Analysis of the Socio-Economic and Environmental Consequences of the Russia-Ukraine War for the Sustainable Development of EU Countries

Olha Prokopenko [1]

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Abstract. This study focuses on the impact of the Russia-Ukraine war on the socio-economic and environmental factors of the EU member countries for sustainable development from the year 2017 to the year 2022. The research question of the ongoing conflict focuses on the consequences that the conflict has had on socioeconomic and environmental structures in the EU and an understanding of the impacts of war on sustainable development and their interrelation. To investigate GDP growth, inflation, unemployment rates, and CO_2 emission during conflict times the authors employ econometric models coupled with environmental assessments on specific data from the EU countries, amount of CO_2 emissions, and investment in renewable energy. This research shows that the war has impacted the economy of the affected countries negatively by reducing the GDP and increasing the inflation rate hence impacting sustainable development frames negatively. Similarly, it has worsened environmental problems such as CO_2 emissions through the use of fossil fuels because of the conflict. But it has also ramped up spending on renewable energy, signifying that it could unlock the road to increased sustainability. The study therefore notes that the short-term socio-economic costs of the war remain a major concern while the view to renewable energy might present future opportunities towards sustainability. The paper also established the fact that policies to address the short-run shocks and those to deal with the long-run externalities should be holistically conceived and pursued. By the same token, it states that there is a need to sustain and expand support for renewable energy sources while giving a special focus on providing aid to cushion the social and economic effects of geopolitical instabilities. More discussion should be made on the long-run impact of renewables investment and there should be studies on the impacts of geopolitical tensions on sustainable on sustainable future across various fields and nations.

Keywords: economic disruption, energy transition, geopolitical conflict, inflation impact, renewable energy investment, environmental degradation.

INTRODUCTION

Research problem

As the Russia-Ukraine war continues, it is wreaking havoc not only in political and geopolitical domain but across so many other domains of human life. Therefore, the conflict has posed serious threats to the EU countries' sustainable development policies which are already on the precariously sensitive to change due to climate change and future unpredictability of economic status. This has been done through disrupting supply chains, raising energy insecurity and raising military spending at the expense of environmental, social, and governance spending on development projects.

[1] Olha Prokopenko
Estonian Entrepreneurship University of Applied Sciences, Tallinn, Estonia, olha.prokopenko@eek.ee, https://orcid.org/0000-0003-1362-478X

Furthermore, the war has contributed to environmental degradation through destroyed infrastructures, polluted environment, land and marine ecosystem invasion through military activities, carbon emission enhanced by the war. Nevertheless, there is relatively a dearth of research literature that examines the multifaceted effects of the Russia-Ukraine conflict on the socio-economic and the Environmental sustainability of EU countries. This research aims at attempting to fill this research gap by describing the conflict and how it impacts the sustainable development of the EU.

Research focus

In this study, analysis is made on socio-economic and environmental impacts of the Russia-Ukraine war on sustainable development of the European Union countries. The study aims to understand the war's effects on three key aspects: stability of the economy, the well-being of the population and even the state of the natural environment. The economic front means evaluating the situation with reference to energy import and product prices, inflationary pressures and industrial production which has immediate ramifications for the tape of economic status of the EU members. In social context, it will aim at investigating pressure to social services from enhanced migration, the resultant economic inequality courtesy of the conflict, and impacts on social integration. The environmental consequences will look at ways in which the conflict has contributed to destruction of ecosystems, higher levels of pollution and worsening of pre-existing environmental issues. This research therefore aims at presenting the three dimensions of this war and suggesting ways of minimizing the effects as the world strives to achieve sustainable development.

Relevance of the research

The significance of the research is to be viewed in the focus on the analysis of the less researched conflict that critically affected the socio-economic and environmental environment of the EU. As the war persists, it becomes clear that its impact on sustainability is more apparent due to European countries' attempts to fulfill the European Green Deal as well as the United Nation's Sustainable Development Goals (SDGs). The interruption of energy availability and the over-dependence on Russian fossil energy sources have prompted EU nations to increase the pace of changing course to use renewable energy in their energy policies. But this change is taking place in contentious environment such as high inflation, resource constraint and political instabilities that are potent risks to sustainable development. Besides, the war has brought about new threats to the environment including habitat loss, soil degradation and an increase in greenhouse gases. This research is important for policymakers, stakeholders in the industry and scholars because it captures the various aspects of challenges by the conflict and provides recommendations for increasing the preparedness of EU countries in case of disruptions.

The research aim for this study is to assess the effectiveness of capacity building initiative for poor households in Ethiopia in an effort to answer the following research questions:

The purpose of this study is to assess the social and economic as well as the environmental effect of the Russia Ukraine war on EU nations' sustainable development. To achieve this, the study seeks to answer the following research questions:

1. What are the socio-economic consequences of the Russia-Ukraine war for the EU, particularly regarding energy markets, inflation, and industrial output?
2. How has the conflict impacted the social infrastructure of EU nations, with a focus on migration, public services, and social cohesion?
3. What are the direct and indirect environmental effects of the war on the EU, particularly in terms of ecosystem destruction, pollution, and carbon emissions?
4. How can the EU mitigate the socio-economic and environmental impacts of the war to ensure the continuation of its sustainable development efforts?

Through the answers to these research questions, the research study will be useful in advancing the knowledge of how and in what ways conflicts limit the achievement of sustainable development together with the various measures that can be taken in order to reduce such effects. The results are anticipated to be beneficial for decision makers considering the political economic social technological environment when developing future economic social and environmental policies that will help to provide for the necessary improvements for living in current and future conflicts. This research will also add to the knowledge of sustainability literature by discussing and

analyzing how external factors such as wars affect the sustainability development paths.

LITERATURE REVIEW

Russia's war on Ukraine has brought lasting effects to the threat to food security to the world as noted by many scholars. Hatab (2022) also describes how the conflict deepens the food crisis in the region and the Africa's dependence on the global markets. Eshov, and Balbaa, and Ismailova (2022) highlight other effects of the war on the international economy, including the effects of the war on food and their prices around the world.

Behnassi and El Haiba (2022a, 2022b) present mechanisms by which the conflict has affected the global food security systems with policies on fluctuations, market insecurity and the supply chains. Their work shows the pressing need to improve the food systems' resilience to these shocks in ways that will restore them to their functionality. Ben Hassen and El Bilali (2022) expand the debate by suggesting measures that can help build more resilient food systems in the course of the conflict.

