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# GREEN DEAL IN AGRICULTURE THROUGH THE SIGHTS OF RESEARCHES[5]

*The Green Deal in agriculture has the ambitious goal of making agriculture greener, more sustainable, more viable and contributing to limiting greenhouse gas emissions. The consequences of the Green Deal in agriculture are still unknown, but various publications discuss the expected effects of the Green Deal on the livestock and crop sectors in the EU. The aim is to systematize scientific publications from the Scopus and Web of Science databases, which are related to the assessment of the effects of the implementation of the European Green Deal, the Common Agricultural Policy, and the EU and UN Sustainable Development Goals until 2030. The systematization and the evaluation are based on a meta-analysis. With meta-analysis, a comprehensive overview is achieved by integrating the results of the scientific research, as well as by comparing the economic and agroecological effects. The findings indicate there are both challenges and opportunities, which are intertwined.*
*Keywords: meta-analysis; AHP; agriculture; Green Deal; CAP; sustainability*
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## 1. Introduction

The Common Agricultural Policy (CAP) clearly distinguishes the objectives of combating climate change, protecting and restoring natural resources and biodiversity, sustainable, competitive agriculture, as well as improving the quality of life in rural areas.

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The "Farm to Fork strategy as a part of the EU "Green Deal" should change the agroecology and farmers' practice. The expectation of the Green Deal's implementation is to reduce by 50% the use of chemical pesticides, at least 20% the use of fertilizers, reduce the use of antibiotics for farm animals by 50% and organic farming area to reach at least 25% of the total arable land. The Biodiversity Strategy provides protection of biodiversity and restoration of ecosystems (Buitenhuis, Y.; Candel, J.J.L.; Termeer, K.J.A.M.; Feindt, P.H. 2022)

At the farm level, these strategies set ambitious quantitative targets by 2030 and aim to accelerate the transition to sustainable food systems under climate change and achieve carbon neutrality by 2030. At the national level, the targets are linked to the e Sustainable Development Goals (SDGs) and they are directed to improve the food system.

The "Green Deal" strategy and CAP policy anticipate environmental restrictions on farming activities (Kabadzhova, M et al, 2024) and technological requirements that will put pressure on agricultural production systems and should have long-term direct ecological and economic effects. However, the Farm to Fork and Biodiversity Strategies will have the greatest impact on agriculture, as they include the environmental goals of promoting organic farming, managing raw materials and fertilizers in an environmentally friendly manner, reducing greenhouse gas emissions and improving the food system and supply chains.

This study of the potential effects of the Green Deal should contribute to filling the gap in the assessment of the impacts in terms of sustainable development (economic, social, and environmental). The assessment will display the effects on prices, agricultural production and productivity, farmers' revenues and on food system as a result of the green and sustainable transformation in agriculture.

The consequences of the implementation of the green and environmental goals of the strategic documents are insufficiently studied especially the impacts on agricultural production in the long term and how far they will ensure the security and stability of the food system. The assessment of the Green Deal is based on meta-analysis and it will be an addition to the already-started debate about the effects and benefits of green transformation. Meta-analysis is an approach for analyzing and systemizing the results of independent studies examining the same problems. (Gurevitch et al. 1992; Cooper & Hedges 1994;. Gurevitch&Hedges 2001). Meta-analysis enables the interpretation of the findings from different studies, taking into account "the chance character" of the findings (Jessica Gurevitch and Larry v. Hedges pp. 1142, 1999).

Mata-analysis data are obtained from scientific publications from the Scopus and Web of Science databases, which are related to the assessment of the effects of the implementation of the European Green Deal, the Common Agricultural Policy, and the EU and UN Sustainable Development Goals until 2030. We hope with the meta-analysis to give a comprehensive overview of the positive and negative effects of the green transformation in agriculture by integrating the results of the scientific research, as well as by comparing the economic and agroecological effects.

The variety of different approaches suggests that in the analysis of the Green Deal and agriculture, there is an added value to using quantity methods, which can provide a valuable

indication for the future. The heterogeneity of the studies indicates that meta-analysis can be beneficial to better understand the hypothetical effects of the changes after the Green Deal is implemented.

The aim of the paper is to set up a way to trace up and explore the main findings and conclusions deployed in the studies related to Green Deal and global initiatives for reducing the carbon-printing from agriculture and to evaluate the expected outcomes and impact from those goals on the agriculture development and performance. In the paper, the outcomes and impacts of the new environmental global goals are scrutinized in terms of agro-environmental aspects, supply-side effects and demand-side reflections.

## 2. Literature Review

The European Green Deal includes diverse and complex aspects, linked to quantity and quality targets that aim to improve food production and agriculture in general. In order to reach such aspiring objectives, the Green Deal, which is reflected in the new CAP sets new requirements for farmers. The Green Deal of the EU is a broad initiative that puts goals not only in agriculture and environmental issues but put goals also for decarbonization, decentralization, democratization, justice, etc (Peneva, 2021).

The Green Deal has been created in response to the climate changes, but its goals are very ambitious. They have been set as a political decision (Wesseler 2022), while sound scientific approaches require solid proof of how their quantity and quality requirements comply with the sustainable production of agriculture and the competitiveness of farms. Wesseler (2022) warns that economic studies do not prove that the positive effects of the quantity requirements in the Farm to Fork strategy (which is a key milestone of the Green Deal) will outweigh the negative consequences and emphasize the need for more technological and institutional interventions.

