Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 25, Issue 2, 2025
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ESTIMATING EUROPEAN UNION FIELD CROPS FARM SUSTAINABILITY THROUGH MEASURING POLICY IMPLEMENTATION EFFICIENCY BY DATA ENVELOPMENT ANALYSIS

Veselin KRUSTEV

Institute of Agricultural Economics, 125 Tsarigradsko Shose Boulevard, Block 1, Sofia, Bulgaria, E-mail: veselin.krustev@gmail.com

Corresponding author: veselin.krustev@gmail.com

Abstract

European Union`s Common Agricultural Policy (CAP) supports farm sustainability as a definition by its measures and tools, but the issue of its implementation efficiency differs despite of the common sense that European Commission (EC) stimulates the cohesion and coherence principles to all of the Member States (MS). This paper aims to reveal the efficiency of CAP implementation on field crop farms separated by economic sizes (6 classes) and compared to non-specialized average farm`s sustainability levels. The technical efficiency (TE) scores are received by applying Data Envelopment Analysis (DEA) using Benefit of Doubt (BoD) modelling modification on 15 indicators representing equal number of variables of the three main sustainability dimensions – economic, social and ecological. The received results clarify a huge difference of CAP implementation between the most advanced, largest holdings and the other five smaller economic size classes. Furthermore, it is exposed that payments per unit area benefit the most efficient farms that apply the best return of scale (and scale efficiency) at the expense of all others.

Key words**:** *agricultural holdings, Common Agricultural Policy, European Union, field crop farms, sustainability*

INTRODUCTION

In the recent years Europe depends more and more on responding to the main challenges: adaptation to climate changes, depopulation of rural communities, limitation of natural resources. This is the reason why enormous expectations are placed on sustainable management to balance between nature, society and the economy. Nowadays, the question of the optimal ratio between the number of agricultural holdings and their productivity and efficiency is becoming increasingly relevant. This issue is a subject of the Common Agricultural Policy as a definition and execution (subsidizing).

CAP is a widespread object of analysis in the academic community. One of the most important scientist`s goals was highlighted at the Conference in Rio de Janeiro – monitoring system on decision making units in the context of sustainability development to be established (United Nations, 1992) [16]. Furthermore, this monitoring process from a scientific point of view has its fundamental prerequisites – multidisciplinary indicators supported by significant weights in a long term time period to be available.

In order statistical error to be minimized, it is obligatory the used set of indicators to be extracted by a single data set that is able to provide sufficient financial information on the socio-economic relations and fund raising. Both sides of its distribution are in a sharp conflicts of interests. On the other hand, scientists` and policy makers` needs to diverse quantitative values to assess the qualitative effects of the agriculture`s environmental impact.

Hopefully, various databases are created, improved and provided by the European Commission. Even EC has already announced the conversion of Farm Accountancy Data Network by replacing accounting with sustainability – FSDN aiming to enrich and support the policy monitoring (European Commission, 2024)[10].

However, some of desired indicators were collected for the second inspected time period only which is a barrier in front of the priority of constructing a long-term investigation and aiming not to affect data homogeneity.

Organization for Economic Co-operation and Development (OECD) warns when quantitative data is scarce, like in the current case, proxy indicators might be used (Nardo et al., 2008) [14]. Their extraction involves using data taken from the DMU`s expenditures made on the main production factors (e.g. purchases of the detrimental (synthetic) inputs, energy usage).

The last necessary and mandatory condition to build this study is the task specific measuring tool to be chosen, adopted and implemented – the Data Envelopment Analysis maintaining a specific modelling approach – the "Benefit of the Doubt" which is famous by allowing more than several (up to 5-6) indicators to be enforced in the DMUs` technological performance without distorting the received composite indicators or the so called indexes.

Articles dedicated to sustainability assessment in a long-term period are very few. Most papers put an attention on a different sustainability issues, e.g. competitiveness, social prosperity or female management, good agricultural practices, agro-ecology. Other popular part of the studies that are fully committed to agricultural sustainability are focused on so called situational picture of a current moment (Bachev, 2016; Ivanov et al., 2009, Bachev and Terziev, 2017) [2, 12, 4], and other that can be directly applicable to the assessment of governance efficiency (Bachev et al., 2017, Bachev, 2017) [3, 5].

Nevertheless, such an assessment can compare a measurement to an earlier point in time, where details frequently presented – once per couple of years (Bachev, 2022)[1]. Hypothetically, such an approach might skip some fluctuation in the agricultural management`s behaviour where several successful years might be followed by a catastrophic circumstances reflecting on yields and respectfully economic results. This is a process that could be significantly alleviated by a governmental support.

One of the exceptions (regardless its mid-term observation period 2011-2018) is an article which covers all the sustainability pillars. Despite the shortcomings of using different databases, that paper is based on a sufficient quantitative indicators including the Eurostat and Faostat, FADN and Statistics Poland data (Kalinowska et al., 2022) [13]. That research is based on a set of variables very similar to those used in the current article in terms of their number and structure.

This observation gives an assessment which is a mixture between decision making units' management and the efficiency of governmental policy implementation where the weight is put on the governance sustainability ranking and its impact on administratively separated different production scale agricultural holdings.

MATERIALS AND METHODS

DEA's popularity stems from its relative lack of assumptions, ability to benchmark multi-dimensional inputs and outputs as well as computational ease owing to it being expressible as a linear program, despite aiming to calculate efficiency ratios (Cooper, William, Seiford et al., 2011) [9]. DEA is a nonparametric tool in operations research and economics for estimating the production frontiers (Charnes, Cooper & Rhodes, 1978) [6]. DEA creates virtual producer on the production border combining the most efficient decision making units (DMUs) in the sample. The other scores computed by the program is presented as a coefficient according to the distance from the best indicators combination between 0 - 1.

In 2008 the Organization of Economic Co-operation and Development issued the Handbook on Constructing Composite Indicators (or indices) where the "Benefit of Doubt" approach (modification of Data Envelopment Analysis) was presented as an instrument for benchmarking countries` performance (Nardo et al., 2008) [14] especially appropriate for the needs of measuring sustainable development (Cherchye and Kuosmanen, 2006) [7]. The authors proposed an approval of method usage that estimates the achieved technological production level in a competitive economic conjuncture that is applicable as a policy application efficiency concerning all other conditions being equal (e.g. soil quality or climate and weather impact – not kept into

consideration). This instrument has already been used as a composite index assessment tool in the context of policy effectiveness assessment (Cherchye et al., 2007) [8].