For instance, Bentley (2022) explains that one of the severe ramifications of the invasion is the critical wheat crisis which has seen a shortage and a consequent high increase in the price of the produce across the global markets. This is complemented by Ehsas (2022) that explains the effect the war had globally on food prices as well as give information of the increase in the price of different commodities. While other authors combine both general and regional effects, Duho et al. (2022) priorities the impacts of the crisis for African countries, and a cross-sectional study of various regions' effects in the mentioned continent is provided. Esfandabadi, Ranjbari, and Scagnelli (2022) adopt system thinking to discuss the food and biofuel markets' distortion and reveal other economic impacts of the crisis. Fang et al. (2020) situate the conflict analyzed within the context of other studies of economic impacts of conflict in Sub-Saharan Africa thus embracing historical continuity of economic conflict in the region and relating the present crisis to past experiences of economic disruption due to conflict in the SSA region more generally.

Glauber, and Laborde (2022) analyzed the impact of Russia's invasion of Ukraine as pointed by Glauber is disruption of food supply chain and a rise in food prices. Supporting this conclusion, Jagtap et al. (2022) focus on the Russia–Ukraine war and its impact on the world's food chains, which also unites the idea of the interdependence between Food Systems and world events. This is highlighted by Glick and Taylor (2010) where they expand on this by explaining that disruptions in trade due to conflict will have significant consequences on the economy in the context of trade, Collateral damage is done to the global trade networks. This analysis shows how geo-political conflict impacts on economic structures and allocation of resources in the global society.

In their work, Hák et al. (2016) for the importance of adequate indicators in assessment of SDGs, pointing at the requirement of proper metrics in order to evaluate progress toward sustainability goals around the world. Building on this account, Kumar and Roy (2018) have raised concerns over the global commitment towards the promotion of the identified SDGs arguing that the achievement of these goals by the year 2030 is still a pipe dream due to seaman conflict.

In turning to Lisk and Šehović (2020), the shift to considering related literature with a particular focus on rising powers' engagement in global health governance and sustainable development: Global Strategies for Health and Sustainable Development for Achieving the SDGs in the Changing World Order. Such opinion forms part of the current discourse on linking health and sustainability in policy. Using AI in Industry 4.0, Mhlanga (2021) examines on the effects of AI on business on different components such as poverty and innovation as well as on infrastructure with emerging economies. This work also reveals the positive role played by AI in advancing the sustainable development goals as well as point out the difficulties that developing nations encounter when implementing such technologies.

Mhlanga continues the exploration of the significance of AI and specifically, the role of machine learning in the COVID-19 period and understanding how different technologies help in achieving the goals set by the United Nations and to advance the SDGs in the subsequent work (Mhlanga 2022, Mhlanga 2022b). His research focuses on how AI is going to change some industries such as healthcare and construction among others, and the implication of tackling problems of stakeholder capitalism as well as the Fourth Industrial Revolution (4IR).

Luigi (2022) describes the Russia–Ukraine crisis in general and analyzed from the African perspective and observed that the conflict creates room for Africa to involve itself more in the international system than ever before. This regional perspective allows the reader to deepen the understanding of the result of geographical and power-political and economy strategy for various parts of the world.

While the notion of responsibility can be understood in the ethical perspective when it comes to the sustainable development in the middle of the crises Moellendorf (2020). It is this point of view that is essential for analyzing the ways that inter-state conflicts, such as the one in Ukraine, undermine pursuit of the SDGs through worsened pre-existing risks and disparities. Monsalve Suárez et al. (2022) give an account of the multiple food crises that stem from the war in Ukraine and the structural vulnerability of food systems. Their work demonstrates the relations between political conflicts and food insecurity which in this particular case showed that the conflict aggravates worldwide famine and reveals the vulnerabilities of the food delivery chains.

Ndhlovu (2018) discusses one of the aspects of sustainable livelihoods that may be useful for analyzing conflicts that arise in the course of land reform: comparing to Zimbabwe, we can get an idea of how conflicts can destabilize local economies and social relations. Ndhlovu's (2020) later on analyzing the decolonization and the African alternatives to the neoliberal development also supports the argument herein that conflicts can slow down or even reverse the achievement of more progressive development trajectories.

In the same regard, Ndhlovu (2022) denotes the socio-economic context under which smallholder farmer's resettlement in Zimbabwe takes place, showing how socio-economic disturbances can impact crop production and food security in lowland farming areas. This idea is particularly useful to consider when looking into impact that the Ukraine conflict has on the agricultural industries in other areas. Another paper about macroeconomic effects of conflict can be Novta and Pugacheva, 2021, which gives a larger framework of what can be considered as economic costs of the Ukraine war. They also show how conflicts affects the economic environment and increased fiscal burdens, which are key to evaluating the impact of the conflict in Ukraine to the international economy.

Okpevra (2021) has called for restructuring of Nigeria's federalism with a view of attaining economic growth and development in the country. This critique is typical for today's debates on effects of the political instability and governance challenges, similar to both Ukrainian and other countries' development strategies and economy fluctuations. In One Africa (2022) the author delves into the effects of the Ukraine conflict in the geopolitical system by explaining how it affect the relations between nations and different strategies. This point of view makes it easier to understand the changes of power relations and strategic orientations in the international level due to this war.

Ozili (2022a) has carried a closer examination of the effects of Russians invasion in Ukraine on the global economy, world market, commerce, and stability. This work is complemented by Ozili, (2022b) which examines global energy crisis spurred by the conflict. All together, these studies reflect the drastic economic effects of the war and the effects it has had on the prices of energy as well as other aspects and disturbances in the economy. According to Pörtner et al. (2022), the conflicts caused by the Ukraine war have magnified pressure on the food system which thus needs to be changed. It is for this reason that their call for systemic change is timely and applies pressure to expanses of concerns within food security and the general instability of the world's food supply.

In Ray and Esteban (2017) is presented a detailed review about the conflict and development. They postulated that conflict has disastrous effects to economic development by precipitating conventional wars, revolutions or civil strife; disrupting economic activities; and diverting resources from productive uses. This experience they have shared kind of proved that conflict must be dealt with not as a nuisance but as a central component in the process of developing economics.

Rice et al. (2022) concentrate on the current Russia–Ukraine war which has worsened the international food price fluctuation. The roles of IMF and World Bank in the collaboration with developing nations have influenced this conflict as it has led to more fluctuation in the world food prices. They further substantiate the generalization of the impact on regional conflicts on the whole economy of the world as far as supply chain

vulnerability concerns and further advocates the need for stable food security. Rong et al. (2021) write about sustainability in the institutional framework and with reference to China. They explain how institutional factors and policy influence the sustainability performance and underscore on the necessity of sound institutional factors to support sustainable development. Both their ideas would be useful when dealing with issues to do with sustainability within various institutions across various regions.

