2.31., Appendix 4). In this field of research, the applicant believes the following two papers to be of key importance:

- Mrówczyńska-Kamińska A., Baer-Nawrocka A. (2018): *Changes in labor productivity in the agribusiness in European Union countries*. Acta Scientiarum Polonorum. Oeconomia 17 (2018), No. 1, p. 85–94.
- Baer-Nawrocka A., Mrówczyńska-Kamińska A. (2019): *Materiałochłonność i importochłonność w rolnictwie Unii Europejskiej w świetle przepływów międzygałęziowych (Material intensity and import intensity of European Union agriculture in light of input–output tables)*, Zagadnienia Ekonomiki Rolnej (1) 2019, p. 3–21.

Changes in labor productivity in the agribusiness in European Union countries (Item 3.2.32., Appendix 4) is a paper which presents an assessment of changes in labor productivity in the agribusiness compared to labor productivity in the entire national economy of EU countries. The pursuit of that research goal required determining gross value added in the entire agribusiness and its three spheres. These figures were calculated for selected years from the 1995–2010 period based on input–output tables. As shown by the analyses, despite some favorable changes, labor productivity in agribusiness in new EU member states continues to be lower than in most EU-15 countries. This is primarily caused by surpluses of labor in the agricultural sector which still plays a major role in the structure of agribusiness in new member countries. It was therefore concluded that in many new member states, the number of agricultural employees not only implies a low level of efficiency in agriculture itself but is also the main reason behind the disparities in labor productivity in the agribusiness. It was also demonstrated that in highly developed EU-15 countries, especially in Western and Northern Europe, a smaller gap in labor productivity exists between the agribusiness and other sectors of national economy.

In turn, *Materiałochłonność i importochłonność w rolnictwie Unii Europejskiej w świetle przepływów międzygałęziowych* (Item 3.2.33., Appendix 4) is a paper addressing the issue of sub-sectoral interdependencies in the agriculture of European Union countries. Input–output tables for particular EU states served as a basis for calculating the coefficients of direct material intensity of agriculture (expressed as the ratio between the value of goods used in agriculture and the value of global production) and the coefficients of import intensity (the

ratio between imported goods consumed directly by the agriculture sector and the value of global production) in 1995, 2010 and 2014. As shown by the analyses, the agricultural sectors of the EU-15 witnessed an increase in material intensity. In some Western and Northern European countries with a developed agricultural sector (Austria, Sweden, Germany, Belgium), an increase was observed in the value of productive inputs originating from the 2nd sphere of agribusiness (agriculture); this confirms the existence of a new phenomenon affecting the material flows in these countries. As emphasized, this could be related to the growing importance of organic farming which requires the use of productive inputs originating from the agricultural sector. Another finding was the gradual increase in importance of non-agricultural inputs in the total mix of material flows in EU-13 countries. Differences were discovered both in the level and structure of material inflows to the agriculture, depending on the level of economic development of European Union countries. It was stressed that the agribusiness patterns formulated in the 1950s also prove to be true at the current stage of economic development of Community members. Therefore, the analysis allows, on the one hand, to validate a pattern recognized in agricultural economics and, on the other hand, to identify new processes taking place in the agriculture of the most developed EU countries. The above adds value to the process of exploring the trends followed by today's agri-food sector.

5.2. Publication statistics

The applicant's scientific and research work is documented in 78 papers, including 72 written after her Ph.D. For a detailed list of published scientific papers or creative professional activities, see Attachment 4. Table 1 below is only a synthetic summary.

Table 1. Summary of publications (including those identified as a scientific achievement)

Category	Before being awarded a Ph.D.	After being awarded a Ph.D.	Total
Original published scientific papers			
including: Papers published in journals covered in the Journal Citation Reports	-	5	5
Papers published in journals covered in the Web of Science (without IF)		3	3
Papers published in other peer-reviewed journals	4	37	41
Scientific monographs	-	4	4
Scientific monograph chapters covered in the Web of Science	-	1	1
Other scientific monograph chapters	2	8	10
Chapters in academic books		4	4
Conference papers		4	4
Research reports	-	1	1
Expert assessments and elaborations	-	5	5
Total	6	72	78

154 credits were awarded for publications comprising the applicant's scientific achievement, calculated as per the parametric evaluation system used by the Ministry of Science and Higher Education (in accordance with the Ministry guidelines of December 9, 2016). The applicant's other publications earned **657** credits. A total of **811** credits were awarded for the applicant's publications (including **767** after her Ph.D.).