However, area payments affect very significant the field crop production and in this paper the perception that the CAP focus is concentrated on the sustainability of this type of agricultural holdings considering the following conception: the bigger is their production scale, the greater is their sustainability level.

The current research, which this paper is a part of, also aims to determine the production specialization where CAP should be improved in terms of economic, social and ecological aspects. The results of this article are going to be used as a benchmarking fundament to calculate the lack of sustainability of the other types of farming (e.g. horticulture, wine, milk, etc. which FADN dataset could support). Keeping in mind the consequences of area payments support on farms` large scale production technology, the following policy focus should target which might be the most appropriate production scale for each production specialization.

That research is focused especially on micro-economic level and includes 15 indicators, 5 per each pillar which are focused on pointing out the DMUs` production scale and figuring out the efficiency of some main production, social and detrimental factors.

Data Envelopment analysis is applied using a classical input oriented model confirming constant return to scale.

Sustainability indicators and measuring units

Economic variables – agricultural area (ha), labour (annual working units – AWU), capital (€), gross production (€), intensity of land usage (€/ha).

Social variables – income per family member, paid wages, own production factors, gross farm income, cash flow and services to the rural society – sum of provided services and rent payments (all in €).

Ecological variables: fertilizers, plant protection, energy (expressed by costs in €), environment payments as a share of the total area payment and nitro-fixing (protein) crops as a part of the crop rotation strategy (both coefficients).

As a benchmark in this study is used the average values of a common synthetic farm that combines all of the specializations and economic sizes from the FADN dataset (2007 - 2022).

Results are separated in two inspected periods and covers 8 years in a row respectfully when the different policies were applied (2007-2014 and 2015-2022).

RESULTS AND DISCUSSIONS

This policy efficiency measurement is quite specific concerning the diversity of scores which present the three sustainability pillars as summarized results into a cumulative function received by applying a 15 indicator DEA-BoD optimization model. This means that in the most cases policy implementation effects are "summed" in the final score which might be equal to the highest pillar or might be higher than each single pillar assessment. This circumstance presents a significantly different estimation then the usual and common agricultural sustainability estimation approaches are made where the compound sustainability scores are found as an average mean between the different sustainability pillars.

This "sum" is logically justified by the multidisciplinary function of the agricultural sustainability by adding social and environmental features to the main economic goals which causes extra effects on the main policy implementation checkpoints while at the same time these three pillars exclude each other or there is conflict of interests between them. First sustainable fundament is the economic pillar which creates the funding of other activities, second is the social pillar where the labour and social interests are collateralized, and the last production priority in the sustainability concept is defined as environmental pillar. However, nowadays the last production priority became the most important thing in human attitude and subsistence.

First Economic Size Class (ESC1) Farms (2, 000 – 8,000 €Standard Output)

This farm group was left by Italy and Spain after 2014 when Estonia achieved such representatives which were not performing during the first CAP period (Table 1). This is the reason why they are not included (last column on Table 1) and respectfully their smallest agricultural organizations are not presented on the Figure 1 where the summarized technical efficiency results are illustrated.

Table 1. ESC 1 holdings` total utilized agricultural area, economic output (earliest available accounting year) and data availability.

Member State	Total UAA (ha/farm)	Gross output (€/farm)	Data 2007-2014	Data 2015-2022	Incl./ Not
Bulgaria	**6.5**	6,637	8/8	8/8	Yes
Greece	**6.3**	9,419	8/8	7/8	Yes
Spain	***22.0***	*16,548*	*8/8*	*0/8*	-
Italy	***7.4***	*22,433*	*7/8*	*0/8*	-
Latvia	**23.6**	9,876	3/8	2/8	Yes
Lithuania	**25.3**	10,054	7/8	8/8	Yes
Hungary	**10.9**	8,702	8/8	8/8	Yes
Poland	**12.4**	14,677	8/8	8/8	Yes
Portugal	**10.3**	5,605	8/8	6/8	Yes
Romania	**6.7**	6,819	8/8	8/8	Yes
Cyprus	**7.4**	5,767	7/8	8/8	Yes
Slovenia	**5.4**	9,124	3/8	7/8	Yes
Malta	**2.2**	4,744	1/8	7/8	Yes
Estonia	***13.9***	*5,852*	*0/8*	*4/8*	-

Source: FADN [8].

That tiny farm group is characterized by relatively larger farms in the Baltic countries and smaller ones on the Balkans.

There are three types of behaviour among the smallest farm representatives:

The Greek farms gain a spectacular score which is presented as more intensive and sustainable than the reference EU values in both investigated CAP schedules and furthermore, their trend follows the increasing common EU farms` sustainability tendency.

The second CAP benchmark is only passed by Portugal farmers who strengthened all the estimated sustainability pillars but most intensively the ecological performance. In those cases, the change is covered by a raise in the economic and ecological (the pillar which is above EU farm average) sustainability aspects.

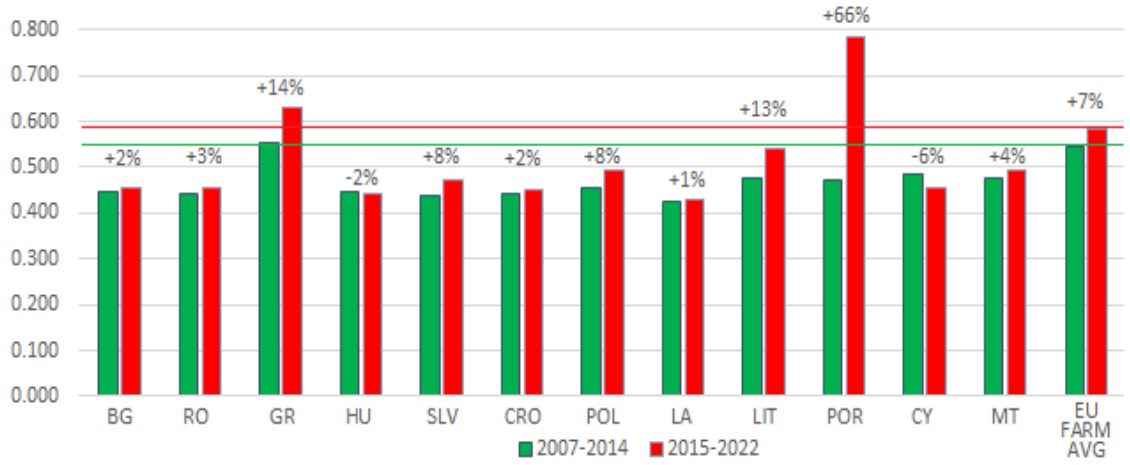

Fig. 1. Sustainable Policy Implementation Efficiency ESC1
Source: Own calculations based on the data from FADN [8].