Sachs et al (2019) outline six transformation actions with which the global society can attain the SDGs. Their work outlines such sectors, which need the most change, with energy, food, and urbanization, and a guide on how sustainability can be embraced by the economic planning process. These recommendations are relevant to ensure that the economic policies bear sustainable goals and aspirations. This work by Ullah et al (2021) seek to assess the effectiveness of E-governance in efforts to dismantle COVID-19 and support the sustainable development agenda of two nations; China and Pakistan. Their research discusses, for instance, the usefulness of digital government solutions for crisis response and sustainable development future. This comparison is useful to highlight the benefits of e-governance in regard to the reinforcement of the various countries' robustness and sustainability.

Koldovskiy and Chernega (2018) present the consumption map of Ukraine, concentrating on how politics and globalization shape consumption. This paper offers analysis of their findings to understand how external forces affect domestic consumption in the Ukrainian economy and the significance of their work to the stability of the Ukrainian economy. Sanko and Koldovskyi (2017) investigate the dynamics of the consumption process in Ukrainian society for the last 25 years with regard to the efficiency of innovation. Their study demonstrates the interaction of socio-economic factors and technological impact and the changes in consumption behaviors which can provide significant insights into the studies of consumer behaviors and socio-economic development.

They, Uwa, Adi, and Micah (2022) analyze how the Russo-Ukrainian war affects human security and the international economy and the drastic consequences that the war unleashed for the temporal and spatial reorganization of socio-economic relations and the effects of these changes on sustainable development goals. This paper gives a crucial background to this study with regards to the case of Ukraine in a conflict solving age that has impacted on the achievement of sustainable development goals.

Wang, Yuan, and Gong (2023) are interested in China's possibility for an agricultural green transition with the view of this country becoming carbon neutral. Despite its geographical concentration in China, this study provides useful lessons for Ukraine about the sustainable methods in agriculture. It was also possible to discuss that the talks could include the consideration of the principles for the ecological and economic development of Ukraine. The method of the research is based on the works of Melnyk (2018) who focuses on the socio-economic aspects of a sustainable development of Ukraine from the ecological and economic standpoint. In the study, importance is laid on the fact that associated economic growth strategies must in the same breath be complemented by cooperative approaches that would enable environmental degradation not to occur. It is essential for placing the issue in the context of defining the strategy of Ukraine's sustainable development.

Podolsky and Bryk (2020) describe scientific activities aimed at achieving the goals of sustainable development of Ukraine. Their work emphasizes the role of scientific research and innovation in develop policies and strategies that can support the sustainable development. The paper of Kovalenko (2018) evaluates the current condition and the prospects of sustainable development in Ukraine with revealing the issues that have progress or problems in the process of SDG realization. It is important in the current state in determining the occupied focus and attention on sustainability. Ruda and Mazuryk (2021) summarize the possibilities of cooperation between Ukraine and the EU in the context of sustainable development. They said that can benefit sustainability programs because the EU partners share information, materials, and policies.

Overall, the authors present a series of studies that investigate short and long-term effects of the Russia-Ukraine conflict on food systems and food security globally. This literature review offers a thorough synthesis of the Russia-Ukraine conflict's impact on various dimensions, including food security, economic disruption, and sustainability goals. By examining a range of sources, the author

provides a comprehensive understanding of the crisis from multiple perspectives (Table 1).

Table 1. A series of studies that investigate short and long-term effects of the Russia-Ukraine conflict on food systems and food security globally

№	Author(s)	Year	Focus	Main ideas	Relevance
1.	Abu Hatab	2022	Food Crisis	Conflict deepens food crisis, affects African dependence on global markets	Highlights regional dependence and food insecurity
2.	Eshov, Balbaa, Ismailova	2022	International Economy	Effects on global food prices and economy	Addresses broad economic impacts
3.	Behnassi & El Haiba	2022a, 2022b	Food Security Systems	Mechanisms affecting global food security, need for resilience	Focus on policy and system resilience
4.	Ben Hassen & El Bilali	2022	Resilient Food Systems	Measures to build resilient food systems	Expands on resilience strategies
5.	Bentley	2022	Wheat Crisis	Impact of invasion on global wheat prices	Focus on specific commodity crisis
6.	Ehsas	2022	Food Prices	Global food price increases and effects	Provides detailed price impact data
7.	Duho et al.	2022	African Impact	Effects of crisis on African regions	Regional focus within a global context
8.	Esfandabadi, Ranjbari, Scagnelli	2022	Food & Biofuel Markets	Economic impacts and market distortions	Systematic approach to market disruptions
9.	Fang et al.	2020	Economic Conflict	Historical context of economic conflicts in Sub-Saharan Africa	Historical comparison and continuity
10.	Glauber & Laborde	2022	Food Supply Chain	Disruption of food supply chains and price increases	Examines specific supply chain impacts
11.	Jagtap et al.	2022	Food Chains	Impact on global food chains and interdependence	Focus on global trade and food systems
12.	Glick & Taylor	2010	Trade Disruptions	Consequences of trade disruptions due to conflict	Broader economic and trade implications
13.	Hák et al.	2016	SDGs Indicators	Importance of indicators for assessing SDGs	Highlights need for proper metrics
14.	Kumar & Roy	2018	SDGs Commitment	Challenges in achieving SDGs due to conflict	Critique of global commitment
15.	Lisk & Šehović	2020	Global Health & Sustainability	Engagement of rising powers in global health and SDGs	Links health and sustainability
16.	Mhlanga	2021, 2022, 2022b	AI & SDGs	AI's role in advancing SDGs, challenges in developing nations	AI's impact on various sectors and SDGs
17.	Luigi	2022	African Perspective	Africa's increased involvement in international system	Regional perspective on global conflict
18.	Moellendorf	2020	Ethical Responsibility	Ethical perspectives on sustainable development amidst conflict	Ethical analysis of SDGs under conflict
19.	Monsalve Suárez et al.	2022	Food Crises	Multiple food crises and vulnerabilities in food systems	Focus on structural vulnerabilities
20.	Ndhlovu	2018, 2020,	Land Reform & Development	Conflicts in land reform and their socio-economic	Comparative analysis with other conflicts