The participation in numerous projects financed by such bodies as the National Science Center, the Ministry of Science and Higher Education, the National Agency of Academic Exchange, the State Committee for Scientific Research and the Volkswagen Foundation, involved research activities in various types of research teams. The applicant's active involvement in team efforts resulted in a series of publications co-authored by other researchers. The applicant contributed no less than 50% to the vast majority of co-authored publications (for detailed information, see Section I, Appendix 4).

Below you may find the indexes calculated for the applicant's scientific and research background (April 26th, 2019):

Number of citations for scientific publications covered in:	Web of Science (WoS)	3
	Journal Citation Reports	3
	Public or Perish	362
	Google Scholar	332
	BazEkon	23
Hirsch index for publications covered in:	Web of Science (WoS)	1
	Journal Citation Reports	1
	Public or Perish	10
	Google Scholar	10
	BazEkon	3

• **total Impact Factor: 7.577**

(Land Use Policy - **IF 3.194**, PloS ONE - **IF 2.766**, Journal of Policy Modeling - **IF 1.237**, Ekonomista - **IF 0.15**, Berichte uber Landwirtschaft - **IF 0.23**)

5.3. Participation in research projects

As part of her scientific efforts, the applicant participated in **ten research projects**, including two carried out by international teams (*Comparative analysis of the transition process in the agricultural sector of Central and Eastern European countries* and *The role of small farms in the sustainable development of the food sector in the countries of Central and Eastern Europe*). The applicant was the manager of one of the domestic research projects (*Agricultural income in European Union countries in the light of the evolution of the Common Agricultural Policy*, own project endorsed by the Ministry of Science and Higher Education). The applicant also co-authored two own research projects financed by the National Science Center (*Use of quantitative methods in predicting the effects of changes to the Common Agricultural Policy of the European Union* and *Agricultural sector and its transformation in the EU in the light of the theory of agribusiness*), acting as the implementing scientist. The applicant was also the implementing scientist in the two research projects listed below. *The global milk market and its impact on the Polish dairy industry* was a project implemented in cooperation with the scientists from the Institute of Agricultural and Food Economics —

National Research Institute. In turn, *Absorption of CAP funds in Greater Poland, as illustrated by the example of selected support instruments* was a project implemented in cooperation with the scientists from the Poznań Academy of Economics (currently, the Poznań University of Economics and Business). *Regional differences in food economics across Poland in the process of integration with the European Union* was a project financed by the State Committee for Scientific Research. *Problems involved in the development of the agri-food sector and rural areas in the context of Poland's accession to the EU and Consequences of the accession and challenges facing the agri-food sector and rural areas in Poland in the light of the CAP formula in place until 2020* were projects financed with funds allocated to statutory research of the Poznań University of Life Sciences.

For details of the applicant's participation in project implementation efforts, see Section II G of Appendix 4.

5.4. Scientific awards and honorable mentions

The applicant received a total of **eight awards** for her scientific achievements. This includes three awards granted by His Magnificence Rector of the Poznań University of Economics and Business (formerly the Poznań Academy of Economics): one award for an interdisciplinary research project implemented in cooperation between universities; and two awards for original creative scientific achievements in the academic year, as documented by a contribution to monographs. The five other awards were granted by His Magnificence Rector of the Poznań University of Life Sciences: four awards for scientific achievements documented in publications; and one award for an outstanding doctoral dissertation.

For a detailed list of scientific activity awards, see Section II H of Appendix 4.