In a smaller scale this is common also for Poland and Lithuania, but their performance is not that essential and below the reference.

From another side, the smallest farms in Cyprus and Hungary lose a small part of their tiny environmental dignities which reflects on the sustainability levels. The rest of the

participants share mutual trend of development which is expressed by inflation related but inconsiderably positive fluctuation in the social pillar.

The smallest farms size group is losing a 20% of its members and is also the poorest sustainable economic size class of the field crops farms.

Second Economic Size Class Farms (8,000 - 25,000 €SO)

Second farm group was left by Slovakia as confirming not interested in boutique farming and being famous with their large farm cooperatives (Table 2).

The largest farms according to their physical size in that class belong to Scandinavian MS with higher than the average rate of sustainability due to the high social levels (Figure 2).

Table 2. ESC2 holdings` total utilized agricultural area, economic output and data availability

Member State	Total UAA (ha/farm)	Gross output (€/farm)	Data 2007-2014	Data 2015-2022	Incl./ Not
Bulgaria	**40.8**	14,535	8/8	8/8	Yes
Czechia	**26.9**	27,620	8/8	3/8	Yes
Denmark	**28.5**	67,775	8/8	5/8	Yes
Estonia	**59.6**	26,142	8/8	3/8	Yes
Greece	**12.0**	19,693	8/8	7/8	Yes
Spain	**40.8**	27,240	8/8	7/8	Yes
Italy	**13.3**	27,926	8/8	8/8	Yes
Cyprus	**8.3**	25,762	8/8	8/8	Yes
Latvia	**62.9**	20,555	8/8	8/8	Yes
Lithuania	**47.8**	21,867	8/8	8/8	Yes
Hungary	**29.7**	25,226	8/8	8/8	Yes
Malta	**3.3**	18,133	8/8	7/8	Yes
Austria	**29.9**	33,743	8/8	8/8	Yes
Poland	**26.4**	30,214	8/8	8/8	Yes
Portugal	**21.1**	16,963	8/8	8/8	Yes
Romania	**15.4**	24,788	8/8	8/8	Yes
Slovenia	**14.7**	22,472	8/8	7/8	Yes
Slovakia	***37.7***	*23,178*	*2/8*	*0/8*	-
Finland	**43.7**	27,674	8/8	8/8	Yes
Sweden	**47.2**	70,123	8/8	1/8*	*Yes
France	**6.7**	27,473	3/8	8/8	Yes
Croatia	**12.7**	16,027	2/8	7/8	Yes

Source: FADN [8].

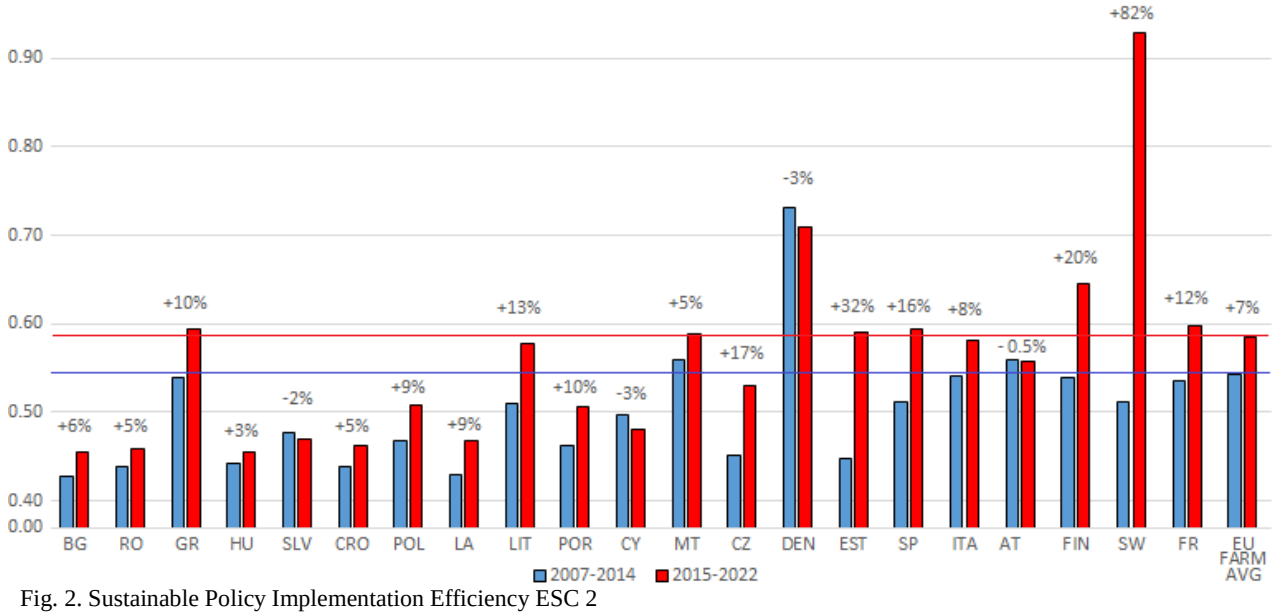

Fig. 2. Sustainable Policy Implementation Efficiency ESC 2
Source: Own calculations based on the data from [8].

Same applies to the Baltic countries and Spain, but Latvia could not reach the needed ecological policy applications and is outside that definition. Those farms have above 40 ha farms land (Denmark only 28.5 ha). This is

similar to Bulgaria where is detected the smallest output in this size class. A size contrast appears in a comparison with Cyprus - below 10 ha farms which present one of the most disappointing results.

Malta and France also possess very small units of this class but they gain an increasing and above average sustainability scores after an economic performance improvement.

Most of the Balkan member states– Romania, Bulgaria, Croatia, Hungary and Slovenia, also Latvia, share common trend – slowly increasing social level below the benchmark. While Romania, Bulgaria and Latvia slightly rise the ecological rates, Hungary could not, similar to Slovenia and Croatia which have greater economic levels than Czechia and Poland regardless their better composite sustainability achievement.