There are concrete studies of such questions, which highlight the positive effects as well as negative aspects of the Green Deal with reference to agriculture. The multifaceted topics of the Green Deal and the different strategies it encompasses, call for interdisciplinary research, making it challenging to do a rigorous review of all issues included. It is still important to reflect on the potential impact in advance to help stakeholders prepare for the process and where necessary revise the requirements to make sure that environmental and economic aspects are balanced. The Green Deal and agricultural greening initiative in a global context are supposed to establish the specific governance, which includes institutions and decision-making processes for work and enforcement (Ivanov, 2021) that can be further evaluated as an element of "governance sustainability" (Bachev et al, 2020).

The special targets, which aim to improve EU climate neutrality, are at the focus of researchers, who explore the effect on the EU level and study possible consequences for farms across EU member states. Within the given framework for the Green Deal, there are different options on how to fulfil the quantity requirements. Such options are associated with different economic consequences for the farms. Research shows that it is not only important to raise awareness about the environmental goals, but also about the different pathways that

can lead in the same direction but with uneven impact on farms' competitiveness. Through six plausible policy scenarios, for farms across 26 MS, Petsakos et al (2023) conclude that the post-2020 CAP reform can lead to improvements for the environment, but with different costs for the farms in the six scenarios. Their results show that enhanced conditionality seems to play a stronger role than eco-schemes when it comes to achieving improvements for the environment. Petsakos et al (2023) examine the potential impact for farms and the environmental impacts, using data from FADN for 83,292 across 26 MS, as well as the CAPRI model database and Eurostat.

Along with the positive effects of the Green Deal, there is a need to reflect on both potential opportunities and challenges in order to prepare stakeholders to reach the new goals. Research has explored key determinants that distinguish the practice in MS and can be used to foresee how MS will move towards a greener transition. Some of the key quantity requirements in the Green Deal are linked to the use of pesticides and bio-production. Such topics have caused heated discussions for the past years and continue to be debated in the context of the Green Deal and to split MS into different groups with varying GDP, selling prices and production capacities. Robu et al (2023) identify three clusters, which highlight regional differences. In order to study the influence of key economic and social variables, Robu et al (2023) use several regression analyses to explore 27 EU member states and distinguish between the newest MS, MS with a big population and MS with the highest GDP per capita – each of them using pesticides to a different extent. Their research shows that GDP per capita, prices and real income have a positive influence on the use of pesticides, while subsidies and bio-production areas negative impact.

From the demand side perspective, Robu et al (2023) emphasize that in MS with bigger populations, which means higher demand for food, the pressure on productivity establishes higher use of pesticides. If the nation is wealthier, which means that buyers can afford to spend more for healthier food, there has been a reduction in the use of pesticides for the past few years. Exploring the effects of consumer surplus after the foreseen ambitious goals are met, research goes a step further and finds negative influence. By quantifying some of the costs and benefits, associated with the green transition set in the F2F strategy, Wesseler (2022) stresses that aggregate consumer surplus will be negatively influenced and there will be total net welfare loss, while it remains unclear what the benefits for the environment will be.

From the supply side, research shows how prices influence farmers' behaviour. Robu et al (2023) prove that better market opportunities increase farmers' motivation to produce more and earn higher profits. The authors highlight that where bio-agriculture increases (towards the new quantity targets), pesticides are less used. However, it takes targeted efforts to convince producers to explore more sustainable pest control and production techniques with less synthetic pesticide use, and for now, the main leverage is through financial incentives.

The quantity indicators are difficult to reach, as research shows. They impose additional expenses for farmers, who need to invest in the greener future of Europe. This is why some authors highlight that there must be support that is sufficient and targeted. Research has begun on the situation in specific member states. Pilvere et al (2022), among others, highlight that the Green Deal, which goals are reflected in the new CAP from 2023 will impact the resilience of farms. The results suggest an increase in the possible base support payments

following the CAP reform. Pilvere et al (2022) imply that this may lead to higher emissions of greenhouse gas and may obstruct the achievement of the goals of the European Green Deal.

Their research confirms their hypothesis that the new CAP reform can lead to contradictions, namely between support for smaller farms, promotion of employment, reduction of greenhouse gas and enhancement of the efficiency of agriculture. Other authors share similar conclusions. Wesseler (2022) warns that the new quantity requirements in the Farm to Fork strategy will lead not only to a reduction in agriculture production, but also to higher prices in the EU for food.

The Green Deal is included in the new CAP, and that is why some authors review the measures and interventions of CAP as well as their potential impact. Kiryluk-Dryjska et al (2022) concentrate on how farmers in Poland perceive the CAP support structure to model a hypothetical strategic game and predict the preferences of farmers. They highlight that one of the key challenges is to make agrarian structures better, as only competitive farms can fulfil the new requirements and stay on the market.