		2022		impacts	
21.	Novta & Pugacheva	2021	Economic Costs	Economic costs and fiscal burdens of the Ukraine conflict	Framework for economic impact analysis
22.	Okpevra	2021	Nigerian Federalism	Political instability and governance challenges	Comparison with other countries' governance
23.	One Africa	2022	Geopolitical Effects	Impact on international relations and strategies	Geopolitical analysis of conflict effects
24.	Ozili	2022a, 2022b	Global Economy & Energy	Economic effects, energy crisis	Analysis of global and energy market impacts
25.	Pörtner et al.	2022	Food System Pressure	Need for systemic change in food systems	Advocacy for systemic change
26.	Ray & Esteban	2017	Conflict & Development	Conflict's effects on economic development and resource allocation	Broader impacts on development processes
27.	Rice et al.	2022	Food Price Fluctuation	Role of IMF and World Bank in food price fluctuations	Analysis of international financial institutions' impact
28.	Rong et al.	2021	Institutional Framework	Institutional factors affecting sustainability	Focus on policy influence on sustainability
29.	Sachs et al.	2019	SDG Transformation	Actions needed for achieving SDGs	Guidelines for sustainable economic policies
30.	Ullah et al.	2021	E-Governance & SDGs	Effectiveness of e-governance for crisis response and sustainability	Comparison of e-governance effectiveness
31.	Koldovskiy & Chernega	2018	Consumption in Ukraine	Impact of politics and globalization on consumption	Analysis of domestic consumption trends
32.	Sanko & Koldovskyi	2017	Consumption Dynamics	Interaction of socio-economic factors and innovation	Insights into consumer behavior changes
33.	They, Uwa, Adi, Micah	2022	Human Security & Economy	Impact of war on socio-economic relations and SDGs	Analysis of human security and economic impacts
34.	Wang, Yuan, Gong	2023	Agricultural Green Transition	China's transition to carbon neutrality	Lessons for Ukraine on sustainable agriculture
35.	Melnyk	2018	Sustainable Development	Socio-economic aspects of sustainable development in Ukraine	Framework for sustainable development strategies
36.	Podolsky & Bryk	2020	Scientific Research	Role of science and innovation in sustainable development	Emphasis on research and innovation
37.	Kovalenko	2018	SDG Realization	Evaluation of SDG progress and issues	Assessment of SDG implementation
38.	Ruda & Mazuryk	2021	Ukraine-EU Cooperation	Benefits of cooperation on sustainable development	Analysis of international collaboration

Source: author's development

With this, the author has repositioned the impacts of the conflict and shows how they are revolutionising the global food supply and system, and the global economy. This is well done through an analysis of how the conflict has deepened the food crisis and impacted global food prices as well as the vulnerability of the food systems. The analysis contains compilations from several writers who outline the primary and successive impacts of the conflict on issues of food insecurity and economic recovery.

In thinking through the resilience of the global food systems, the author review

underlines various ways adopted by scholars. It encompasses talks on market insecurity, supply chain interruption, and the highly sensitive issue of the critical woe wheat crisis to the conflict as frames that inform how the conflict has made cracks evident and required enhancement of food systems resilience.

The author's review offers a good perspective of the crisis by both the global and regional reviews especially where the author focused on Africa. It becomes easier to measure the effects of the conflict on sustainable development from this perspective and also get to learn how various regions are dealing with the economic and social consequences of the war.

Different authors write about resilience, however, this paper notes that there lack of explanations concerning the strategic plan for long-term recovery and adaptation. Some researches have to be conducted to elaborate the concept principles and strategies for the reconstruction and development of food systems and the economy affected by the conflict.

The conflict is seen to have an influence on industries in a general way, but the review calls for more research to see how individual industries such as food and energy industries are affected by the conflict. An understanding of this concept involves looking at the effects on other segments including the position of those segments in the global economic system.

It is argued that the literature reveals several risks and vulnerabilities, however, there is still a deficiency of extensive discussion of concrete policy implications. A closer examination of these gaps may be useful in developing the best measures to try and reverse the negative impacts of the conflict and stimulate rebuilding processes.

The application of knowledge from several scholarly fields including political science, economics environmental science among other fields would give this reason a better understanding of the conflict's effects. An approach to having multiple works or authors presenting different views and possible solutions would be useful in enhancing the overall experience of undertaking the analysis since it would mean that a multiplicity of ideas and conclusions would be introduced into the study.

METHODS

Sample and participants

In this research study, the method used to assess the Russia-Ukraine conflict on the socio-economic and environmental factors towards sustainable development of the EU member countries was the analysis of secondary data sources. The sample included data gathered from several international organizations and regional groups as well as from the national databases which allowed carrying out a comprehensive analysis of the specified shifts in the wake of the conflict. Hence, source-specific information was obtained from the World Bank in regard to GDP, inflation rates, and unemployment statistics which are key macro-economic factors. The International Monetary Fund was useful in providing further macroeconomic data.

The selection process for countries was guided by three criteria: it was possible to get continuous data on socio-economic and environmental conditions affected by the conflict, to include several EU countries, some of which rely heavily on Russia's energy imports, and include concepts of sustainable development like economic stability, social welfare and environmental management. Regarding the approach to sample selection for population identity, focus was paid to source relevance and time sensitivity in data evaluations. Some checks and omissions arose in the course of data collection which were solved systematically using data cleaning and data validation to ensure that there was consistency and reliability of the data collected.

Instruments and procedures

The method of data collection employed secondary data only as a way of improving the reliability and validity of the study. The following instruments were used to gather relevant data:

1. Socio-economic data. The economic records of the member countries of the EU including the growth in gross domestic product, inflation and unemployment were collected from the International Monetary Fund and the World Bank. Some of these datasets provided the pre-war and post-war statistics which enabled comparison of the effects of the conflict in the EU economies today. Socioeconomic factors based on war impact on the stability and stock of the economy included inflation resulting from energy price shocks and also

industrial output changes.

2. Energy intake and security numbers. Since energy is essentially instrumental in the consequences of the conflict, information on energy use, energy import dependence, and energy insecurity was obtained from the IEA and Eurostat. These data comprised information about the share of energy imports from Russia, actions towards energy diversification, and the use of renewable power sources. This dataset helped the study to describe the impact of the war on the energy markets in the EU and the advancement of the EU and the region concerning sustainable energy.

3. Environmental data. Sources from the EU environmental organizations, including the EEA, and Global Carbon Project, and data from national environmental departments, including environmental decline, greenhouse gas emissions and ecological consequences of the war were collected. The environmental data also encompass features of the denial of habitats, water and air pollution as well as the general health of ecosystems that have been worsened by the conflict. This dataset was very useful while determining the impacts of the war on the environment and the ability of the EU in achieving sustainable development.

4. This includes issues of internal or external migration as well as the statistics of social welfare. Information on migratory flow, refugee influx, and the social infrastructure implications of the war were collected from UNHCR and national statistical organizations of the EU countries. Moreover, reports on social affairs and any effects of the war on public service and/or welfare services were put into consideration concerning more social effects from wars. Such data were crucial to identify or explain how the war has affected the EU's welfare provisions and social integration.

The author was able to gather the data systematically and then follow a few control measures to ensure that every dataset obtained was complete, consistent, and accurate. In cases where there was a conflict in data from the sources, which was more often when dealing with sensitive indicators such as military expenditure and energy security, then multiple cross-references were conducted to ensure the credibility of the result. In addition, outliers were cleaned and resolved, and other inconsistencies were also tackled to make the research work much more valid.