Greece achieves environmental growth, which concerns also Italy where the economic drop is compensated by a social progress which go hand by hand in Austria at account of a low ecological reduction to form the last farms that have high sustainability indexations.

Third Economic Size Class Farms (25,000 – 50,000 €SO)

The most impressive results in the lower-medium economic size class are presented again by the production units of the Scandinavian member states (Figure 3). Denmark and Finland get optimized their energy usage which reflects on the agri-ecological performance. Sweden gain an increase by maximizing the economic efficiency by consistently improving inflation related productivity of labour and capital. Exactly the opposite is the behaviour of Italy Germany and France, forming a half of the European Union founding countries, demonstrate composite sustainability indicators above at least the first reference level. Nevertheless, decades after the establishment of the so called "green revolution" in particular European chemical factories converting one of the most polluting human activities into producers of agricultural factors of production (Pingali, 2012) [15] are loudly announced to be replaced by a massive new wave of ecological priorities taking a solid part of the currently adapted EU policies, despite being below the EU separator. The same irregularities were applied also in Romania Bulgaria, the Czech Republic and Estonia, Greece and Cyprus.

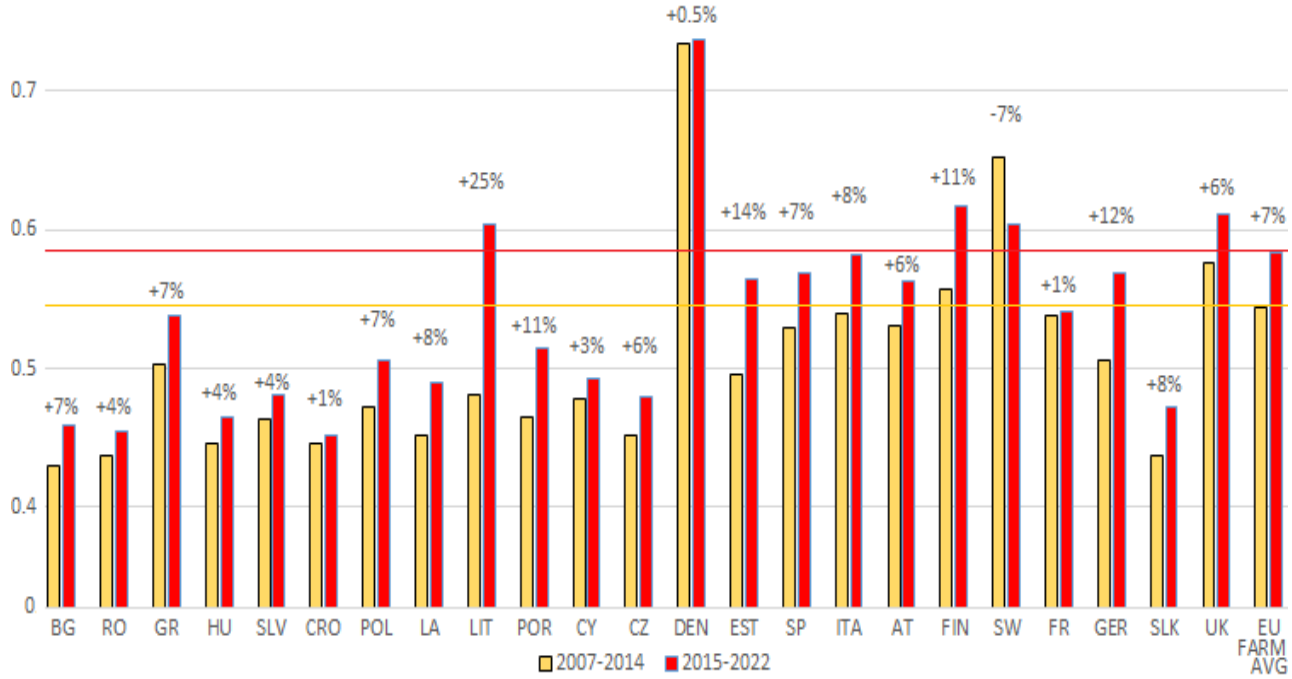

Fig. 3. Sustainable Policy Implementation Efficiency ESC 3
Source: Own calculations based on the data from [8].

Table 3. ESC3 holdings` total utilized agricultural area, economic output and data availability

Member State	Total UAA (ha/farm)	Gross output (€/farm)	Data 2007-2014	Data 2015-2022	Incl./ Not
Bulgaria	**109.2**	38,029	8/8	8/8	Yes
Czechia	**61.0**	56,466	8/8	8/8	Yes
Denmark	**51.5**	101,827	8/8	8/8	Yes
Germany	**36.9**	63,024	8/8	7/8	Yes
Estonia	**132.9**	62,369	8/8	8/8	Yes
Greece	**22.9**	44,969	8/8	7/8	Yes
Spain	**81.6**	56,599	8/8	7/8	Yes
France	**56.8**	65,677	8/8	8/8	Yes
Italy	**24.9**	60,864	8/8	8/8	Yes
Cyprus	**18.8**	36,512	8/8	8/8	Yes
Latvia	**117.5**	60,910	8/8	8/8	Yes
Lithuania	**108.0**	59,195	8/8	8/8	Yes
Hungary	**72.5**	53,770	8/8	8/8	Yes
Malta	***5.7***	*41,805*	*8/8*	*1/8*	-
Netherlands	**20.6**	88,039	2/8	5/8	Yes
Austria	**50.5**	58,882	8/8	8/8	Yes
Poland	**61.1**	64,336	8/8	8/8	Yes
Portugal	**63.5**	38,457	8/8	8/8	Yes
Romania	**87.7**	42,082	8/8	8/8	Yes
Slovakia	**71.8**	51,047	8/8	8/8	Yes
Finland	**89.7**	67,578	8/8	8/8	Yes
Sweden	**73.2**	68,492	8/8	8/8	Yes
UK	**59.2**	67,313	8/8	6/8	Yes
Ireland	***52.9***	*51,567*	*2/8*	*0/8*	-
Slovenia	**23.6**	45,259	3/8	6/8	Yes
Croatia	**31.1**	33,339	2/8	7/8	Yes

Source: FADN [8].

That staging is not negative in Poland, Latvia and Finland and even slightly but non-essentially increasing as well as in Croatia, Slovenia and Hungary, Slovakia and Lithuania, Spain.