5.5. Participation in conferences

Throughout her scientific career, the applicant participated to a total of **57** scientific conferences and seminars (mostly international events), including **6** held abroad. The applicant delivered a total of **38** lectures at conferences, including **10** in English. The applicant's lecture was qualified for presentation at one of sessions of *Productivity and its impact on global trade*, a scientific conference held in Seville, organized by the International Agricultural Trade Research Consortium (IATRC) and the European Commission's Directorate-General for Agriculture and Rural Development. The applicant views it as a great privilege. Another distinction was the qualification of two lectures authored by the applicant for presentation at the 14th session of the European Association of Agricultural Economists

held in Ljubljana. The applicant was also invited to deliver a lecture and participate to the discussion with international OECD experts during a seminar related to the publication of the *Rural Policy Review: Poland*, a report by the OECD.

For a detailed list of conferences, see Sections II – I and III – B of Appendix 4.

6. Teaching and knowledge dissemination activities

As part of her teaching activities at the Poznań University of Life Sciences, the applicant lectured and taught classes on a total of 14 subjects, including 3 taught in English (Section III – J., Appendix 4). The applicant taught the following classes in Polish in first-cycle and second-cycle full-time and/or part-time programs in Economics and in Finance and Accounting: *food economics, agribusiness, agri-food policy, the market for agri-food products, European market for regional products, regional products in tourism, micro- and macroeconomic bases of agricultural incomes, methods for accessing European Union funds*, and the *theory of public choice*. The applicant taught the following classes for students enrolled in the Land-use Management major: *differences in agricultural activity across regions* and *accessing EU funds for municipal development*. As part of second-cycle English-language programs offered at the Poznań University of Life Sciences and as part of the Polish–Dutch–German *International Agri-Business* program, the applicant lectured and taught classes on such subjects as *public choice, applying programming tools for agri-economic analysis* and *agri-food policy*. The applicant's teaching activities also included graduate seminars for first-cycle degree programs in *Economics* and *Finance and Accounting*. As shown by evaluation surveys, the applicant's teaching efforts were highly appreciated by the students irrespective of the subject taught.

The applicant's teaching activities as an Assistant Professor included supervision over 25 successfully defended M.Sc. theses in Economics and 64 successfully defended bachelor theses in Economics and in Finance and Accounting (Section III–J., Appendix 4). Currently, the applicant supervises five students preparing their M.Sc. theses in Economics and fourteen students preparing their bachelor theses in Economics. The achievements of successful graduates include a honorable mention awarded to one of the theses in the Professor Jerzy Zwoliński Best M.Sc. Thesis Competition in academic year 2015/2016.

The applicant was also a tutor for student groups during national and international study visits as part of the *Knowledge, practice, success. Competency development program at the Poznań University of Life Sciences*, a project co-financed by the European Fund, and was the organizer of numerous academic trips for students, including the events held at the annual Farming and Agribusiness FORUM in Poznań.

The applicant also acts as assistant supervisor for two doctoral dissertations (for detailed information, see Section III K, Appendix 4).

The applicant lectured on two subjects (*Economic account: principles of farm accountancy* and *Agricultural economics*) at a post-graduate program in *European Integration: agribusiness and rural areas*, offered at the Faculty of Economics and Social Sciences of the Poznań University of Life Sciences.

During her stay at the Department of Agricultural Economics in Ege University in Izmir, Turkey, under the ERASMUS+ program, the applicant took part in a scientific seminar and delivered a series of lectures on the European Union's agricultural policy.

As part of efforts taken to combine science with practice, the applicant contributed to six expert assessments: three commissioned by the Ministry of Agriculture and Rural Development, two commissioned by the Foundation of Assistance Programs for Agriculture, and one commissioned by the Institute of Agricultural and Food Economics — National Research Institute based in Warsaw (for detailed information, see Section III M, Appendix 4).

The applicant reviewed 26 papers, including 7 published by the *European Association of Agricultural Economists* and the *European Rural Development Network* (for detailed information, see Section III P, Appendix 4).

The applicant is a member of the *European Association of Agricultural Economists (EAAE)*, the *European Rural Development Network (ERDN)* and the *Association of Agricultural and Agribusiness Economists*.