Due to the complexity of the topics, included in the Green Deal, some publications choose to narrow the focus to a specific topic. The analysis of the multifaceted impacts is targeted towards production processes, including environmental, economic and financial aspects. Some authors study the effects of bio-production and how farmers would change their work. Concentrating on agroecology and bioproduction, in particular, they discuss how much the areas under such regimes would increase. Using descriptive statistics, the authors analyze data from the Romanian competent authorities and conclude that there is an upward trend in organic farming, but it is not easy to achieve the European targets. They highlight the role of CAP incentives for transforming farming in the country. Other authors reach similar conclusions. Mowlds (2020) declares that it will be difficult to achieve the ambitious targets.

The slow and uneasy change towards more environmentally conscious agriculture is discussed also in Robu et al (2023), which indicates the necessity for targeted action and the role of incentives for the green transition. Wesseler (2022) continues in the same direction to state that if the positive effects of the Farm to Fork goals outweigh the negative, it should be complemented with further measures that can support the green transition.

The Green Deal includes multiple goals, which show what will change in terms of production patterns and technologies. Therefore, some authors choose a specific focus on one of the most debated issues – the use of pesticides and the introduction of new technologies, which can help farmers in the environmental transition. Di Guardo et al (2022) highlight the significance of pesticide use at the field scale and reflect on the opportunities to make this practice more sustainable.

The authors propose how new technologies, such as an online tool, and models can assist farmers in their efforts to be more environmentally friendly and treat their fields differently, depending on their characteristics. The role of technologies is also discussed by Aggarwal et al (2019), as they analyse the situation on the global level through a systematic literature review. Di Guardo et al (2022) highlight the importance of distinguishing between risks, identifying risk trends and parcels most at risk. The tool they propose helps not only farmers

to manage the production, but also provides an opportunity to increase awareness about water contamination and improve farmers' practices.

***Table 1. List of reviewed articles***

| Author(s) | Title | Author(s) | Title |
|---|---|---|---|
| Di Guardo et al | MIMERA: An online tool for sustainable pesticide use at field scale | Grochowska, R. et al | Searching for a more balanced distribution of direct payments among agricultural farms in the CAP-post 2020 |
| Boix-Fayos et al | Challenges and potential pathways towards sustainable agriculture within the European Green Deal | Boulanger et al | European Union Agricultural Support 'Coupling'in Simulation Modelling: Measuring the Sustainability Impacts |
| Alexoaei et al | Good practices in reforming the common agricultural policy to support the European Green Deal – a perspective on the consumption of pesticides and fertilizers | Magrini et al | Assessment of agricultural sustainability in European Union countries: A group-based multivariate trajectory approach |
| Dan et al | Trends In Ecological Agricultural Production in Romania | Ursu, A., Petre, I. L. | Forecasting the optimal sustainable development of the Romanian ecological agriculture |
| Mowlds, S. | The EU's Farm To Fork Strategy: Missing Links For Transformation | Mouratiadou et al | Quantifying sustainable intensification of agriculture: The contribution of metrics and modelling |
| Wesseler, J. | The EU's farm-to-fork strategy: An assessment from the perspective of agricultural economics | Domagala, J | Economic and Environmental Aspects of Agriculture in the EU Countries |
| Robu et al | Regional Patterns of Pesticide Consumption Determinants in the European Union | Viegas et al | Assessment of inequality in the Common Agricultural Policy in Portugal |
| Dabkiene et al | Development of agri-environmental footprint indicator using the FADN data: Tracking development of sustainable agricultural development in Eastern Europe | Pramod Aggarwal et al | Importance of considering technology growth in impact assessments of climate change on agriculture |
| Clora et al | Impacts of supply-side climate change mitigation practices and trade policy regimes under dietary transition: the case of European agriculture | Jurkėnaitė et al | The sustainability prism of structural changes in the European Union agricultural system: The nexus between production, employment and energy emissions |
| Poponi et al | Multi-Actor Governance for a Circular Economy in the Agri-Food Sector: Bio-Districts | Alaoui, A.et al | A New Framework to Assess Sustainability of Soil Improving Cropping Systems in Europe |
| Petsakos et al | Farm-level impacts of the CAP post-2020 reform: A scenario-based analysis | Hurduzeu et al | The Development of Sustainable Agriculture in EU Countries and the Potential Achievement of Sustainable Development Goals Specific Targets (SDG 2) |
| Kiryluk-Dryjska et al | The Environmental and Climatic CAP Measures in Poland vs. Farmers` Expectations – Regional Analysis. | Rudnicki et al | Towards Green Agriculture and Sustainable Development: Pro-Environmental Activity of Farms under the Common Agricultural Policy |
| Pilvere et al | Evaluation of the European Green Deal Policy in the context of agricultural support payments in Latvia | Lososová et al | Simulation of the impacts of the proposed direct payment scheme – The case of the Czech Republic |
| Czyżewski, B., Guth, M. | Impact of Policy and Factor Intensity on Sustainable Value of European Agriculture: Exploring Trade-offs of Environmental, Economic and Social Efficiency at the Regional Level | | |

*Source: Literature review*

Diverse aspects of the application and the effects of the Green Deal are analyzed and various methodologies are applied in the different studies on the Green Deal and agriculture (Table 1.). They include quantitative and qualitative assessments. The research shows that there are many empirical papers, which use international databases as well as national statistics. There are articles with concrete effects. Some use econometric models, others – simulations with projections to what extent the quantity requirements of the Green Deal can be fulfilled. There are models which indicate to what extent the balance (between environmental and economic aspects) can be kept while abiding to the new obligations. Many publications use descriptive statistics, others – concrete case studies. Others are based on interviews with farmers exploring production issues and the protection of biodiversity.