Portugal and Austria are the only members that improve their economic outcome more significantly even not achieving the separating line which is succeeded by United Kingdom (after a triple growth in all the sustainability dimensions) and Sweden the economic resilience is improved at the expense of both ecological and social challenges which are therefore ignored.

In addition to their unsatisfactory results, Romania, Bulgaria and the Baltic countries have built the largest production facilities in this group by economic size (Table 3), which further worsens the achieved results, although this fact is not taken into account by the applied method.

Fourth Economic Size Class Farms (50,000 – 100,000 €SO)

The upper medium economic size class presents a surprizing output – not because Cyprus but United Kingdom is one of the only two presented island countries that maintain a decrease leading to a drop down the benchmark in the second inspected program period (Figure 4).

While this trend is accompanied by a decline only in the economic index of the resource larger country, the other one (that cultivate significantly limited agricultural area on macro level) realize a decline spread through all of the sustainability dimensions, and furthermore the economic pillar`s decline is severely drastic.

The last available Cyprus data score is 2016 which affects the economic sustainability crash by 88.5 % compared to 2007. This policy implementation is explaining the lack of farmers participating in the ESC 5 (Table 5).

Despite the overall sustainability increase, the economic sustainability drops are observed through the holdings of the Baltic member states, Bulgaria and Romania, whose farms cultivate the biggest agricultural areas according to most of the others in that size class (Table 4).

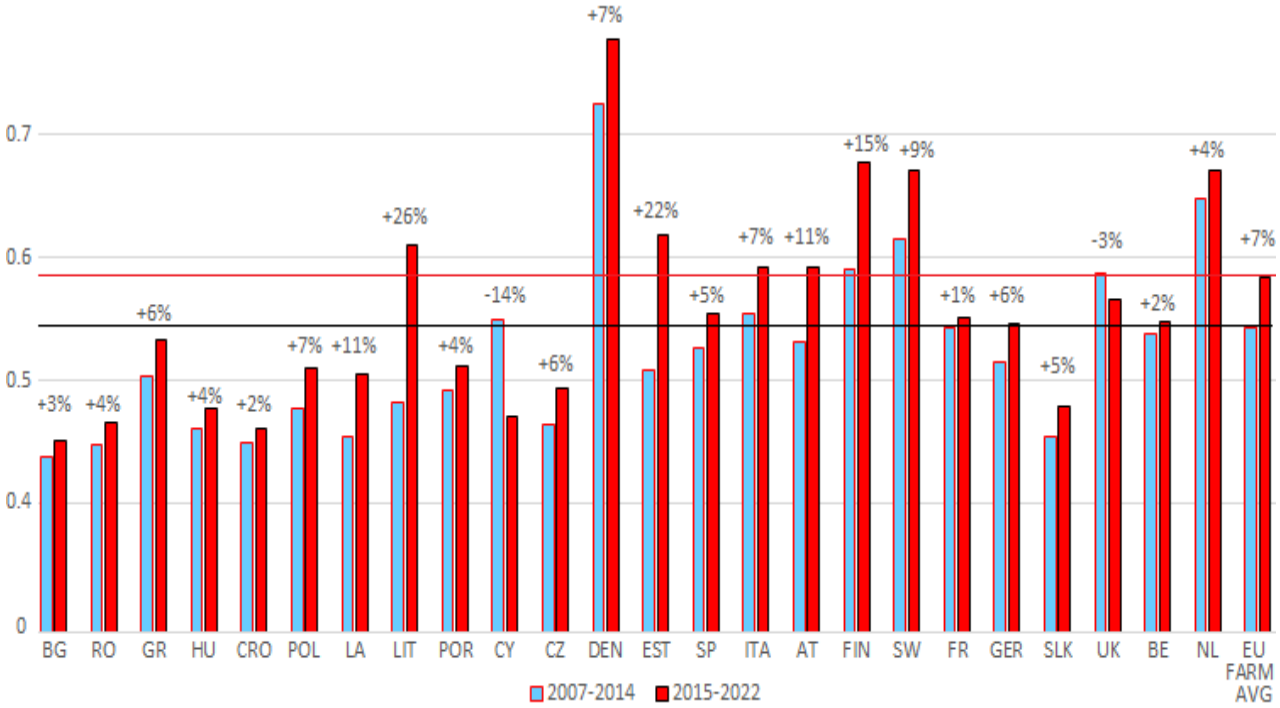

Fig. 4. Sustainable Policy Implementation Efficiency ESC 4
Source: Own calculations based on the data from [8].

Table 4. ESC 4 holdings` total utilized agricultural area, economic output and data availability

Member State	Total UAA (ha/farm)	Gross output (€/farm)	Data 2007-2014	Data 2015-2022	Incl./ Not
Belgium	**44.5**	73,559	8/8	8/8	Yes
Bulgaria	**227.2**	75,877	8/8	8/8	Yes
Czechia	**120.4**	108,756	8/8	8/8	Yes
Denmark	**83.0**	226,246	8/8	8/8	Yes
Germany	**62.1**	103,887	8/8	7/8	Yes
Estonia	**253.5**	145,535	8/8	8/8	Yes
Greece	**33.6**	63,475	8/8	7/8	Yes
Spain	**120.7**	95,195	8/8	7/8	Yes
France	**99.1**	119,336	8/8	8/8	Yes
Italy	**43.5**	80,886	8/8	8/8	Yes
Cyprus	**17.2**	113,368	8/8	2/8	Yes
Latvia	**254.2**	127,135	8/8	8/8	Yes
Lithuania	**200.4**	124,759	8/8	8/8	Yes
Hungary	**147.9**	111,819	8/8	8/8	Yes
Netherlands	**30.3**	189,077	8/8	8/8	Yes
Austria	**72.1**	95,839	8/8	8/8	Yes
Poland	**120.6**	120,218	8/8	8/8	Yes
Portugal	**119.2**	91,055	8/8	8/8	Yes
Romania	**165.6**	64,078	8/8	8/8	Yes
Slovakia	**158.2**	116,721	8/8	8/8	Yes
Finland	**131.6**	112,749	8/8	8/8	Yes
Sweden	**112.4**	130,887	8/8	8/8	Yes
UK	**103.2**	121,599	8/8	6/8	Yes
Ireland	***69.2***	*72,573*	*5/8*	*1/8*	-
Slovenia	***23.0***	*58,015*	*3/8*	*0/8*	-
Croatia	**57.1**	67,932	2/8	7/8	Yes

Source: FADN [8].