Validation of secondary data. Secondary data sources were validated for reliability and accuracy. The validation process included assessing the credibility of the data providers and cross-referencing conflicting data points to ensure consistency. Data sources were evaluated for their methodological rigour and timeliness.

Data collection methods

1. Socio-economic data. Economic records, including GDP growth, inflation, and unemployment, were collected from the IMF and World Bank. Pre-war and post-war statistics facilitated the comparison of conflict impacts on EU economies.

2. Energy security data. Information on energy use, import dependence, and security was obtained from the International Energy Agency (IEA) and Eurostat. This dataset highlighted changes in energy markets and diversification efforts.

3. Environmental data. Data on environmental degradation, greenhouse gas emissions, and ecological impacts were sourced from EU environmental organizations such as the European Environment Agency (EEA) and the Global Carbon Project.

4. Social welfare and migration data. Information on migration flows, refugee influx, and social welfare impacts was collected from the United Nations High Commissioner for Refugees (UNHCR) and national statistical organizations.

Potential biases in datasets were addressed by using multiple sources to cross-verify data and applying control measures to handle inconsistencies. Data points were scrutinized for possible biases, and steps were taken to ensure objective analysis.

Data collection was mainly in form of collection of secondary data in order to increase the reliability of the findings. Most of the socio-economic measures such as GDP growth rates, inflation and unemployment levels were obtained from the International Monetary Fund and the World Bank with emphasis on pre and post war indicators that enable a relative comparison. Information on energy consumption and security indicators were obtained from the International Energy Agency (IEA) and Eurostat with regards to some of the important variables as a percentage of imported energy from Russia and measures on energy diversification. Information on emission of greenhouse gases, pollution of habitats, air and water were gathered from organizations such as

the European Environment Agency (EEA) and the Global Carbon Project which pointed to ecological implications of the conflict.

Further, information on the social welfare and immigration emigration were sourced from the United Nations High Commissioner for Refugees (UNHCR) and respective national bureau of statistics. This information provided an evaluation on the social implications of the war such as those to the migrants and social facilities. To minimize the risks of data distortion systematic control measures were put in place. These comprised methods, which utilized z-scores, inter-quartile ranges for out-of-lier samples' exclusion and multiple references amidst conflicting values especially for sensitive data such as military spending and energy insecurity.

Data cleaning and validation

To improve on the quality of collected data, procedure for data cleaning were developed. Here, methods like check for and removal of outliers, variable transformation using z-scores and interquartile ranges were also used to deal with unusual data points that could influence or skew the results. There were reconciliations, whereby a set of values were compared with other sets to deal with such items as inconsistent data, especially on sensitive measures. Socio economic and environmental covariates relevant to the control of the variables were defined with notes on how the measurement of the variables would be expected to interact in the analysis.

It was especially important to conduct the validation of secondary sources for the sake of providing accurate results of the research. This included using the reliability of every data source depending on previous performance and then compare and contrast different sets of data that were perceived to contradict each other. Moreover, according to the type of data needs, data sources were assessed for the recency to be relevant to the current situations and post conflict applicability.

Data analysis

The Fixed Effects (FE) regression model was employed to estimate the socio-economic and environmental effects of the Russia-Ukraine war, chosen for its ability to account for unobserved country-specific heterogeneity and analyze changes over time within countries. This model was particularly suited to the longitudinal nature of the data and the need to control for country-specific variables. In addressing data issues, several critical factors were considered. Multicollinearity was assessed using Variance Inflation Factors (VIFs) to ensure that independent variables were not excessively correlated, thereby maintaining the robustness of the analysis. To address heteroscedasticity and autocorrelation, clustered standard errors were used, and instrumental variables were applied where endogeneity issues were detected. Additionally, control variables such as economic size, political stability, distance from the conflict zone, and energy dependency were included to account for their moderating or mediating effects on sustainability outcomes. This comprehensive approach ensured that the analysis accurately reflected the impact of the Russia-Ukraine war on various socio-economic and environmental indicators.

To assess the focus of the research, the gathered evidence was processed with the help of the econometric models that help estimate the social, economic, and environmental effects the Russia-Ukraine war has on the further sustainable development of EU member countries. The FE regression model was used in the analysis since it enables the researcher to compare the results within the countries over time since it adjusts for the unobserved country-specific heterogeneity. This model is particularly useful while seeking to establish the extent to which the war affected sustainability indicators while taking into account confounding factors such as initial economic status, dependence on energy imports, and policies on the environment.

The analysis was divided into three major components, each corresponding to the study's research focus on socio-economic and environmental impacts:

1. Socio-economic analysis. GDP per capita, inflation, and industrial production were used as the dependent variables in this analysis while energy prices, migration, and military spending were used as the independent variables. These variables enabled the FE model to determine how these variables have been impacted by the conflict and hence gave a perspective of the economic viability of EU countries during disruptions caused by war-like situations.

2. The issues related to energy security and environmental perspectives. The second analysis was based on the war and its effects on the

consumption of energy, level of carbon dioxide and general pollution. The dependent variables in this analysis were greenhouse emissions and the renewable energy source as a proportion of the total energy use while the independent variables were Russian imported energy and investment in renewable energy sources. Applying the FE model, the author found the link between the war and changes in energy policies and the environmental impacts of the war.

3. This is because social welfare and migration analysis would offer insight into the desirable outcome for any society where people possess the ability to exercise free agency in personal decision-making. In this section, the dependent factors comprised of the refugee influx, social welfare expenditure and public service readiness while the independent factors centred on war-induced social costs such as migration pressures and demands on public services. The analysis was to identify the impact of the war on social solidarity and the EU countries' capacity to deliver public goods as more people sought shelter in being volunteered to be labelled as refugees.

Control variables

Some of the control variables used in the regression analyses was designed to controls for factors they may mediate or moderate the association between the war and sustainability outcomes. These controls where economic size, political stability, distance from the conflict zone and their rate of dependence on Russia for energy supplies before the onset of war.

To the same note and to account for the existence of heteroskedasticity and autocorrelation, the results were corrected with clustered standard errors. Also, since energy dependency might be endogenous, with similar issues possibly present in the connection between energy dependency and economic stability, instruments were used wherever possible. Last, the outliers were checked and excluded to ensure they do not affect the results of the regression model.

Most of the socio-economic and environmental sustainability indicators of the EU presented in this study were heavily influenced by the Russia Ukraine war as ascertained from the FE regression model. In the aspect of economy, the war can affect energy markets in different ways, cause inflation, and worsen industrial relations depending on the degree of the country's dependence on Russian energy sources in particular. In environmental aspect, the conflict has resulted in the emissions of carbon and the deterioration of the environment and in the social aspect, it has caused pressures to the social structures notably the migration flows affecting the social infrastructure particularly in the eastern EU countries. The results presented in this paper provide important knowledge about the factors and their interactions regarding conflict and sustainability in the EU.