## 3. Methodology

This study analysis is done to understand and eventually evaluate the findings and discovered outcomes in agriculture development emanated after the new goals for greening and climate change mitigation consisted in the academic research. The academic articles and papers that are found might be an important source for a better understanding of this topic and processing those studies is thought to reveal the relevant appraisal of the feasible effects and outcomes. For the sake of applying this literature review and state of the arts study is chosen to fulfil the meta-analysis tool.

There are various ways and algorithms to fulfil a meta-analysis available in the scientific literature. The use of meta-analysis was rarely done until the 1970s whereby quantitative synthesis techniques for working with social studies and disciplines were identified (e.g., Schmidt & Hunter, 1977). What constitutes a “true” meta-analysis is debatable (Shelby and Vaske, 2008). Gliner, Morgan, and Harmon (2003), for example, defined meta-analysis as a research synthesis that uses a quantitative measure, to indicate the strength of the relationship of studies to make up synthesis. The meta-analysis has been done following the well-known and widely-recognized stages (Steel, Beugelsdijk&Aguinis 2021, Normand 1999, Durlak&Lipsey 1991). The key stages of meta-analysis are conditionally defined and oriented to guide up the application, comprising: the selection and identification of relevant studies and datasets, choosing the suitable tool for quantitative analysis, performance of analysis and synthesis of results. The limitations of the meta-analysis are well documented in the literature, linked to the role of the meta-analysis, the abstracting and the formulation of the results. However, given the early stage of the Green Deal and the lack of comprehensive quantity data for a sufficient amount of time, which would allow the use of other methods, quantity-based, it is an appropriate choice to explore the early stage effects and consequences of the Green Deal for agriculture.

In the case of this study, the first step in the meta-analysis is attributed to the identification of relevant publications, which is carried out to select and identify the proper scientific articles dedicated to the theme of agricultural greening and agricultural new environmental objectives. Such publications are assumed to be found in Scopus and Web of Science databases, which are the most prestigious and scientifically proven research-based databases. For the sake of designing the article selection, the search is organized on three keywords

consisting in the article description – Green Deal, Common Agricultural Policy and agricultural sustainability.

The second step in the meta-analysis process is the estimation method set-up and fulfilment. It is pointed out that the meta-analysis is a quantitative-driven study, which is bound to process and work with a relatively big dataset. The data process method conducted for the meta-analysis is the Analytical Hierarchy Process (AHP), which is elaborated by Saaty, as a plausible decision-making tool. As a common case, it can be used when evaluating or trying to find out the ranks of different alternatives or solutions. According to Chai et al.(2013), the AHP method makes it possible to assign and collate particular alternatives to other disposable alternatives through a preference value algorithm. Such values can be used to classify and select alternatives into a hierarchically arrayed structure (Leal, 2020).

The mainstream AHP model is composed as a hierarchy representing an upside-down tree where the goals and objectives are interconnected and ranked orderly. The objectives are ranked in different levels, where each partial objective can be decomposed into objectives at descending levels, and those objectives are interconnected and might be used as criteria to evaluate and score alternatives. The alternatives are placed and compared against each other from the point of meeting the objectives, or criterion. Pairwise collation of the alternatives can be conducted by adopting the method described by Saaty (2013), which usually is done through experts' judgment.

In the case of article research, the selected papers are scrutinized in three objective or criteria directions. These criteria are established in the direction of feasible effects and probable consequences which can be identified on agriculture as a result of the Green Deal of the EU and global initiatives for the implementation of the Sustainable Development Goals of the United Nations. The effects and eventual impact of agricultural greening, which in different countries and regions are revealed and implemented in distinctive ways are explored as 1) agroecological; 2) production and supply economics; and 3) consumption and demand economics. Thus, the articles selected for review are evaluated with respect to these three criteria or objectives and in six formulated alternatives. The alternatives are probable effects and consequences from the greening tendencies in agriculture, which are evaluated on a scale demarked into six alternatives: highly affective (-10 ranking points), moderately affective (-5 ranking points), neutral (0 ranking points), moderately favourable (+5 ranking points), highly favourable (+10 ranking points) and not assessable.

During the initial phase of research and selection, around 60 articles are reviewed and covered, but only 27 are included in the evaluation and meta-analysis study through AHP. The selected bunch of those 27 articles are overviewed and evaluated by experts on their results and findings concerning the effects and considered the impact of greening allotted to the three objectives and elaborated six alternatives. Because some of the articles are quite complex and divergent in terms of assumed effects and consequences, it is accepted that each article must have equal weight within the particular objective field. Thus, one article in one of the three objective fields pertaining to agroecology, agricultural supply and production as well as consumption and demand participates as many times as it is judged, where the sum of total weight might not exceed 1. Abreast with that, if the results and anticipated effects can be designated to more than one objective, for example, combined effects referring to

agricultural supply from one hand and food demand on the other side, those articles are explored separately to those objectives, receiving alternative evaluations.