Most of the new MS farms` performances are struggling economically together with France, Portugal and Spain. Such a finding is still quite sharp away than expected by a new ideological prism declared in European Community policy.

In the other hand are situated definitely smaller production scale units – Netherlands, Italy and Greece (below 50 ha) which are increasing the ecological narrative while holding stable the other sustainability components.

The overall sustainability is increasing most sensitively in the Scandinavian MS and

furthermore Sweden, Poland, Austria and Belgium gain success in all the sustainability pillars after the policy switch.

Fifth Economic Size Class Farms (100,000 – 500,000 €SO)

The Baltic states and Bulgaria (the only depressed compound index on Figure 5) and Romania are again struggling the emerging negativity in the economic sustainable development (-20% to -32%) mostly in favor of ecological goals of the contemporary agricultural policy.

This concerns also the Czech Republic, Hungary and Slovakia (they all share common trends on Figure 5).

Even Italy and Portugal joined the eco group after the policy change in 2014 and applied that by 2015 supporting schemes. This phenomenon is even more spread among the largest agricultural producers.

Among the new member states (ESC 5), representatives below 300 ha agricultural land are available only in small Slovenia and Croatia (Table 5).

While the farms next to Alps increase the sustainability level due to socio-economic improvements (like the Baltic MS but not due to environmental practices), so the newest Mediterranean MS reveal the lowest sustainability score in the first of the largest farm size groups.

Again CAP impact on Scandinavian agricultural units is in accordance with the highest sustainability performances among all the three dimensions.

This is not applicable to Sweden`s environmental score, which is applied also by the Netherlands, Belgium and most of the Balkan countries.

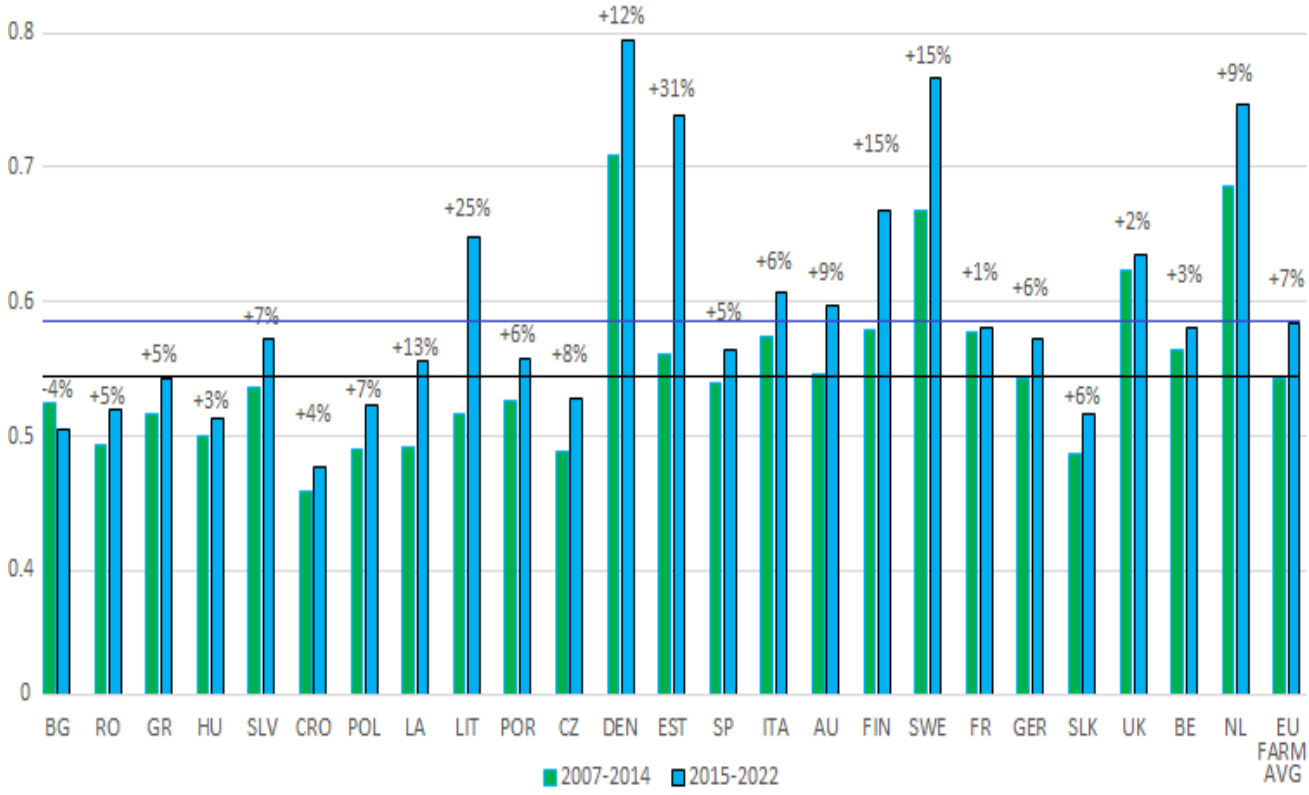

Fig. 5. Sustainable Policy Implementation Efficiency ESC 5
Source: Own calculations based on the data from [8].

Table 5. ESC5 holdings` total utilized agricultural area, economic output and data availability

Member State	Total UAA (ha/farm)	Gross output (€/farm)	Data 2007-2014	Data 2015-2022	Incl./ Not
Belgium	**91.1**	217,254	8/8	8/8	Yes
Bulgaria	**747.8**	264,878	8/8	8/8	Yes
Czechia	**339.2**	321,235	8/8	8/8	Yes
Denmark	**215.6**	404,187	8/8	8/8	Yes
Germany	**141.9**	240,109	8/8	7/8	Yes
Estonia	**706.1**	393,000	8/8	8/8	Yes
Greece	**39.4**	92,302	8/8	7/8	Yes
Spain	**292.8**	217,950	8/8	7/8	Yes
France	**165.7**	244,203	8/8	8/8	Yes
Italy	**101.4**	216,209	8/8	8/8	Yes
Cyprus	***61.5***	*101,868*	*5/8*	*0/8*	-
Latvia	**639.1**	447,352	8/8	8/8	Yes
Lithuania	**477.2**	356,251	8/8	8/8	Yes
Hungary	**392.1**	316,635	8/8	8/8	Yes
Netherlands	**74.7**	323,527	8/8	8/8	Yes
Austria	**85.4**	186,308	8/8	8/8	Yes
Poland	**340.8**	339,961	8/8	8/8	Yes
Portugal	**140.9**	219,585	8/8	8/8	Yes
Romania	**536.0**	234,311	8/8	8/8	Yes
Slovakia	**525.6**	426,255	8/8	8/8	Yes
Sweden	**257.2**	359,623	8/8	8/8	Yes
UK	**227.1**	323,323	8/8	8/6	Yes

Source: FADN [8].