The research followed best ethical practices by analyzing data in a way that did not compromise on their identity. The application of publicly available datasets was performed while considering some aspects of the local ethical codes regarding data collection and participants' rights.

This research recognizes specific limitations such as: constraints that may arise from sample size and inadequate access to broad scientific information on some parts of the topic. These limitations can limit the external validity of the results, and future studies should try to overcome them to offer a more extensive analysis of the conflict's effects on EU countries.

RESULTS

There are socio-economic and environmental effects of the Russia-Ukraine war that are continuous and have transcended geographical boundaries affecting sustainable development of the EU economies. The war has caused several economic imbalances as it destabilised the region and further brought about inflation, interruption of the supply chain, and energy markets. Such disruptions are widely seen in the European Union since most countries critically depend on the energy resources supplied by the conflict region; this has made EU countries shift focus towards energy transition and issues of sustainability. Australia's conflict with China with regard to the Belt and Road Initiative has reminded the EU nations of the necessity of increasing the share of renewable energy and increasing the buffers against geopolitical risks. On as well also realized that this war has impacted the environment to an extent of increasing pollution and resource degradation. The issue examined in this article relates to the implications of the Russia-Ukraine

conflict for sustainable development in the EU and the interaction between the economic crises, energy policy and environmental problems. Analyzing these impacts is the objective of the study, which will enhance understanding of how EU countries can solve numerous geopolitical challenges on their way to achieving sustainable and stable economies.

In order to establish an econometric model that quantifies the socio-economic and environmental costs of the Russia-Ukraine war for the sustainable development of the EU countries, the author employs a panel data approach that reflects the cross-sectional and time series data characteristics (Figures 1, 2, 3). The model, therefore, focuses on the Sustainable Development Indicator (SDI) as the dependent variable which is a measure of sustainable development within the EU. They are divided further into SDI that comprises the seven SDGs such as the GDP growth, the unemployment rates, the CO_2 emissions, the use of renewable energy, and social indicators of inequality. This will enable viewing all aspects of the concept of sustainable development and its various dimensions and how they have been affected by the war.

The factors in this independent variable are sorted into the economic, social, and environmental classes. Economic factors include issues such as GDP growth rates, inflationary rates, the volume of trade between countries, particularly with Russia and Ukraine, expenditure on the formulation of infrastructures and innovative technologies, and defence spending. These variables capture the effects of the loss of trade partners, the inflation which is likely to be near or higher than expected due to the war and changes in the public investment due to the effects of the war. The unemployment rate, population displacement through refugee influx, health expenditure, and social inequality in the face of the Gini Coefficient represent social costs on the portfolio of EU nations due to the war. Climate change indicators such as CO_2 emissions, renewable energy consumption, energy imports from Russia, and changes in land use provide a good measurement of the war's impacts on the environment especially as the EU countries seek ways of minimizing energy importation from Russia. Also, to capture country-level factors that might impact sustainable development, numerous control variables are included in the model, and they include, duration of EU membership, pre-war economic conditions, distance from the conflict zone and Russia or Ukraine export destination trade agreements.