Having in mind that in some of the paper cases, the assumed effects and results are not classified on sectors or another functional realm but rather on a country level, the weighting is conducted due to the share of countries falling into each particular alternative in order to keep the principle for the same weight in each paper in the objective set. In this preparation stage of article overview and evaluation, the experts made judgments to classify and appraise each article to which alternative it belongs. Because in some of the articles, the assumed effects and impact are not quantified and measured clearly rather than, qualitative scores are used, it is prepositioned that A1 (highly affective) means adverse quantitative effects of more than 20% on the certain sector or aspect, A2 (moderately affective) is ranked when the assumed effects and consequences are between 0 up to -20%. On the other hand, alternative A4 (moderately favourable) is given to articles, when the identified effects and impacts are considered to reach from 0 to 20% and A5 (highly favourable), when those effects and results on the agroecology, production supply and consumption demand are judged to be over 20%.

Following those steps in the analysis after the preparation stage is proceeded with an estimation of alternative priority scores. The comparison between alternatives is carried out through the modification of the formula proposed by Saaty, which is made for each objective or assumed effects:

$$pr_j = \frac{1}{a_{ij} * \sum 1/a_{ik}} \quad (1)$$

$$pr_j = \frac{\sum a_{iw}}{\sum a_{ik}} \quad (2)$$

The difference between formula (1) and (2) is the calculation of alternative importance scores ($a_{ij}$ and $a_{ik}$), which in Saaty's formula (1) are given in the way, the intensive importance may range from 1 up to 9 at odd scores, where 1 score refers to the equal importance of alternative i to j and 9 stands for extremely important of alternative i to j. Thus in Saaty's formula, it is calculated 1/ $a_{ij}$., which means as low is this score so less important is alternative j compared to alternative i. However, in the modified formula (2), the $a_{ij}$ is superseded by $a_{iw}$, which is derived not as a judgment of importance but as a weight of each article to the defined objectives.

Proceeding with the formula (2), the estimation is carried out in 3 tables, each one in the format T3x1. The scores $a_{iw}$ are generated from the initial tables with the weights of each article to the three objectives related to the evaluation of the sixth alternatives. Aftermaths, the three tables with the alternative priorities $pr_j$ for each objective are compiled in a matrix A6x3. This matrix A is composed of 6 rows and 3 columns, where the alternatives are set on rows, whereas the columns are designated to objectives. This matrix A is multiplied by matrix B3x1, which is composed of calculations of article number to each of the three objectives. Thus, a table T3x1 is filled up, with the total sum of articles in the three objectives is 27, where each row number is divided to the total sum. As a result of the multiplication of

matrices A6x3 by B3x1, a new matrix C6x1 is formed up. The rank of each alternative is estimated, whereas high is this ranking so important and substantial are the assumed effects and studied outcomes. The alternative ranking is represented in ranking order obtained as:

$$ARO_{ij} = \frac{AR_{ij}}{\sum AR_{ij}} \quad (3)$$

In the meta-analysis, which is fulfilled through AHP, the alternatives are ranked and it reveals what and how impactful are the new measures and actions connected to greening in agriculture. Because the studies related to agricultural greening progressively increase and vary widely in terms of focus, topics and results' presentations, the AHP turns out plausibly to demonstrate the possible effects and reflection of this motion on agricultural supply, consumption and agroecology.

## 4. Results and discussion

The systematic review of the chosen studies will support a better understanding of the effects of agroecological orientation and prioritization, including the Green Deal of the EU in the field of agriculture. The AHP analysis, which is implemented as an estimation tool for the meta-analysis is designated to synthesize the assumed effects and impact of greening priorities on the specified objectives – agroecology, production supply and consumption demand. The analysis is set up on the articles and papers found in the Scopus and Web of Science databases, which are dedicated to the keyword topics – CAP after 2020, agricultural sustainability and Green Deal. The total number of alternatives is six and those alternatives represent the evaluated effects and impacts of greening to each objective.

***Table 2. Ranking articles by the defined objectives in relation to evaluated alternatives***

| Groups/ alternatives | Alternative effects (-10) | Alternative effects (-5) | Alternative effects 0 | Alternative effects 5 | Alter-native effects 10 | Alter-native effects N | Total ranking |
|---|---|---|---|---|---|---|---|
| Agro-ecological Objective | 0,00 | 0,21 | 0,18 | 0,41 | 0,04 | 0,16 | 1,00 |
| Production Supply Objective | 0,03 | 0,21 | 0,06 | 0,25 | 0,09 | 0,37 | 1,00 |
| Consumption and Demand Objective | 0,00 | 0,33 | 0,33 | 0,33 | 0,00 | 0,00 | 1,00 |

*Source: Authors' calculations.*

Table (2) illustrates the ranking scores of the articles' results distributed in the defined alternatives. Most of the articles fall into production supply objective (18,84) and agroecological objective (13,16) and less into demand effects (3), keeping in mind that a paper can have multiobjective effects and results but it may not have a weight different from 1 related to each of three separate objective categories. Most of the analyzed articles indicate

favourable or adverse effects of the implementation of greening in agriculture, due to different initiatives and measures undertaken globally and particularly in the EU context. For that reason, some articles can take part in more than one objective category – agroecology and production supply. The positive impacts on agroecology, which is estimated to improve moderately the situation driven by greening, which quantitatively is levelled up to 20% are identified in 15 articles. Where the assumed effects can be judged by more than 20% is found in 2 articles. According to the ranking score where some negative and harmful effects can be noted in a total of 6 articles. It should be noted that the articles have different weights for each objective because the effects diverge in relation to different aspects or countries, the number of articles in each objective is not equal to the ranking score, which takes into account the article weights. It is notable that the multiple articles are judged as indiscrete, which means those ones may not bring and explicate feasible effects arising from the activities to fulfil the greening movement in agriculture.