There is not a single example of a decrease in the social aspects of that size class.

Sixth Economic Size Class Farms (more than 500 000 €SO)

The highest levels of policy efficiency (touching the ceiling) are presented in the largest farms class (Figure 6). However, the agricultural holdings are separated in two rapidly different performance directions. Positive trends are seen in the cases of Lithuania and Slovakia (new MS), Belgium, the Netherlands and Germany (Founding MS), Denmark and United Kingdom.

Declining group is consisted mostly of the New MS (highest production scale - above 1,300 ha, Table 6) which lose some of the reached sustainability level gained during the first inspected program period. France and Italy (smallest scale in the class) also cannot succeed to earn some points after 2014. All the presented new MS lose economic performance while only Lithuania gains an ecological acquisition. Only Belgian farms succeed to realize a potential in all sustainability pillars.

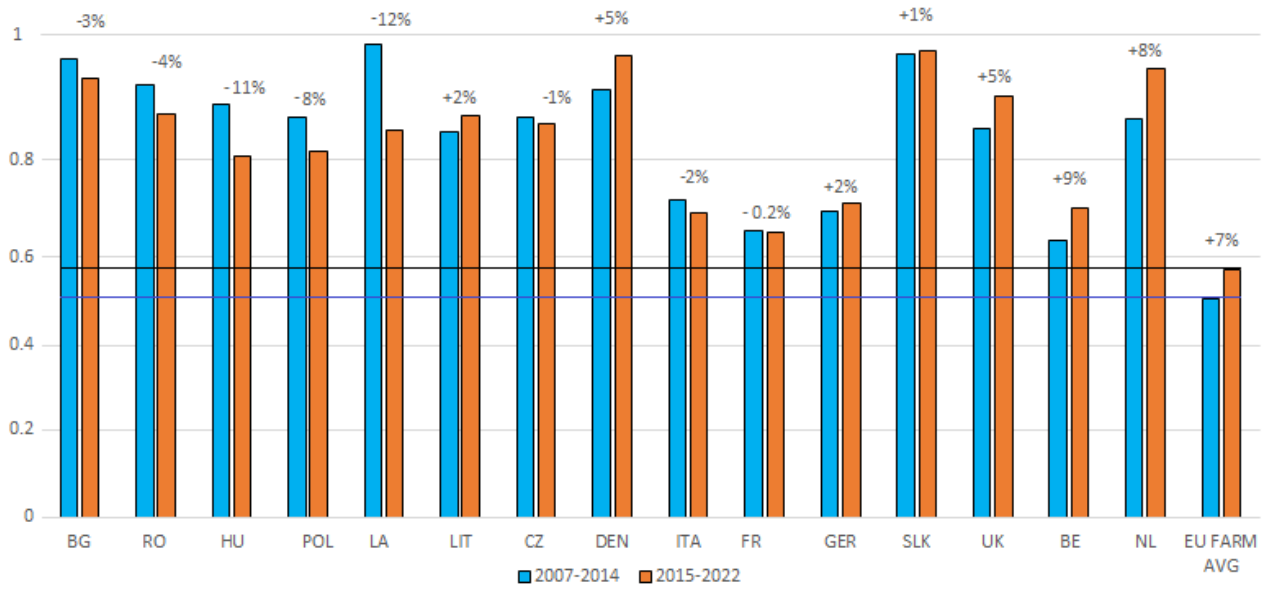

Fig. 6. Sustainable Policy Implementation Efficiency ESC 6
Source: Own calculations based on the data from [8].

Table 6. ESC6 holdings` total utilized agricultural area, economic output and data availability

Member State	Gross UAA (ha/farm)	Total output (€/farm)	Data 2007-2014	Data 2015-2022	Incl./ Not
Bulgaria	**1,954.2**	883,167	8/8	8/8	Yes
Czechia	**1,317.4**	1,636,743	8/8	8/8	Yes
Denmark	**656.1**	1,198,765	8/8	8/8	Yes
Germany	**674.3**	1,028,185	8/8	7/8	Yes
France	**219.8**	691,158	8/8	8/8	Yes
Italy	**359.0**	946,569	8/8	8/8	Yes
Hungary	**1,816.5**	1,749,451	8/8	7/8	Yes
Netherlands	**182.1**	1,005,782	8/8	8/8	Yes
Poland	**1,295.0**	1,424,812	8/8	8/8	Yes
Romania	**2,313.1**	859,165	8/8	8/8	Yes
Slovakia	**1,902.7**	1,699,860	8/8	8/8	Yes
UK	**626.0**	1,217,940	8/8	6/8	Yes
Lithuania	**1,509.7**	1,193,655	5/8	8/8	Yes
Belgium	**102.6**	485,859	3/8	2/8	Yes
Latvia	**1,575.1**	1,739,646	3/8	8/8	Yes
Estonia	***1,403.7***	*1,145,011*	*0/8*	*8/8*	-
Spain	***359.2***	*1,029,257*	*0/8*	*8/8*	-
Sweden	***719.8***	*1,521,419*	*0/8*	*3/8*	-

Source: FADN [8].

Summary of the Empirical Results

In terms of the "virtual producer" who perform on the highest production frontier in the sample, the peer-designers constituting the 15-indicator best production function of that efficiency estimation on sustainability policy implementation are as following:

-ESC 1 – Portugal 2018 (leading ecological pillar).

-ESC 2 – France 2016 (economic pillar).

-ESC 3 – Denmark 2021 (social pillar).

-ESC 6, economic oriented: Romania, Slovakia, Denmark (2008) and the Netherlands (2022).

-ESC 6, social oriented: Bulgaria, Romania and Denmark (2022) Slovakia (2016) and again Romania (2008).