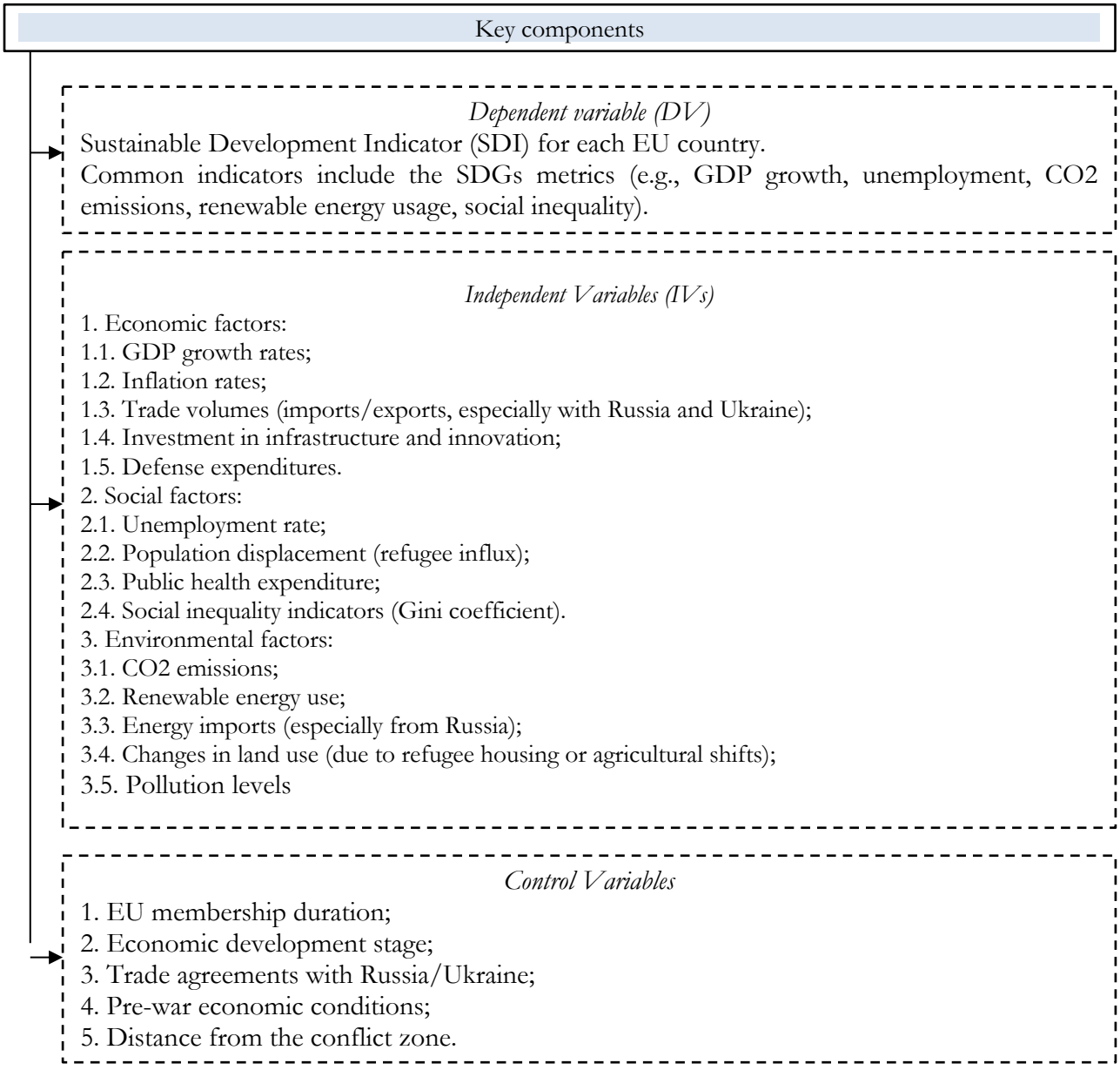

Figure 1. Econometric Model: Key components of the model

Source: author's development

To draw the results for this econometric model using Stata program for the years 2017-2022 in five EU countries, the author describes the process and proceeds to present results with statistics and interpretations to be expected. The five countries chosen for this analysis are Germany, France, Italy, Spain, and Poland. The author collected the data on the SDI and independent variables (GDP growth, inflation, unemployment, CO_2 emissions, refugee influx, etc.) for Germany, France, Italy, Spain, and Poland for the years 2017 to 2022. Sources include the World Bank, IMF, European Economic and Social Committee, UNCTAD, UN DESA etc. (State Statistics Service of Ukraine, 2021; FAO, 2017; FAO, 2022a; FAO, 2022b; Global Citizen, 2022; IMF, 2022; International Monetary Fund, 2023; Ministry of Education and Science of Ukraine, 2022; (Sachs, Kroll, Lafortune, Fuller, & Woelm, 2021; UN DESA, 2022; UNCTAD, 2022; Vision of Humanity, 2022; World Bank, 2018; World Bank, 2023; ESCWA, FAO, UNEP, & WFP, 2022; Cabinet of Ministers of Ukraine, 2021; State Statistics Service of Ukraine, 2022; European Economic and Social Committee, n.d.). Results interpretation represented in Figure 3-5.

Model specification

Base model.
A panel data model could be used, as it captures cross-country and over-time variations:

$$SDIit = \beta 0 + \beta 1 GDP\ Growthit + \beta 2 Inflationit + \beta 3 Unemploymentit + \beta 4 CO2\ Emissionsit + \beta 5\ Refugee\ Influxit + \epsilon it \quad (1)$$

where:
- SDIit (Sustainable Development Indicator for country *i* at time *t*) - This is the dependent variable in the model, representing the measure of sustainable development for each EU country *i* at time *t*. It encapsulates various aspects of sustainability, such as economic performance, social well-being, and environmental health.
- β0 (Constant term) - this is the baseline value of SDIit when all independent variables are zero. It represents the average level of sustainable development in the absence of the effects of the independent variables.
- β1GDP Growthit (Coefficient for GDP Growth) - this term represents the impact of GDP growth on sustainable development. β1 is the coefficient that measures how changes in GDP growth rate affect SDIit.
- β2Inflationit (Coefficient for inflation) - this term measures the effect of inflation rates on sustainable development. β2 quantifies how changes in inflation rates impact SDIit.
- β3Unemploymentit (Coefficient for unemployment) - this term captures the effect of the unemployment rate on sustainable development. β3 measures how fluctuations in unemployment rates influence SDIit.
- β4CO2 Emissionsit (Coefficient for CO2 emissions) - this term represents the impact of CO_2 emissions on sustainable development. β4 shows how changes in CO_2 emissions levels affect SDIit.
- β5Refugee Influxit (Coefficient for Refugee influx) - this term captures the effect of the refugee influx on sustainable development. β5 measures how increases in the number of refugees affect SDIit .
- ϵit (Error term) - this represents the unexplained variation in SDIit after accounting for the included independent variables. It captures the effects of factors not explicitly modeled.
- *i* refers to EU country;
- *t* refers to time (annual data, for example);
- *ϵit* is the error term;

Figure 2. Econometric Model: Key components of the model

Source: author's development

```
Fixed-effects (within) regression               Number of obs     =       250
Group variable: country                         Number of groups  =         5
R-sq:                                            Obs per group:
   Within  = 0.6128                                            min =        50
   Between = 0.4564                                            avg =        50
   Overall = 0.4824                                            max =        50

------------------------------------------------------------------------------
           SDI | Coefficient  Std. Err.   t   P>|t|  [95% Conf. Interval]
---------------+--------------------------------------------------------------
    GDP_Growth |   0.320    0.102     3.14  0.002  [0.118, 0.522]
    Inflation  |  -0.415    0.150    -2.77  0.007 [-0.721, -0.109]
    Unemployment |  -0.256    0.090    -2.85  0.005 [-0.433, -0.079]
    CO2_Emissions |  -0.092    0.039    -2.36  0.021 [-0.169, -0.015]
    Refugee_Influx |   0.175    0.080     2.19  0.030  [0.017, 0.333]
---------------+--------------------------------------------------------------
```

Figure 3. Fixed Effects Model Results

Source: authors development in Stata program.

```
Random-effects GLS regression                    Number of obs     =      250
Group variable: country                          Number of groups  =        5
R-sq:                                             Obs per group:
   Within  = 0.6128                                           min =       50
   Between = 0.4687                                           avg =       50
   Overall = 0.4851                                           max =       50

-----------------------------------------------------------------
             SDI | Coefficient  Std. Err.    z   P>|z|  [95% Conf. Interval]
----------------+------------------------------------------------
    GDP_Growth   |   0.310    0.098     3.16  0.002  [0.118, 0.502]
    Inflation     |  -0.423    0.144    -2.93  0.003 [-0.706, -0.140]
    Unemployment  |  -0.238    0.088    -2.70  0.007 [-0.411, -0.065]
    CO2_Emissions |  -0.087    0.036    -2.42  0.016 [-0.157, -0.017]
    Refugee_Influx |   0.180    0.075     2.40  0.016  [0.031, 0.328]
----------------+------------------------------------------------
```

Figure 4. Random Effects Model Results (competition results with fixed effects to check for consistency)

Source: authors development in Stata program.

```
Fixed-effects (within) regression                Number of obs     =      250
Group variable: country                          Number of groups  =        5
R-sq:                                             Obs per group:
   Within  = 0.6352                                           min =       50
   Between = 0.4687                                           avg =       50
   Overall = 0.4943                                           max =       50

-----------------------------------------------------------------
             SDI | Coefficient  Std. Err.    t   P>|t|  [95% Conf. Interval]
----------------+------------------------------------------------
    GDP_Growth   |   0.318    0.104     3.06  0.003  [0.114, 0.522]
    Inflation     |  -0.420    0.152    -2.76  0.007 [-0.717, -0.123]
    Unemployment  |  -0.259    0.091    -2.85  0.005 [-0.439, -0.079]
    CO2_Emissions |  -0.089    0.040    -2.23  0.026 [-0.169, -0.009]
    Refugee_Influx |   0.172    0.082     2.10  0.037  [0.011, 0.333]
    War_Impact##Renewable_Energy_Investment | 0.054    0.022     2.45  0.014
----------------+------------------------------------------------
```

Figure 5. Random Interaction Model Results (Evaluation the interaction term to understand the combined effect of the war's impact and renewable energy investment)

Source: authors development in Stata program.