Some publications state that the objectives of the Green Deal will have unforeseen economic, social and environmental impacts on agriculture, as the policy decision is not supported by preliminary assessments and research. Only 30% of all articles indicate whether achieving the Green Deal objectives will be useful for the farms. The results in articles (21% of the total number) predict the negative impacts – the European farmers would be economically negatively affected. It can be beneficial to have detailed impact assessments in advance before decisions are taken to avoid creating risks and the danger that the implementation of the Green Deal can lead to unforeseen economic, social and ecological consequences, which could be associated with uncertainty about involved stakeholders.

***Table 3. Prioritization of objectives through ranking scores***

| Prioritization of objectives calculating article weighted number | Agroecological Objective | Production Supply Objective | Consumption and Demand Objective |
|---|---|---|---|
| Article weighted number | 13,16 | 18,84 | 3 |
| Objective ranking | 0,37 | 0,54 | 0,09 |

*Source: Authors' calculations.*

Proceeding with the AHP analysis, the next step is the prioritization of the objectives, which is carried out by ranking those objectives against the weight of articles to each objective. In Table (3), the articles with the assumed effects and impact on agroecology, production supply and consumption demand are judged and ranked but those objectives are anticipated to have different weights compared to each other. As high as is the weighted number of selected articles to a certain objective, so more important and ranked upper should be that objective. Before the final ranking where to evaluate the formulated alternatives through the Analytical-Hierarchical Process, a new matrix is set up based on Table (2), which represents a matrix A6x3, and Table (3) formed as B3x1 matrix.

The prioritization of objectives implicates the importance of the defined objectives, which are described as revealed effects and consequences the greening and agri-environmental goals will cause. It was found out that 18,84 of the weighted number of articles in the

scientific review reveal a predominant impact of greening on the production and supply side. It means that the majority of the reviewed articles identify and seek production and supply side effects of agricultural greening. The agroecological objective is also quite explored in the studies, where the total estimation is 13,16, which corresponds to an evaluation ranking score of 0,37 that covered articles in such frequency deal with the results and effects concerning agroecological objective. The minor impact and effects from the new global initiatives are demonstrated in the consumption and demand side, which leads to a lower ranking of this objective compared to other ones. The less importance of consumption and demand objectives is done, calculating the weight of articles, which explore the feasible effects on this category but it does not mean surely that consumption side effects are quite less important and downplayed compared to other categories. It rather implies that most of the reviewed and selected articles weigh on the agroecological and production effects rather than the consumption and demand side impact and expected consequences of greening.

It is viewed that there are a few things in common among reviewed papers in the context of agroecology and production supply, namely they all discuss the questions about the risks, which arise for farmers, striving to meet the ecological green requirements, as well as the compromises, which agricultural producers would make in their organizations and technologies of production. Some of the results do not outline the effects but they depict strategies and approaches for how to reach the targets of the Green Deal or other greening goals undertaken globally. From the analysis, it is highlighted that the reform of the CAP creates conditions for a negative impact on employment that is perceived as a part of the production objective. It suggests that there can be a reduction in working places, which will influence the social sustainability of agriculture. There are still different statements, but there is no united position, supported by studies, that the instruments of the CAP would lead to an increase in the income in member states as a result of the implementation of the agricultural policy and to what extent this policy plays a role in the rise of the general efficiency of agriculture. The issue is linked also to the discussion about the ecological impact (Czyżewski&Guth 2021).

The final results from the AHP method, which is a tool to carry out the meta-analysis on the topic of agricultural greening and the assumed effects and impact of the Green Deal on agriculture are demonstrated in Table (4). The alternatives are perceived as evaluated effects and impact intensity that greening and the strengthened initiatives to address climate change and lessen agricultural carbon emission. The alternative ranking scores are designated to show the alternative likeliness regarding the assumed effects and results in the covered scientific studies. The results highlight that the biggest ranking score is evaluated for the alternative with effects (+5), reaching up to 0,30. It means that in almost 30% of the articles, the assumed and studied effects and impact are found and concluded to be favourable and propitious regarding the agroecology, production-supply and consumption-demand discourse. A significant share of the explored articles is designated to look for ecological impact on the Green Deal and greening at all, which explicates to a great extent the measured results.