-ESC 6, eco oriented: the Baltic MS, the Czech Republic and Hungary (all 2022).

CONCLUSIONS

The EU`s Common Agricultural Policy has its specifics as far as it is concerned to the so called new member states.

We can see how the physical farms size and sustainability levels changes in different classes being in relation to Bulgaria and Romania, Baltic countries and the others.

Out of the most, it is obvious that there are some exceptions to Poland, the Czech Republic and to some extent the scale efficient Slovakian cooperatives.

Most of the increase in ecological terms lay down on a single CAP tool – the area payments for nitro-fixing crop rotation (EU farm average +112%). Especially bright is the case in Bulgarian **average** field crops farms (+621%), which was a CAP scheme abused by farmers by sowing Alfalfa (Lucerne) as a permanent grassland which in reality pauses the crop rotation for at least 5-year (which was the actual CAP engagement time period).

In several cases the increase started at very low stage – Bulgaria, Croatia (+44%) and Slovenia (+307%), comparable with the Netherlands where the level stays stable in terms of limited and very intensive farm area.

Baltic MS started at higher initial level of that indicator and additionally coefficients raise between 260-400%.

Change in cash-flow volumes of the observed crop rotation vary: up to a hundred percent - Ireland, Italy, Spain, Greece and Germany; to up to 200% in Romania, Poland, Luxemburg, while also massive increase was observed in Denmark +371%, Portugal +488%. Czechia +211%, Finland +197%.

On the other hand, France, UK, Sweden, Austria, Cyprus and Hungary have no structural changes covered by traditional to an extend level.

This paper clearly shows how CAP average efficiency is boosted by the highest economic farm size class of that farm type.

In terms of the scale efficiency, all Balkan holdings smaller than the largest seems to be

inefficient in the policy application, which additionally causes lack of value added per unit area represented in the production functions of the current study, especially Bulgaria and Romania. On the other hand, Scandinavian MS are performing very well concerning the smaller economic classes.

Keeping in mind the constantly decreasing number of small farmers (Eurostat, 2022), the average farm area is permanently increasing and concentrating the CAP subsidies in smaller and smaller amount of decision making units.

This puts out the question – is CAP funding distribution designed to fail? Is the concentration of land, subsidies (power) and production in a small amount of entrepreneurs just a policy design? Is CAP modifying farms` structure in the last programme periods in order to eliminate a huge amount of small farmers or to increase their economic size and production scale (function of the area payments) which might lead to less employment and depopulation of the rural areas pushing the people concentration in the urban areas as indirect policy consequences?

Questions for author`s further research.

ACKNOWLEDGEMENTS

This research is supported by the Bulgarian Ministry of Education and Science under the National Program "Young Scientists and Postdoctoral Students - 2".

REFERENCES

[1]Bachev, H., 2022, A Framework for Assessing the Governance Efficiency of Agricultural Farms, Available at SSRN: https://ssrn.com/abstract=4155798 or http://dx.doi.org/10.2139/ssrn.4155798 .

[2]Bachev, H., 2016, Устойчивост на земеделските стопанства в България (Sustainability of Agricultural Farms in Bulgaria), SSRN: https://ssrn.com/abstract=3568113, http://dx.doi.org/10.2139/ssrn.3568113, Accessed on 27 February 2025.

[3]Bachev, H., Ivanov, B., Toteva, D., Sokolova, E., 2017, Agrarian Sustainability in Bulgaria – Economic, Social and Ecological Aspects, Bulgarian Journal of Agricultural Science, 23 (No 4), 519–525, Agricultural Academy.

[4]Bachev, H., Terziev, D., 2017, Environmental Sustainability of Agricultural Farms in Bulgaria, ASERS Publishing, Vol.8(5), JEMT Vol. VIII, Issue 5(21), Fall 2017. https://doi.org/10.14505//jemt.v8.5(21).02 .

[5]Bachev, H., 2017, Socio-economic and environmental sustainability of Bulgarian farms, Agricultural and Resource Economics: International Scientific E-Journal, Agricultural and Resource Economics: International Scientific E-Journal, Vol. 3(2), June.

[6]Charnes A., Cooper W. W. and Rhodes E. (1978). "Measuring the Efficiency of Decision Making Units." EJOR 2: 429-444.

[7]Cherchye, L., Kuosmanen, T., 2006, Benchmarking Sustainable Development: A Synthetic Meta-Index Approach, Chapter 7. In M. McGillivray and M. Clarke (eds), Perspectives on Human Development (United Nations University Press).

[8]Cherchye, L., Moesen, W., Rogge, N., Puyenbroeck, T., 2007, An Introduction to 'Benefit of the Doubt' Composite Indicator. Social Indicators Research. 82. 111-145. 10.1007/s11205-006-9029-7.

[9]Cooper, W. W.; Seiford, L. M.; Zhu, J., eds. (2011). Handbook on Data Envelopment Analysis. International Series in Operations Research & Management Science (2 ed.). Springer US. ISBN 978-1-4419-6150-1;

[10]European Commission`s Farm Accountancy Data Network, 2024, https://agridata.ec.europa.eu/extensions/FADNPublicDatabase/FADNPublicDatabase.html, Accessed on 25 September 2024.

[11]Eurostat, 2022, Farms and farmland in the European Union – statistics: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics, Accessed 13 May 2025

[12]Ivanov, B., Radev, T., Vachevska, D., Borisov, P., 2009, Устойчивост в земеделието (Sustainability in Agriculture), Avangard Prima Publishing House.

[13]Kalinowska, B., Bórawski, P., Bełdycka-Bórawska, A., Klepacki, B., Perkowska, A., Rokicki, T., 2022, Sustainable Development of Agriculture in Member States of the European Union, Sustainability. 10.3390/su14074184.

[14]Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A., Giovannini, E., 2008, Handbook on Constructing Composite Indicators and User Guide, Organization of Economic Co-operation and Development, 10.1787/533411815016, OECD Statistics Working Paper.

[15]Pingali, P., 2012, Green revolution: impacts, limits, and the path ahead. Proc Natl Acad Sci USA;109(31):12302-8. doi: 10.1073/pnas.0912953109. Epub 2012 Jul 23. PMID: 22826253; PMCID: PMC3411969.

[16]United Nations, 1992, The Rio Declaration on Environment and Development, https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_CONF.151_26_Vol.I_Declaration.pdf, Accessed on 05 February 2025.