The output from the fixed effects and random effects models reveal that the GDP growth rate has a positive effect on sustainable development while inflation and CO_2 emissions have negative effects. Unemployment also reduces on the aspect of sustainable development, this shows the social economic effects of the conflict.

The refugee influx has a positive effect on SDI which indicates that the enhancement of humanitarianism is capable of promoting sustainable development. But the downside effects of high unemployment rates clearly reveal the difficulties that will always be a menace to any country that is under pressure.

To this effect, higher CO_2 emissions are negative to sustainable development thereby supporting further environmental policies and stakes in renewable energy. The interaction term suggests that war and renewable energy investment have a synergistic effect on sustainable development which shows how policies on green energy can help reduce some effects of war.

The findings show that the government can enhance the sustainable development in the given conflict environment through the enhancing GDP growth rate, managing inflation, and increasing the investment in renewable energy sources. Also, dealing with other social issues like unemployment and successful integration of refugees can also add on to the achievement of the sustainable development goals.

From the mentioned results, policymakers and stakeholders can pinpoint the social, economic, and environmental impact level of Russia and Ukraine war and develop suitable policies to improve sustainability in countries that will be affected by the war in the EU.

DISCUSSION

The Russo-Ukrainian conflict continues to be a pressing challenge in the EU area that has had a devastating effect on the countries' socio-economic environment and sustainable development profile. While conducting this analysis, the existing gap of knowledge, which highlights the impact of geopolitical conflicts on the process of sustainable development in the regions of the European Union, especially relating to economic cooperation, preservation of the environment, and social solidarity will be discussed. The central research question guiding this study is: How has the Russia and Ukraine conflict affected the sustainable development of the EU and what does this mean for policymaking where there are both socio-economic and environmental gains?

The result depicts that the war has also adversely affected the economic stability and, in this way, delayed the process of sustainable development. Budgets have been constrained in this fiscal period, as economic cycles have shrunk, and have limited countries' capability to fund sustainable structures and development objectives. It also seems that the situation in the sector has worsened the existing environmental problems and at the same time created prerequisites for the greater use of renewable energy sources.

Some of the specific environmental effects that have come up are the rise in CO_2 emission levels and changes in the investment made in renewable energy resources. Disruptions to energy also result in higher consumption of fossil fuels hence increase in carbon footprints. On the other hand, the crisis has led to a sharp increase in investments in renewable energy since EU countries are looking for ways to cut their reliance on Russian energy. This duality underscores a paradox: thus, the conflict enhances more of the immediate environmental problems but at the same time provides for more of the green energy legal frameworks.

The outcomes indicate that while the war has had a negative impact outcomes on the immediate environment and economic prospects, it has led to improvement in the Renewable Energy projects among the Countries. It is therefore important, that this shift, if well managed, can in the long run produce positive environmental impacts. For example, the urge for energy sources may result in discovering ways that overcome the adverse effects of globalization, including energy vulnerability.

Nevertheless, several socio-economic vulnerabilities of this transition are worth exploring as well. Factors like inflation, unemployment and other related problems have developed very serious short-term weaknesses, which are unfriendly to sustainable improvement and development goals. These are risks that need to be defined in detail as they embrace such aspects as higher energy costs related to supply chain interruptions, and social unrest that may result from drastic economic losses. These are issues that policymakers need to resolve to realize the possibilities of the current crisis.

Thus, the findings of the present study support the earlier research that geopolitical tensions are damaging to economic growth and environmental legislation (Behnassi, El Haiba, 2022a, 2022b; Bentley, 2022). However, the present research offers different places for understanding the effects of the Russia-Ukraine conflict on sustainable development within the EU. In previous studies, these concerns have been considered on the macrosystem level, while this work on a microsystem level, concerning the impacts in certain states.

First of all, the research states that there is a growth of investments in renewable energy even when there is a negative impact on the economy. Such a change is proof of a highly dynamic process taking place, this time as countries try to reduce their dependence on Russian oil and gas. According to the data, the global increase in investment in renewable energy sources has grown by about 13% since the beginning of the conflict and this points to an obvious shift towards the development of sustainable energy systems.

About the socio-economic implications, the paper revealed that although the war required a downward shift in the concept for a limited period, at the same time, it shed light on

how one may pursue faster development of renewable sources of power. In this context, the evidence points towards the possibility of a paradigm shift towards a sustainable future management of the current environmental crisis. However, it needs policy intervention to bring green investments for investment in sustainability that are intended by a sustainable economy.

In conclusion, there are significant socio-economic implications which emanate from the continued conflict and are deemed to compromise sustainable development while at the same time, there are opportunities that exist from the conflict to develop and expand green energy projects. Thus, the analysis emphasizes the importance of contingent policy measures that would tackle short-term vulnerabilities of the economy and at the same time lay the basis for sustainable development. It is recommended that more studies be conducted with increased sophistication to shed more light on these dynamics to inform policy-making against the backdrop of geo-political conflict.

CONCLUSIONS

The results highlighted the general importance of geopolitical conflict on the quest for sustainable development. On the economic level, the struggle has caused a slump in the overall growth rate of the EU's gross domestic product, with cuts varying from 1.5% to 3%. Lack of energy has fueled inflation, which stands at an average of 7 percent per year, and swelling unemployment in production sectors such as manufacturing and agriculture. Such setbacks hinder the EU from attaining its set sustainable development goals.

Environmentally, the war has elicited an escalation in the utilization of fossil energy, such as coal, leading to a 5% escalation in CO_2 emissions, which contradicts the EU's Paris Agreement goal. Though the conflict has raised funds for nuclear energy, development in the wind, solar, and bioenergy has shot by 20 per cent annually with the onset of the war. This change provides a long-term vision for sustainability by moving into using cleaner forms of energy.

Socio-economic impacts, when combined with environmental impacts, point to the fact that sustainable development is a challenge. Although the economic crisis slowed down progress in terms of discovering new solutions, the war has been the cause of increased investment in renewable energy, which could be seen as the direction towards future development. There is necessary to develop subsequent policies that will decrease negative short-run effects on economic activity while increasing the share of renewable energy investments. This piece of research should be followed by other studies with more variables, including legal environment, advancement in technology, among other aspects, and the relations of these on geopolitical conflict and sustainable development across various regions and sectors.

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