***Table 4. Alternative ranking evaluation of the assumed effects of agricultural greening***

| Alternative evaluation | Alternative effects (-10) | Alternative effects (-5) | Alternative effects 0 | Alternative effects 5 | Alternative effects 10 | Alternative effects N | Total score |
|---|---|---|---|---|---|---|---|
| Alternatives score estimation | 0,27 | 3,25 | 1,54 | 4,62 | 1,08 | 4,57 | 15,33 |
| Alternative ranking score | 0,02 | 0,21 | 0,10 | 0,30 | 0,07 | 0,30 | 1,00 |

*Source: Authors' calculations.*

The ecological and climate measures lead to a reduction in GHG emissions predominantly in bigger areas with a relatively good structure of the farms (Kiryluk-Dryjska, et al 2022). Along with such results, covering the effects and the implementation of the quantity requirements of the Green Deal with reference to the reduction of the application of chemical pesticides and inorganic fertilizers, which requires changes and additional expenses for many farmers, research offers strategies linked to risk management, improvement of soil management and pest management (Di Guardo et al 2022). Similar results (Dan et al 2022, Alexoaei et al 2022), highlight the complexity of the relationship between the Green Deal and agriculture (Boix-Fayos& de Vente 2023). Research shows the synergies between the common European goals, the Green Deal and sustainability (Alexoaei et al 2022). In connection to this integration, possible challenges are stated for the transformation towards sustainable agriculture, whereby they stress on the changes, which have to occur with reference to the restrictions for fertilizers – especially for bio-agriculture and suitable for agroecology.

Many results using pesticides and nitrogen fertilizers are reviewed. In particular, it is explored how they can be used with reference to bio-agriculture and agroecology and to what extent financial support from the EU can facilitate the transition towards new inputs and resources. The concrete findings refer to pest control and to what level they have positive or negative effects on human health and the environment. In other words, the protection and restoration of ecosystems are highlighted as a source of improvement for human health and in this respect emphasis is placed on pest control that is mechanical and irrigation (Alexoaei et al 2022). Conclusions of studies show that the area of land for bio-agriculture is rising moderately, with the reduction of the use of nitrogen fertilizers. The authors review different projects and their approaches. The research shows various practices in EU member states for the fulfilment of the obligations from the Green Deal for nitrogen fertilizers. Some authors defend the position that it will be difficult to implement the requirements for nitrogen fertilizers.

As a counterpoint, it should be mentioned that alternative ranking (-5), which stands for a result with negative and adverse effects and consequences on the formulated objectives and areas is also identified frequently with ranking 0,21. It means that in 21% of the studied articles are found results and effects, which assume and denote the worsening of the situation in some areas due to greening and the Green Deal. The most of concerns are related to the impacts of greening on the production-supply area. There are numerous studies stressing the feasible burdening effects of the Green Deal on European agriculture. According to Bremmer et al 2021 in Wesseler (2022), if the use of fertilizers is reduced by 20%, this will impact the production of agricultural goods. Furthermore, it is stated that there will be a reduction in agricultural productivity. In the study, there is a forecast for a reduction in productivity in the

European Union. Agricultural output is stated to decrease by 7%-12% (Beckman et al., 2020 in Wesseler 2022). Other authors project the reduction to be more than 20% (Noleppa et al. 2021 in Wesseler 2022). According to their calculations, it is expected that the average level of output in agriculture will decrease. Moreover, it is forecasted that there will be substantial reductions. This can have important consequences. "Overall, the EU's reduction in food production will increase its food prices. Consumers will bear these extra costs."(Wesseler 2022, p.1834)

It should be also underscored that alternative with effects (0), which anticipates that the greening initiatives and actions will have a rather neutral and minor impact on the agroecology, production-supply and consumption-demand is evaluated with a ranking score of 0,1. It testifies that only in a very limited number of 10% of the studied articles, the consequences of the greening initiative will have little effect and reflection on the objectives. The predominance of the studies (ranking score (of 0,37) assumes the global initiatives for greening and specifically the Green Deal of the EU will have a favourable impact. However, the challenges of this policy are apparently highlighted, where 23% of studied papers (ranking score 0,23) reveal the risks and effects it will render. With reference to the Farm to Fork Strategy, research shows that the EU has to improve its growth rate in order to reach the goal of 25% of land managed by organic farming rules. According to an extrapolation, the study of Mowlds (2020) highlights that if the EU member states are to achieve that target for bio-agriculture, their growth rate has to increase 2.5 times and reach 11%.

The eradication of pesticide usage in agriculture is difficult for a variety of reasons. The finding shows that bigger populations suggest increased use of pesticides (Robu et al 2023), because more food is demanded and there is pressure on productivity. For some articles, the results show that a decrease in the use of pesticides can increase expenses. The complexity of the green transition in European agriculture calls for more research on both the demand and supply side. Clora et al (2021, p.1) highlight that the significance of "dietary transitions" is visible in scientific works, but the effects of possible measures on the supply side are still to be analyzed with the reference "to competitiveness concerns and leakage effects". On the basis of scenarios, some analyses reach the general conclusion that it is expected that up to 2030 there will be an increase of the areas for biological agriculture. (Hurduzeu et al 2022) show that thirteen of the EU member states have reached levels for organic farming that are higher than the EU average, while fourteen EU countries have areas for the same purpose which are lower than the average areas for the EU. Their estimation suggests a decrease in the number of member states that have levels higher than the average indicator for the EU, from thirteen to ten. On the basis of projections in the research, particularly focused on the achievement of the target of 25% for bio-agriculture, it is expected that member states will increase the areas for this type of farming. But only Austria and Estonia can reach measures above the threshold of 25%. It is expected however that for some countries, there will be a reduction with reference to the areas for organic farming.