Since 2014, the applicant has cooperated with the Foundation for the Development of Polish Agriculture (FDPA) on the periodic publication *Polska wieś. Raport o stanie wsi* (Polish rural areas. A report on the condition of rural areas). With its interdisciplinary dimension, the publication presents the socio-economic, political, demographic and environmental changes taking place in Polish rural areas.

7. Organizational activity

During her work at the Faculty of Economics and Social Sciences of the Poznań University of Life Sciences, the applicant actively participated in organizational activities. Since 2007, the applicant has been a member of the Council of the Department of Economics and Economic Policies for the Agribusiness at the Faculty of Economics and Social Sciences of the Poznań University of Life Sciences, and a member of the Faculty Council since 2012. The applicant is or was a member to:

- the Academic Staff Committee (2012–2017),
- the Studies Committee (from 2012 to date),

- the Committee in charge of interim performance evaluation of university teachers (since 2009 to date).

In 2011, the applicant took active part in preparing the *Outcomes of studying Economics at the Faculty of Economics and Social Sciences* in accordance with guidelines from the Ministry of Science and Higher Education. The applicant is also the author of the *Program and Plans of Studies in Economics*, conceived in accordance with the education standards set out in the Regulation of the Minister of Science and Higher Education of July 12, 2007, published in January 2009. In recognition of these efforts, the applicant received a 1st degree Team Award of His Magnificence Rector of the Poznań University of Life Sciences.

In 2012, the Deputy Rector in charge of Studies at the University of Life Sciences appointed the applicant as an examiner for the *Agribusiness* thematic module at the regional and central level of the annual Agricultural Knowledge and Skills Contest for high school students.

The applicant co-organized seven editions of the European Researchers' Night at the Poznań University of Life Sciences, and conducted workshops and educational games for the participants. Since 2013, the applicant has taken active part in promoting the Faculty of Economics and Social Sciences of the Poznań University of Life Sciences as the coordinator of partnership with a high school and as a lecturer during classes (lectures and workshops) for high school students, held both in their schools and at the University during the Cooperation Days organized by the Faculty of Economics and Social Sciences. Also, the applicant delivered lectures at the University of the Third Age.

The applicant believes her membership in the editorial team of the *Journal of Agribusiness and Rural Development (JARD)* to be one of her key organizational activities. First as the secretary (2015–2017) and then as deputy editor-in-chief (since 2018), the applicant has actively contributed to a series of efforts taken to internationalize the journal and to continuously improve its scientific quality. These measures include: efforts involved in the editorial process; implementation of the *Open Journal System*; preparing applications for funding of tasks related to dissemination of science and to support for scientific journals filed with the Ministry of Science and Higher Education; and preparing evaluation surveys for Index Copernicus, Web of Science and Scopus. In recognition of my activity related to the JARD, the applicant received two awards from His Magnificence Rector of the Poznań University of Life Sciences.

In 2012, the applicant co-organized the *Knowledge as a factor of rural areas development*, an international conference of the *European Rural Development Network (ERDN)*. The applicant has been a member of the Scientific Committee of international

conferences organized by the ERDN: *Innovation and cooperation in smart, sustainable and inclusive rural regions* held in Eistenstadt (Austria) in 2017; and *CAP 2021+: balanced development among the dimensions of rural sustainability*, to be held in 2019 in Velké Bílovice (Czech Republic).

8. International cooperation and trips (other than conferences)

The applicant's scientific career included five international internships and trainings in international institutions and scientific centers such as the Federal Institute of Agricultural Economics in Vienna, the University of Bonn and the University of Kiel (Section III L, Appendix 4). Also, as part of a project co-financed by the European Social Fund, she went to a seminar and study visit to the European Parliament and European institutions based in Brussels (Section III A, Appendix 4). As a participant of Erasmus+, the applicant stayed at the Ege University which provided her with an opportunity to establish cooperation with scientists from the Department of Agricultural Economics.

For the applicant, her membership in international associations and networks (Section III H, Appendix 4). means not only scientific development but also an opportunity to enter into and continuously enhance cooperation on the *Journal of Agribusiness and Rural Development (JARD)*. In the recent years, this was reflected in a notable internationalization of the Journal, including the participation of international scientists in the Scientific Board and in the reviewers team and their contribution as authors.

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