As a result, from the review of scientific publications and the AHP fulfilment of the meta-analysis is noted that a substantial part of those articles are designated to bring evaluation and conclusions on the effects and impacts supposed to occur in the agriculture from greening and Green Deal. With a ranking score of 0,3, those articles consist of the second biggest portion of the reviewed scientific papers, which deal with the keywords and formulated

objectives but do not tackle the evaluation and judgment discourse. It can be underlined that probably due to the short time after the active announcement and launch of the Green Deal and generally to the greening policy in agriculture, particularly set goals and targets, the share of those descriptive and not specified concrete effects papers is quite big. A notable part of those indifferent in terms of effects and impact articles deal with the issues of how and where the greening and Green Deal measures will bring pressure, but those articles do not reveal what would be those effects and how the situation would be changed. The transition is not only a technical question for farming practices (Alexoaei et al 2022), but it also requires the development and introduction of an integrated approach between the intensification of the agricultural system and the ecosystems. It should be also noted that there are different modes for demonstrating the eventual effects and impacts in the papers that identify and expose such results. The majority of those papers do not quantitatively measure the effects of the greening and Green Deal but through the conducted analyses manage to judge or assess qualitatively certain consequences and outcomes. Although a large portion of articles do not conclude either positive or negative effects and impact on the specified objectives from the greening in agriculture, it is very obvious and equivocal that the greening movement in agriculture will bear changes and novelties, which will drive the development of agriculture for multiple decades ahead.

## 5. Conclusion

The meta-analysis is a sound tool to fulfil scientific study on a topic when the data provision and availability are limited and a profound state-of-the-art investigation is preferred. A meta-analysis is a reliable approach, which allows on the one hand to cover big data and information for reviewing and on the other hand through quantitative or similar tools to process that data and obtain appropriate outcomes. Having in mind the goal of this study to perform a preliminary assessment of the initial perceptions and assumed effects of greening in agriculture and particularly the Green Deal of the EU, the Analytical-hierarchical process analytical tool is used for the meta-analysis. The meta-analysis covers an in-depth analysis of 27 scientific papers published in the Web of Science and Scopus databases, which are dedicated to the explored goal and appeared in the period from the beginning of 2020 up to the first half of 2023. The results from the paper review and the meta-analysis show that the ecological and climate measures set by the new CAP and the other strategies in the EU bound to greening in EU offer new challenges and opportunities for development of the agriculture towards more sustainable and environmentally friendly agriculture.

The review shows that in some articles for the assessment of the effects of the Green Deal, the indicators, which are analyzed and the specificities of the effects and conclusions that are found are either limited or qualitatively established. It seems that it is challenging to overview the general “picture” of expected ecological improvements from the implementation of the new CAP and green strategies. Moreover, the current structure of agriculture and the capacity of the farms in the EU are to a significant extent unprepared and unaware to adapt easily to the new measures and targets and to contribute to promoting the transition towards an environmentally-driven food security system. It is found out that there is a necessity to increase research and go more concretely into the topic and this field to assess the effects,

and impact and give a more comprehensive view of the complexity of the Green Deal in agriculture. In some articles, the results with reference to the measures in CAP regarding the climate and the environment are assessed positively regarding production supply, because it is expected the new green measures to lead to a reduction in greenhouse gas emissions and due to the opportunities for farmers to take advantages from funding coming from the eco-schemes.

The evaluation of the alternatives formulated for the purposes of the AHP analysis outlines a slim predominance of the favourable effects that are worked out in the studies, but it does not mean that the positive and propitious effects prevail over the negative and harmful. It indicates that over the studied and reviewed paper, a bigger part of the research is dedicated to investigate the impact and consequences of greening on the agroecological aspect. It is underlined that the effects of greening on the agrienvironment will be notable even though it seems difficult for a predominant part of the papers to assess to what extent the quantity of used pesticides would drop down in coming years. Besides, the majority of the articles point out negative and adverse effects of greening predispose to a decrease in agricultural production, which will enhance the prices of food. This will be linked with additional expenses for consumers. It means that the impact will be negative, in terms of increased prices for consumers and there is the risk of shrinking in agricultural supply as well. From the in-depth analysis of the scientific studies, it is ascertained that it is required to do more studies and comprehensive analysis on the relationship between the environmental targets, the competitiveness of farming and the role of public subsidies.

With reference to financing agriculture, some results are not concrete and quantitative. A great number of studies just assert and depict indirect effects on agroecology, production supply and consumption-demand but a little focus is posed on the governance of this greening and Green Deal particularly. Governance is a crucial factor that not only may determine the real outcomes and performance of the agricultural greening and Green Deal in different countries but also raise questions about how this initiative is established and integrated with public and policy systems. Insofar, the issues with the governance of greening, which will affect not only agriculture but numerous other aspects of the economic and social life are missed and not adequately tackled. Generally, the results of the reviewed studies indicate different aspects and targets of the EU Green Deal in particular separate specific effects, but do not give the overall impact. As a result of the meta-analysis, the findings outline both positive and negative impacts. Among the key positive aspects are better quality of food, options for diversification of production and reduction of greenhouse emissions. Some of the key issues are linked to a reduction of consumers' surplus, risks for supply and disparities in the competitiveness among countries and regions due to eventual unfair engagement in implementing the global sustainable development goals. By carrying out this study and using AHP analysis, it can be concluded that the AHP method is an appropriate method that might be applied whenever the purpose of the research is connected to the evaluation of priorities and classification of the findings considering the importance of the formulated objectives and adopted criteria.

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